



Mount Penn Preserve

BERKS COUNTY, PA

forest stewardship and trail assessment plan

January 2025



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1031 Palmers Mill Road
Media, PA 19063
610-353-5587
natlands.org

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executive summary

purpose

The Mount Penn Preserve is a unique resource, being a large natural area just on the outskirts of the City of Reading. The Preserve is valued by the community for its scenic beauty, recreation opportunities, and natural resources. The community sees the importance of the forest for their air quality and managing stormwater. The Preserve is so important that community members say that it's what they love about living in the area and why they stay. Actively stewarding and protecting the natural resources and trails will ensure that they are sustainable into the future to benefit the community for years to come.

The purpose of this plan is to assess current conditions and provide recommendations for how the Mount Penn Preserve's (Preserve) forests and trails that are within public and Berks Nature land can be best managed to support both recreational use and ecological health.

This plan lays out current conditions, issues and opportunities, and recommendations for management.

process

To create this plan, Natural Lands carried out a multi-step process:

1. **Work with the MP3 Committee, which includes representatives from the various Mount Penn partners, and the MP3 Board to gather information about the Preserve and understand the Partners' vision.**
2. **Conduct background research, reviewing previous plans.**
3. **Conduct site visits to determine on the ground conditions.**
4. **Hold 2 public meetings to gather community input.**
5. **Conduct key person interviews with community members to get more in-depth information about the Preserve.**
6. **Draft plan and review recommendations with the MP3 Committee and Board.**
7. **Finalize plan.**

general findings

Site visits, meetings with the MP3 Committee and Board, and public input through meetings and key person interviews provided important information on the current conditions of the forest and trails within the Preserve. In general, the forests fit into one of two types. The first is older forests dominated by oak forest with a sparse understory and primarily native plants. The second type is younger forests in areas that had been previously cleared. These areas still have a high proportion of native plants in the canopy, but the shrubs and herbaceous plants, while dense, are primarily invasive plants. There were some other pockets of forests with a different composition, such as a young birch forest, but these were small areas and scattered. In general, the forests could benefit from controlling deer and invasive plants and supporting a greater diversity and abundance of native plants.

The 30 miles of trails provide opportunities for hiking and mountain biking. They connect visitors to both nature and the historic sites around the Preserve. The trails are nearly all earthen, which are typically a smooth surface but have wet areas, or stone surfaced, which are generally dry but can have very uneven footing. The Gravity Trail has some sections of compacted gravel and fines. The slope of trails ranges from an easy, level trails and switchbacks to more intense slopes and tighter turns.

The trails are generally in good condition. There are some issues that can be addressed, including obstacles to access, braided trails, erosion, hazards, steep slopes, and wet areas. Additionally, there are areas where trails were built using destructive methods and nuisance areas where people carry out activities that are not permitted within the Preserve.

priority recommendations

Based on the public input and on-site assessment, the following recommendations were identified as priorities for implementation:

expand the ranger program

Safety was called out repeatedly by community members and the MP3 Committee as the highest priority for managing the Preserve. Currently, Berks County has a ranger program that monitors the Preserve as part of a circuit with the rest of their parks. Expanding the ranger program to include City-hired rangers can increase the number of hours rangers would spend at the Preserve and would increase coverage to City-owned properties.

continue the deer management program

The deer management program is necessary to control the deer population. Currently, the population is so high that deer are over browsing native plants, create forest conditions where there are few seedlings and young trees. This is an issue as it means there are no young trees to replace the existing canopy trees over time, calling into question the sustainability of the Preserve's forests. This program can be expanded.

work together

The Mount Penn Preserve Partnership is a great example of governments working together. However, the Preserve

would benefit greatly from more cooperation at the user level. Mountain bikers, walkers, runners, birders, dog walker, ecologists and others use Mount Penn in different ways, at different times and for different reasons. All of these user groups have a right to be there and bring valid concerns and needs. These groups need to work together formally, to strengthen the community of users. This group should be organized formally as a council, commission, network, steering committee or similar task force. They should meet on a regular basis, perhaps quarterly. Whether required by their structure or not, as a best management practice, they should prepare agendas and minutes and report out to the Mount Penn Preserve Partnership.

improve and install stormwater management measures

Water is the biggest threat to every local trail system. With a few exceptions, the trails handle water fairly well. However, the stormwater management can still be improved in two major ways.

First, water should be captured before it enters a trail or be diverted shortly after it enters a trail. Secondly, water must be managed after it is diverted off the trails. Water on the trails erodes the tread surfaces. Sometimes the erosion is barely noticeable, slowing degrading over time. Sometimes its catastrophic, like the washout that occurred at the Gravity Trail and nearby Antietam Creek Trails a few summers ago. Additionally, once water is removed from the trails, it still must be managed, otherwise it will erode the surrounding forests, further damaging those ecosystems. In most cases, trail side rain gardens and swales can capture water and infiltrate it into the ground before it damages the trails or surrounding forests.

enhance legibility of the trail system for easier navigation

The critique most often stated in public meetings, key person interviews and interactions with the project committee and others, is that the trail system is too confusing. There are definitely too many trail names. Some trail names provide wayfinding hints, like the Radio Tower Trail, but too many change names abruptly or are

considered different trails. This causes trail users to constantly question their location, needing to refer to trailforks or other online sources. Unfortunately, with so many trails and names, there doesn't appear to be a way to make it easier to navigate EVERY trail segment.

However, the preserve does feature a handful of existing, long, single named trails, or a series of similarly named segments, which should become the backbone of the trail naming and navigation system. The Gravity Trail, Ferndale Trail, and Bridal Path are all long trails under a single name, or a hyphenated name with a common name. These longer trails are already the backbone of the trail system. However, they should be named and mapped accordingly.

A new signage system and maps should emphasize these major routes and the major features along these routes. If a visitor is lost on the preserve, they may not know exactly which short, oddly named segment they are on. But they should be able to use an online map or trail app to find a major route nearby. The visitor should then be able to follow the major route to a park, major road or other point of interest, like the Pagoda. From these locations, they should be able to find their way.

additional recommendations

The plan contains a range of additional recommendations to help land managers care for the forests and trails. For the forest stewardship recommendations, all forest areas were divided into management units to guide management. Recommendations were given for the entire Preserve and for the individual management units. In addition to managing deer, there are recommendations for improving habitat, increasing native plant abundance and diversity, managing the impact of recreation on the forests, and adapting and increasing resiliency to climate change.

For trails, there are additional recommendations around the interconnection of trails and natural resources focused on reducing the damage to surrounding natural resources by trail use and infrastructure and protecting threatened species. Other recommendations look to enhance visitor access and experience by improving parking access, creating a shuttle service around the Preserve, and creating universally accessible trails.



introduction

plan purpose and objectives

The purpose of this plan is to assess current conditions and provide recommendations for how the Mount Penn Preserve’s (Preserve) forests and trails that are within public and Berks Nature land can be best managed to support both recreational use and ecological health.

The Mount Penn Preserve Partnership (MP3) requested that the plan address fourteen objectives:

1	Review existing trail systems	8	Develop universal trail sign design requirements
2	Review and combine individual trail and forest plans	9	Identify and develop a plan to manage invasive species
3	Review all trail priorities	10	Identify emergency access points
4	Provide cost estimates	11	Determine how to manage forest carbon storage
5	Develop a trail system which protects the Preserve’s natural resources	12	Develop a universal trails maps
6	Identify the forest characteristics of the entire preserve	13	Develop a stewardship plan
7	Identify forest management sections	14	Develop sample trail use regulations

mount penn preserve initiative background

The Mount Penn Preserve initiative has been under way since the spring of 2016. This multi-municipal partnership was designed to coordinate plans to make the Mount Penn Preserve a recreational and entertainment destination, while embracing the historical resources of the site.

In April 2017, the Mount Penn Preserve Master Plan was completed. **The master plan divided the Mount Penn Preserve into five (5) use areas including Skyline, Central Mountain, Antietam, Gravity Railroad, and Mountain Village.**

- 1 Skyline
- 2 Central Mountain
- 3 Antietam
- 4 Gravity Railroad
- 5 Mountain Village

The recommended improvements include items such as programming, activities, and transportation improvements.

On July 25, 2018, representatives of the Borough of Mount Penn, the Townships of Alsace and Lower Alsace, the City of Reading and the County of Berks, formally signed the document officially creating the Mount Penn Preserve Partnership Council of Governments (MP3 COG).

This plan builds on the previous master plan by focusing specifically on the trails and forest stewardship, going into more detail than the master plan while building on its recommendations.

plan process

To create this plan, Natural Lands took a multipronged approach to assessing current conditions. Firstly, the MP3 Board established a study committee to work with Natural Lands. This committee included staff from the City of Reading, Berks County, and Berks Nature, as well as representatives from the Berks Area Mountain Biking Association (BAMBA). This committee provided information, insights, and feedback throughout this planning process through three meetings, informal communications, site visits, and public meetings. Secondly, Natural Lands staff conducted 7 site visits to carry out

on-the-ground assessments of both the trail and forest conditions. Study committee members were invited to join Natural Lands staff on these visits, and did so for most of the visits. Additionally, Natural Lands held two public meetings to gather community input and one meeting with the MP3 Board. Additional information about the public input can be found in the Public Input Synopsis Section. Natural Lands also reviewed past plans including the 2017 Master Plan and 2018 Antietam Lake Park Natural Resources Stewardship Plan.

From this input and on-site information gathering, Natural Lands developed draft recommendations for trail management and forest stewardship. These draft recommendations were presented to the study committee, the public, and the MP3 Board for feedback. Natural Lands then created this final plan.

history of land use

The area that is now considered the Mount Penn Preserve previously contained local resorts, clubs, and wine houses that were served by the scenic Gravity Railroad that began service in 1889. Before the mountain was used as a retreat, the forest was used for quarrying, mining, furnaces, and charcoal. These uses impacted the forest we see today.

mining

The Eckert and Brothers Mine was within what is now the Preserve area. Isaac Eckert owned a considerable tract of land along the side of Mount Penn. The ore from these mines was hauled to the Henry Clay furnaces, in Reading, where it was used in the manufacture of iron. A great deal of ore was taken from the mountain up to around 1871, when mining ceased there on account of the large quantity of water that flooded the mines. Mining operations moved from atop Mount Penn to Hill Road, Eckert Avenue, down into City Park and along North 13th Street.

sources:

"Eckert And Brothers Mine, Reading, Pennsylvania." The Diggings. The Diggings, Accessed July 22, 2023. <https://thediggings.com/mines/usgs10250442>.

"The Reading Iron Company." Go Reading Berks, February 7, 2021. <https://goreadingberks.com/the-reading-iron-company/>.

charcoal

Charcoal was produced in the Preserve's forest to fuel iron furnaces. To make charcoal, colliers (charcoal burners) would tightly stack wood in domed piles, known as meilers. The stack of wood was then covered with a layer of leaves and then soil before being ignited. Due to the long burn period of each meiler to produce charcoal, multiple meilers were used at the same time. Each meiler consumed somewhere around one acre of woodland. The charcoal was transported to furnaces, where it was used as fuel to smelt iron. One iron furnace required roughly 600 acres of forest per year. Cut forest would regenerate in around 20-30 years when it could be harvested again. At any time, vast tracts of forest would have been in the process of regrowing, in a very patchy manner.

sources:

Carter, Benjamin. "Black History, Charcoal, and State Lands." Pennsylvania Parks and Forests Foundation. Muhlenberg College, February 1, 2023. <https://paparksandforests.org/black-history-charcoal-and-state-lands/>.

quarry

At the beginning of the 1900's, 10 acres of land were used to quarry stone. However, this venture was quickly ended after an outcry from City residents due to the prominent effect on the landscape. The quarry is still visible in the forest today, with a large peace sign painted onto the rock face and a trail running along its base.

source:

"The Story of the Pagoda: This Is the Saga of a Pagoda that Grew Out of a Stone Quarry." Berks History Center. Accessed July 22, 2023. <https://berkshistory.org/article/the-story-of-the-pagoda-this-is-the-saga-of-a-pagoda-that-grew-out-of-a-stone-quarry/>.

the gravity railroad

In 1889, the Mount Penn Gravity Railroad was built to provide scenic transportation to vacationers and locals traveling to the local resorts, clubs, and wine houses. A wooden fire tower was also constructed to keep watch over the City's 5,000 plus wooded acres and surrounding farmland. The circuit ran north from Pandora Park to

the summit of the mountain, passing many amenities along the way, such as the Fred Kiedeisch Wine Resort at Lauterbach's Spring and The Tower Hotel.

In 1898 the gravity line was electrified, and by 1919, the Gravity boasted a total of 140,205 riders. Popularity declined due to the introduction of automobiles and The Prohibition Era, and then, more significantly, by a fire on April 26, 1923 that destroyed the Tower Hotel and the Fire Tower. After the fire, the railroad was decommissioned and tracks torn up. The original Fire Tower was replaced with the Fire Tower structure seen today using funds from the New Deal in the 1930s.

sources:

Clarke, Austin. "Mt. Penn's Other Tower: The William Penn Memorial Fire Tower." The Pennsylvania Center for the Book. Accessed July 22, 2023. <https://pabook.libraries.psu.edu/literary-cultural-heritage-map-pa/feature-articles/mt-penns-other-tower-william-penn-memorial-fire>.

Crupie, Corrie. "The Gravity Railroad." Pagoda and Mount Penn. Berks History Center, December 4, 2023. <https://berkshistory.org/category/pagoda-mt-penn/>.

continuing legacy

The mountain's history continues to influence the recreational and ecological resources around the Preserve. This is evidenced by the use of the railbeds for trails; the changes in plant composition around areas previously used for tourist sites and structures; and the unique landforms from mining.

There are many sites on the mountain that are recognized for their historic significance, as well as sites that are part of the cultural heritage of the Preserve and the community. There are three National Historic Register sites - the Pagoda, the Lindbergh Viaduct, and the Peter D. Wanner House. Five other sites are eligible for listing on the National Historic Register - The Park Line Historic District; The Penn's Common Historic District; The Pandora Park Channel; the William Penn Memorial Fire Tower; and the Antietam Lake and Watershed and Oblinger Mill and Dam site.

source:

Simone Collins Landscape Architecture. 2017. Mount Penn Preserve Master Plan.

current use

Today, the mountain provides recreational amenities as well as historic resources and some restaurants. There are many miles of hiking and biking trails as well as park facilities. Mountain bikers appear to be the most prominent user group. The trails are also used by runners and hikers. Though not the focus of this plan, there are ballfields with the Preserve parks. Additionally, Antietam Lake Park has heir orchard area and Nature Center.

restrictions

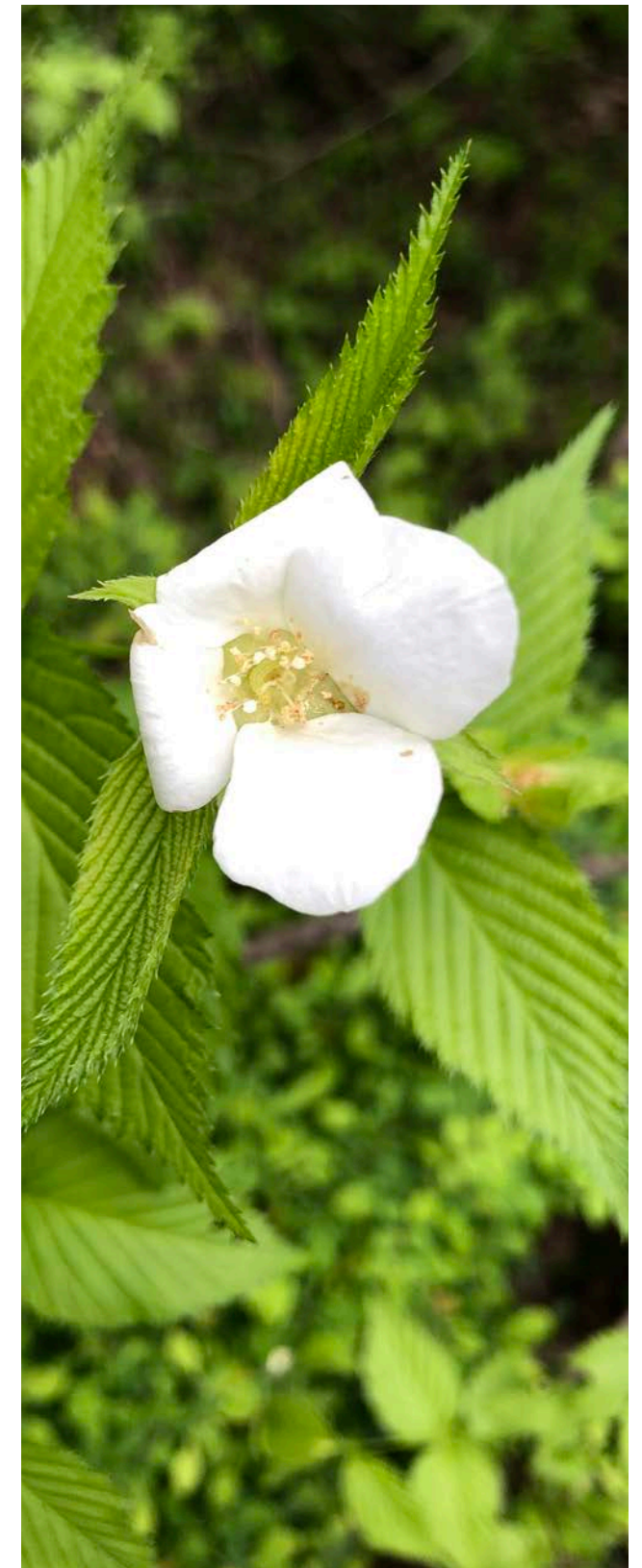
There are formal on sections of the Preserve. The powerline rights-of-way (ROWs) have restrictions on the height of vegetation. Approximately 326 acres are protected by a deed restriction known as The Earl Trust. Clinton Earl was a City of Reading Commissioner from 1927-1034. He had a vision for the mountain to be protected from development and was able to use his funds to protect land around the Mt Penn Gravity Railroad beds by purchasing land during his lifetime and through the establishment of a Trust after his passing. These lands are deed restricted to be "limited to the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources of the real estate for park purposes."

Prior to development of the Lake Ontelaunee reservoir in 1926, the city drew its water from numerous reservoirs on Mt Penn and from the reservoirs at City Park, Bernhardt's Dam, Antietam Lake, and Neversink Mountain. These forested watersheds were all intentionally protected; today, some of these same reservoirs with underground storage are still utilized as holding tanks. Use of these areas is restricted by the Reading Area Water Authority.

sources:

Larry Lloyd, Senior Ecologist, Berks Nature

Earl Trust Final Order and Decree



general site inventory

natural resources

A note about terminology when talking about the Preserve. The mountain ridge runs along Skyline Drive. For the purpose of this plan, the mountain slope between Skyline Drive and the City of Reading is referred to as the frontside of the mountain. The slope on the other side of Skyline Drive leading toward Antietam Lake Park is referred to as the backside of the mountain.

- Schist: A medium-grade metamorphic rock with pronounced foliation, often containing mica. Located on the lower slopes of the mountain.
- Shale and Slate: Fine-grained sedimentary rocks that have been subjected to varying degrees of metamorphism. Located on the lower slopes of the mountain.

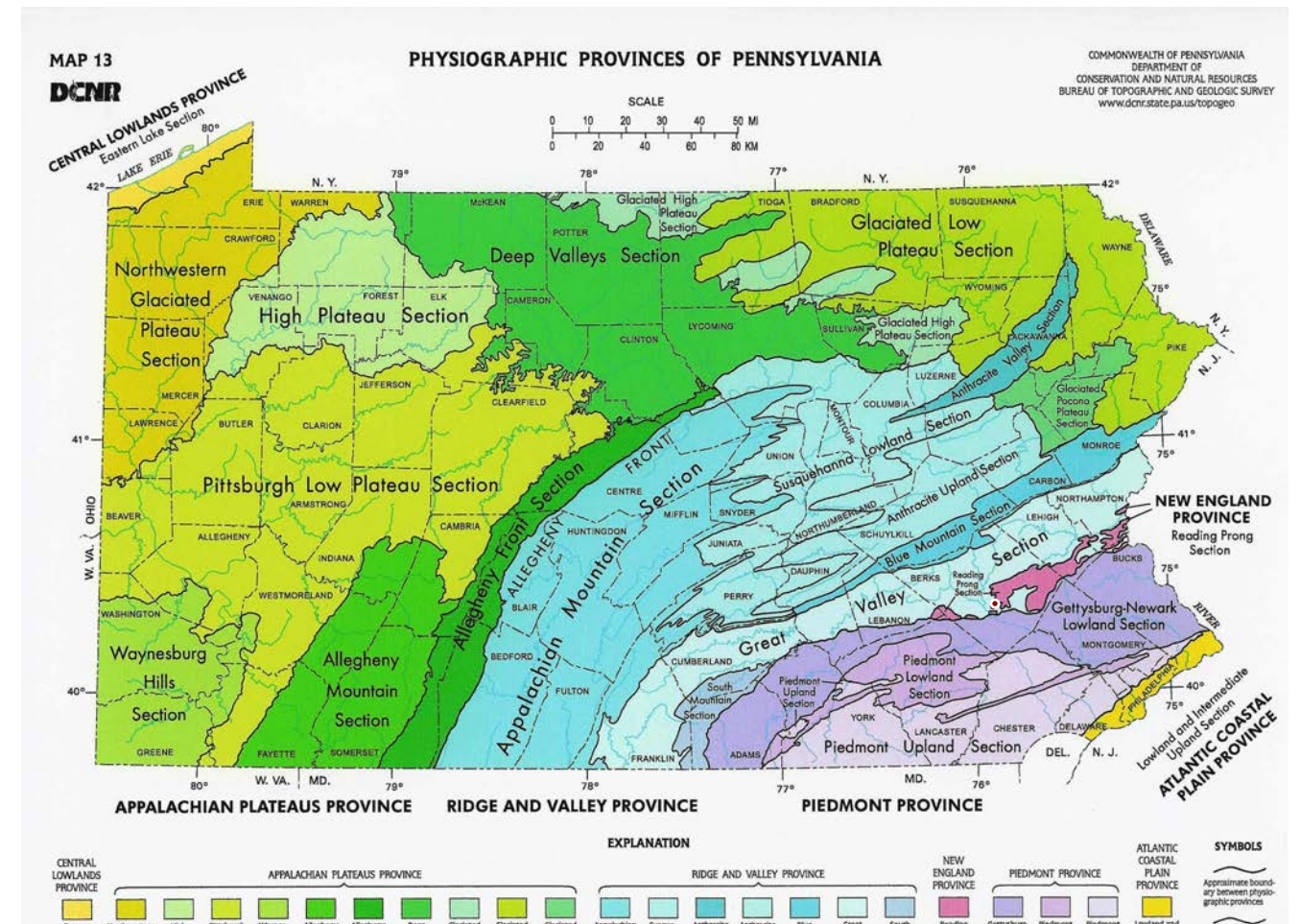
geology

The Preserve is located within the Reading Prong of the New England Physiographic Province. According to the Pennsylvania Department of Conservation and Natural Resources' (DCNR) Geological Survey, the site is predominantly underlain by metamorphic and sedimentary rocks. The dominant types include:

- Quartzite (Hardystone Formation. 656-764 feet above sea level): A hard, metamorphic rock that originated as sandstone. The front side (i.e. the western face that runs from Skyline drive down to the City of Reading) is primarily composed of this quartzite formation.
- Gneiss (Hornblende; Felsic to Mafic. 571-669; 646-748 feet above sea level): A high-grade metamorphic rock with distinctive banding caused by the segregation of mineral types during metamorphism. Most of the central spine of the mountain, running north to south, and the eastern slopes running down towards Antietam Lake, are composed of the gneiss formation.



Rock formations characteristic of the quartzite on the front side of the mountain.



DCNR map of Pennsylvania Physiographic Provinces, with MP3 location highlighted.

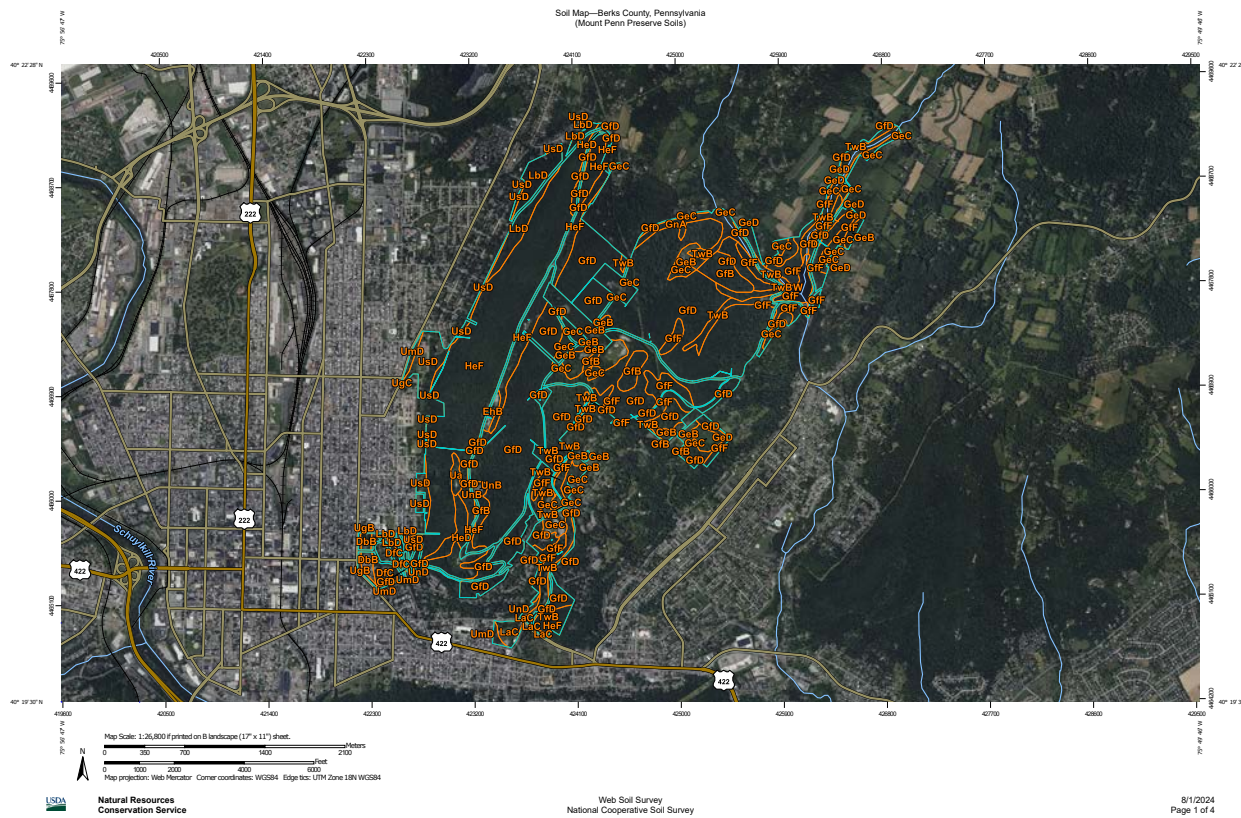
soils

The soils within the Preserve, derived from the underlying metamorphic geology, are typically thin and rocky. They are well drained but are prone to erosion, due to the steep topography of the site. Soils present are mostly composed of gravelly loam, silt loam, and channery loam. Two thirds of the site (1,218.3 acres) are composed of two soil groups: Gladstone gravelly loam (8-25% slopes, very bouldery) and Hazelton very channery loam (25-60% slopes, extremely stony). Gladstone soils are primarily located from the spine of the mountain (Skyline Drive) to the east, down toward Antietam Lake. Hazelton soils are concentrated from Skyline Drive to the west, down to the City of Reading.

The remaining soil groups mostly consist of either Gladstone and Hazelton soils at different slopes, and a silt loam (Towhee), mostly concentrated on the southern side of the mountain, running from Egelman's Reservoir south along Rose Valley Creek to Pandora Park.

Areas of the mountain have historically been cleared for agriculture, and more significantly, for the production of charcoal. Charcoal production on Mount Penn supported the iron industry in the Reading area, beginning in the 18th century, and peaking in the early 19th century, prior to widespread industrialization and the transition to coal as a fuel source.

The process of clearing trees and burning them to produce charcoal have had a significant impact on



Web Soil Survey map of MP3 soil types

the current state of soils on the mountain. Deforestation on steep slopes led to erosion, and the transportation of charcoal contributed to soil compaction. The chemical composition of the forest's soils was impacted as well. Nutrient depletion occurred due to the removal of such a large volume of trees, meaning less organic matter (i.e. leaf litter) was present to regenerate soil. Changes in the pH composition of the soils also occurred as a function of burning. The ash that results from burning wood for charcoal production is alkaline and has made the soils less acidic. The physical and chemical degradation of soils on Mount Penn has contributed to a change in the types of vegetation present on the site, and indeed in the type native vegetation that is able to grow there.

topography

Mount Penn features a rugged topography with steep slopes and a high degree of relief. The landscape is shaped by the resistant nature of its metamorphic rocks, which have withstood erosion more effectively than the surrounding softer sedimentary rocks. The mountain provides scenic views, most notably from Skyline Drive. The mountain features several prominent ridges and valleys, rising to approximately 1,200 feet above sea level at its highest point, down to approximately 500 feet, giving a rise of approximately 700 feet above the surrounding area. The main ridge of the mountain runs north to south. The western slope, or front side, runs down to the City of Reading, while the eastern slopes runs down to Antietam Reservoir.



The view from Skyline Drive overlooking the City of Reading – a rise of approximately 700 feet.

The steep and varied topography, in addition to providing striking view of the city below, is a significant contributor to the popularity of the preserve as a mountain biking destination. Gravity-style mountain biking, i.e. riding downslope at high speeds with limited pedaling, is popular within the preserve. Trails constructed by mountain bikers to enhance the riding experience have significantly altered areas of the mountain, through the introduction of soils to build ramps and embankments. This activity, while highly desirable for the creation of a regionally important mountain biking destination, can contribute to issues of erosion and subsequent soil loss.

water resources

Water serves as an important resource to the Preserve, as well as an issue with its sustainable management, i.e. stormwater runoff and the subsequent erosion of the mountain's soils. Mount Penn has numerous seeps and springs originating from the aquifer beneath its slopes. These seeps are visible as puddles and contribute to stream recharge. They also help to support local wildlife populations by providing drinking water and habitat and alter the vegetation present, creating conditions for plant species associated with wet soils. To the east of Mount Penn is Antietam Lake, a man-made reservoir which was created by damming Antietam Creek. The lake is an important asset for the Preserve, functioning as a control system during flood events, a habitat for local wildlife, and an appealing destination for recreation. Fishing

at the lake is particularly popular and it is stocked with trout. Flowing from the northeast into the lake is Antietam Creek, a 2nd order stream. As it flows into Antietam Lake, it creates a wetland, at the approximate location of the Mudcatcher Parking Lot. An unnamed tributary flows from further to the west, along the base of the mountain, under Angora Road, and directly past the Mudcatcher Parking Lot, creating a wetland at the northwestern corner of the lake. These two streams are designated as cold water fisheries by the Pennsylvania Department of Environmental Protection.



A typical seep on Mount Penn.



Wetland Area abutting Mudcatcher Parking Lot.

Egelman’s Basin, located in Egelman’s Park, is a spring-fed reservoir which historically helped supply water to the City of Reading. However, the basin has been used solely as a park amenity since the 1930s. In 2018, it was drained due to safety concerns related to the masonry wall at its southern end.

The spring feeding the reservoir is above ground and crosses the Gravity Trail trailhead at the far end of the park’s parking lot, creating a possible issue with accessibility to those trails. As water exits the basin to the south, it crosses under Hill Road and past a disused (dry) fishery pond associated with the Isaak Walton League. This water course is Rose Valley Creek. Pedestrians can cross the creek via a historic footbridge over the filter infrastructure associated with the basin’s time functioning as a reservoir for drinking water.

Rose Valley Creek continues downslope to the south, past Mineral Spring Park, beneath the Lindbergh Viaduct, and into Pandora Park, where it goes under the surface on its way to the Schuylkill River. Sections of the creek have historically been channelized into stone sluiceways, built during the Works Progress Administration (WPA) era of public works on the mountain. Some of these sections are falling into disrepair, leading to issues with erosion. They

are also heavily impacted by invasive species, most notably Japanese Knotweed, which lines much of the creek from Mineral Spring Park downward.

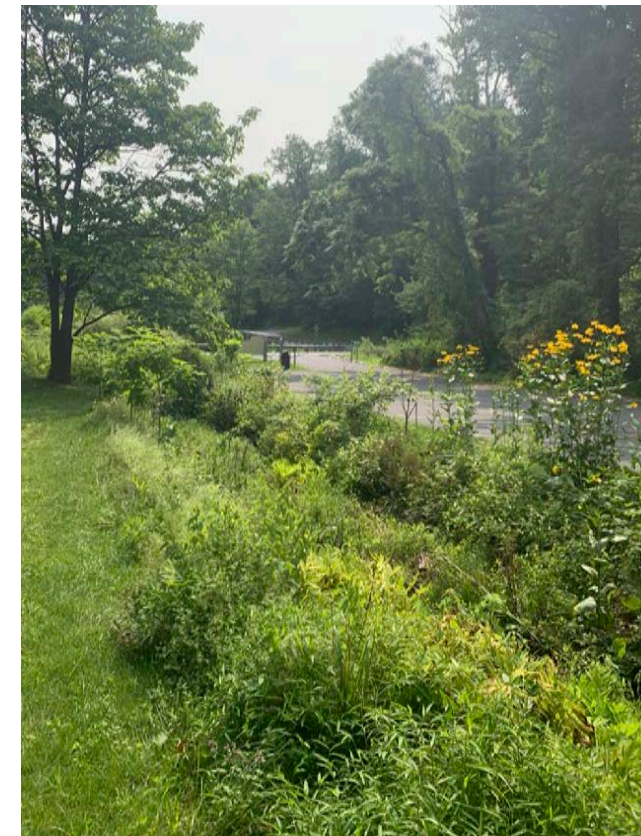
Water plays a critical role in the health of the Preserve. As mentioned above, wildlife populations are supported



Channelized Section of Rose Valley Creek.

by these water resources. They provide scenic and recreational value and are highly prized by visitors to the preserve.

However, erosion caused by stormwater runoff is a critical issue for the continued health of the preserve. The age and condition of infrastructure associated with the hydrology of Mount Penn, as well as the location and construction of its trail system, pose some challenges to the effective management of stormwater. This further impacts the overall health of the site, as erosion can lead to mortality of trees in the preserve, which in turn creates canopy gaps that may be filled by invasive species. Creative and proactive management techniques, such as the stormwater BMP installed in the Antietam Lake Parking Lot, can help to mitigate the impacts of runoff and erosion. Most critically, construction and maintenance of trails on the mountain should take into account the possible impacts on the stability of soils and proactively plan to address these impacts.



Stormwater BMP in the Antietam Lake Parking Lot.

plant resources

This plan covers approximately 1,250 acres of natural areas within the Preserve, of which approximately 1,610 acres are forests. In the areas outside of Antietam Lake Park, there are two predominant forest types, oak forests and mixed hardwood forests. Broad descriptions are included below. There are also smaller areas of palustrine forests. Lists of plant species identified during the site visits are included as an appendix. Additionally, the Recommendations by Management Unit section contains additional details about the plant communities. The plant communities within Antietam Lake Park are more diverse. Descriptions of these plant communities are included in the 2018 Natural Resources Stewardship Plan for Antietam Lake Park. Changes to these communities are noted in the Recommendations by Management Unit section. Plant community locations can be seen in the Plant Communities map, located in the appendix.

oak forests

The oak forests cover +/-940 acres, with areas throughout the Preserve. Most of these forest areas have a healthy canopy dominated by oaks (red oak, black oak, chestnut oak, pin oak), with other canopy trees such as hickories and birch. The understory varies depending on the location.

The front side of the mountain, west of Skyline Drive, has a predominantly birch understory. The shrub and vine layer is very sparse, with few scattered shrubs like mountain laurel and blueberry. This may be due in part to the thin, rocky soils. Some Japanese stiltgrass and barberry are scattered throughout, particularly along trails. There are also more invasive plants along Skyline Drive, along Oak Lane where lawn debris have been dumped, and where the forest was cleared for sightlines off Skyline Drive. There is very limited natural tree regeneration. This forest area correlates with a dry oak heath forest.

The oak forests on the backside of the mountain, southeast of Skyline Drive, are more varied. Lower lying forest areas have an understory dominated by blackgum while higher elevations are the dry oak heath with birch understory trees similar to the oak forest on the frontside of the mountain. Blackgum is characteristic of moister and richer soils that are found in this portion of the mountain. Pawpaw is a common understory tree, forming large, dense patches. There are more areas that have a moderate



The oak forests are characterized by a healthy canopy and sparse understory.

to high level of invasive plants, particularly barberry and Japanese stiltgrass. This generally occurs along disturbances, including trails, roads, active recreation fields, and buildings. There are also areas with extensive patches of hay-scented fern, which, while native, can suppress the regeneration of other native plants. The oak forests on the backside of the mountain also have a greater volume of downed wood. This is important for wildlife habitat. It is also a characteristic of old-growth forests; while these areas are not old-growth forests, these characteristics indicate that they could progress to old-growth over time.

mixed hardwood forests

The mixed hardwood forests cover approximately 264 acres. These areas have been more recently disturbed compared to the oak forests. Tuliptree is the dominant canopy species for most of these areas, and at least a component of all mixed hardwood forest canopies within the Preserve. Other canopy species include, but are not limited to, American beech, hickories, Japanese princess-tree, and birch. Oak may be present, but in much less abundance than the oak forests.

These forests exhibit more signs of disturbance compared to the oak forests. Namely, the understory through herbaceous layers are heavily dominated by invasive plants. This creates a much denser forest, which can provide shelter for wildlife. However, the fact that they are invasive plants means that it is poorer quality habitat compared to native plants. It also compromises the long-



The mixed hardwood forests have dense understoreys, however, this is due to the presence of invasive plants.

term sustainability of the forests due to suppression of native plant regeneration and potential for canopy loss over time. There are canopy gaps throughout these forests, often from ash tree die-off. The canopy gaps are filled with invasive plants rather than native species.

One of the most distinctive areas of mixed hardwood forest is at the site of the old orchard just off Hill Road. This area is comprised primarily of invasive plants. This area was more recently disturbed and then allowed to naturally progress from a managed orchard to unmanaged forest. Of particular concern is the patch of bamboo which spread from an adjacent private property.

There is also a pole stand forest patch that is comprised of young birch trees. This area was disturbed recently, and the young forest is regenerating.

palustrine forests

These areas, which cover approximately 9 acres, are characterized by wet soils and plant species adapted to such conditions. Palustrine forests are located in the central-eastern part of the Preserve near Hill Road. There are two areas separated by a powerline ROW. The western half is underlain by hydric soils and characterized by American Beech, white oak, pin oak, and tuliptree in the canopy. The eastern half is fed by seeps and springs and has black birch, tuliptree, red maple, red oak, and pin oak in the canopy. Both areas have a high prevalence of skunk cabbage and blueberry bushes. These areas had few invasive plants at the time of the site visits.



The meadows along Hill Road provide habitat diversity which can support pollinators and certain bird species.

There is also a palustrine forest within the riparian area along Rose Valley Creek through Egelman's Park, Mineral Spring Park, and Pandora Park. This forest also has species characteristic of wetter areas, including basswood, American elm, and jewelweed. Tuliptree is the dominant canopy species. The area is moderately impacted by invasive plants.

As noted in the water resources section, there are additional springs and seeps throughout the Preserve. Those can also have small areas with wetland associated plants. However, their extent did not warrant defining separate plant communities for the purpose of this report.

meadows

There are pockets of meadow within the Preserve. Outside of Antietam Lake Park, the largest extent of meadow is around Hill Road near the old orchard area. Part of this area was previously used as a leaf dump. It also abuts in multiple locations the heavily degraded mixed hardwood forest, including a meadow patch in the middle of that forest. These meadow areas have a mix of native and invasive species, with more invasive plants present closer to the old orchard area.

Other meadows are present within Antietam Lake Park, which are covered in the 2018 Natural Resources Stewardship Plan.

wildlife

Wildlife surveys were not included in the scope of this project. Some common species were noted during the site visits, mainly white-tailed deer, squirrels, turkey vultures, and chipmunks. Additionally, online information provides insights into what species are or may be present. The Pennsylvania Natural Diversity Index report (PNDI), identifies potential bat habitat within the Preserve. Additionally, eBird surveys which were created by Preserve visitors, identify 166 bird species. The majority of the bird species are considered to have stable populations according to The Cornell Lab of Ornithology. There are two species that are near threatened, the Cerulean warbler and Blackpoll warbler, as well as a vulnerable species, Evening grosbeak. A list of these species is included in the appendix. Other website, like amphibians, are likely present. They were just not encountered during site visits or included in online resources.



The route of the historic Gravity Railway remains a main method of access to the preserve. Maintaining and enhancing these elements contribute to a visitors sense of, and appreciation for, the rich history of Mount Penn.

infrastructure

Mount Penn and the surrounding preserve feature a wealth of historic and contemporary infrastructure - elements that currently serve as destinations along the trail system, and historical features in need of development and/or restoration.

A variety of historic points of interest still exist on the mountain. Many are constructed from stone and are in various states of disrepair. Sites like Kuechler's Roost, a historic hermitage and later a vineyard, restaurant, and stop on the Mount Penn railroad, include interpretive signage to engage the visitor. The first roads up the mountain were constructed in service of these industrial activities, and some of them remain as routes on the mountain today. Also present throughout the mountain are stone sluiceways, constructed during the WPA era. These channels direct stormwater, while also in some case function as trailbeds. Other elements, such as the model airplane field at Drenkel's Field, have fallen into disuse.

In addition to the many infrastructural elements from earlier eras of development that remain intact on the mountain, newer installations, such as the BAMBA Parking Lot, the Skyline gravity mountain biking trail, the radio tower, and the refurbished Bingaman Nature Center, are helping to create a new era of recreation and enjoyment on the mountain.



Interpretive signage at Kuechler's Roost. Signage throughout the preserve should be standardized to enhance a sense of MP3 as a single, unified destination.



The decline in use of infrastructural elements like the model airplane field require reimagining their future use, while respecting the history of the site.



Permanently closed gates limit the ability of visitors to access large areas of the park conveniently.

The Preserve features a number of parking lots, some of which are regularly accessible to visitors, and some of which are gated due to concerns regarding safety/ unauthorized use and short dumping. While these valid concerns must be addressed in order to maintain a sense of authority and care on the mountain, parking is a critical issue that should be addressed as part of the broader development of the trail system on Mount Penn. Currently, the following lots provide the greatest opportunities for visitors to come to Mount Penn and have a sense of where they are and where they can travel to during their visit.

- **BAMBA Lot** – The most recent parking area to be constructed, the BAMBA lot has been a major success in providing convenient parking for the popular use of the mountain's mountain biking trail system.
- **Angora Fruit Farm** – This centrally located lot allows easy access to bike trails and includes an overflow lot for special events.
- **Antietam Lake Lot** – This attractive, well-designed lot provides ample parking, restroom facilities, a forward-thinking stormwater BMP as well as a trail map kiosk and a bike tool station, and access to the viewing/fishing overlook at Antietam Lake. The lot is operated by Berks County, with its gate being shut by attendants during closing hours. Ideally this would be the model for all other lots in the MP3 parking system.



The parking lot at Antietam Lake provides a model for parking access across the preserve.

users profile

The Mount Penn Preserve draws visitors from across the region. Visitors seek out the mountain for its challenging and diverse system of mountain bike trails. The IMBA (International Mountain Biking Association) Bronze Certification bestowed on the site a few years ago has raised its profile among riders looking for a destination site. The mountain features steep downhill and sculpted raceways to suit the most adventurous riders alongside flatter, smoother, gentler trails for riders looking for a more relaxed ride in the woods. All of it is underlain by rock and except for areas where it's been cleared, the trails feature technical elements to challenge riders of all abilities.

Of course, many mountain biking trails also lend themselves to hiking and trail running. Long, gently sloping trails like the Bridle Path offer comfortable terrain for a casual run. Steeper trails, like the Ferndale A-Line, challenge runners with steep slopes, but reward them with views from the top along Skyline Drive. Hikers, dog walkers and walkers can also enjoy the trails, with plenty of variety to suit their needs. With its layers of history and ecology, the mountain also attracts birders and plant and animal enthusiasts, as well as those interested in history. Keuchler's Roost and other historic buildings and remains dot the landscape, typically well hidden amongst the forest.

The trails themselves share the history of the railroads and old forest roads that reflect the Mountain's prior lives as industrial fuel and pleasure gardens.

The Preserve also draws people to the views. People park their cars at the Pagoda or the overlooks along Skyline Drive to enjoy the view out to the City of Reading while eating their lunches or taking a break. Some may venture onto the trails, but they seem to typically stay near their cars before driving off. These overlooks have become the site of numerous illicit activities, forcing the City to regulate access through the installation of large gates.

The many user groups typically coexist without too many issues. However, some conflicts are to be expected. Some trails are more heavily used by mountain bikers travelling at high speeds, which can be dangerous to walkers. Runners can surprise walkers. All users can inadvertently scare away birds or other animals, to the chagrin of birders. Group rides or runs can cause issues for other users due to their size. However, most of these issues can be managed through improved communication and an elevation of common courtesy.

conservation priorities

Every property has numerous conservation values, i.e., resources worth conserving and enhancing. They can range from a highly threatened plant or animal species to a venue for environmental education. The values that are of the highest importance to the site based on their ecological significance and the desires of the land manager(s) are designated the conservation priorities. The protection and enhancement of the conservation priorities becomes the most important goal for the management of the site, while protection and improvement of the other values become secondary. This helps determine the allocation of staff time and funding when implementing stewardship activities.

The Mount Penn Preserve Partnership creates a unique opportunity to create priorities that apply across the mountain. These conservation priorities can be based on the MP3 mission statement, "To protect, promote and enhance the natural beauty, heritage and attractions of the Mount Penn Preserve."

For the Preserve, the conservation priorities are:

- 1. Forest Sustainability**
- 2. Compatible Recreation Opportunities**

Having a sustainable forest means that the forest has abundant and diverse native plants and has natural regeneration of native plants. Across the landscape scale, a healthy forest has different forest ages and types of habitat. It also means that stressors, be it invasive plants, deer, climate change, or other issues, are well managed. These characteristics would mean that the forest is likely to be resilient and be able to provide ecological benefits well into the future, including stormwater management, habitat, and air quality improvements.

Compatible recreation opportunities provide ways for visitors to exercise and enjoy nature while having a minimum impact on the Preserve's natural resources. Having a healthy forest will support recreation by protecting infrastructure through stormwater management and by providing a scenic landscape for visitors.

Recommendations within this plan support these two conservation priorities.

stewardship issues & opportunities

forest sustainability

The overarching goal for forest management should be the long-term sustainability and resiliency of the forest. This means that the forest has an abundance of diverse native plants, full structural layers as appropriate for forest ages, a mix of forest ages, and low deer and invasive plant pressure. This state would allow the forest to regenerate naturally. It would also make the forest less vulnerable to stressors like climate change and pests.

To reach this state, managers will have to control existing stressors, like deer and invasive plants, account for climate change in planning and management, and address issues that currently detract from forest health, like canopy gaps.

deer management

Deer populations in this region have been overabundant for many years due to a loss of large predators, fragmentation of forests, and previously strict hunting limits that restricted the harvest of female deer (this policy has been changed to better control deer populations). Overabundant populations pose a threat to natural areas due to overbrowsing of native herbs, shrubs, and tree seedlings. Sustainable deer population levels are approximately one deer per 64 forested acres (10 per square mile). At this level forests are able to support the deer while still maintaining biologically diverse structural layers and sufficient seedlings and saplings to fill canopy gaps. In forests that have been subjected to overbrowsing for many years, the deer density will probably need to be lowered even further than the eventual optimal level for a period of time to allow the forest to regenerate.

Overbrowsing can dramatically decrease structural and species diversity, creating a forest with little or no understory or one highly dominated by one or two species, particularly invasive plants (a subset of exotic plants that aggressively outcompete native species; see Invasive Plant section). Invasive plants are not a preferred food source for deer, leading deer to preferentially browse native species. Deer overbrowsing of native plants not only frees up growing space for invasives, but the associated soil disturbance and seed transport by deer hooves can further facilitate the spread of invasive plants. Loss of native plants and structural diversity will reduce habitat for local and migratory wildlife. Overabundant deer populations can also cause significant damage to agricultural crops and ornamental plantings, spread Lyme disease, and increase the number of vehicular accidents.

Most areas within the Preserve's forests clearly show the effects of overbrowsing by deer. The oak forests contain sparse shrub layers with just a few scattered shrubs and a sparse herbaceous layer except for where Japanese stiltgrass has proliferated. The mixed-hardwood forests have an abundant shrub layer, however, the shrubs are predominantly invasive species. All areas are devoid of adequate native tree regeneration, jeopardizing the sustainability of the forest.

Deer management should be a high priority for the Preserve. Without it, native plants will be unable to regenerate and plant communities will continue to decline.

Much of the Preserve is already part of a managed hunting program run by the U.S. Department of Agriculture (USDA), which is contracted by the landowners (currently Berks County, Berks Nature, and the City of Reading). This program allows individuals who have been given permission



The oak forests generally have open understories with few plants – a clear sign that deer are overbrowsing the forest.

to hunt the properties included in the program. Hunters must follow all state hunting regulations and pass a safety test. They must also follow any additional rules instated as part of the Preserve's deer management program. To date, feedback about this program has generally been positive. Land managers reported that the program is being run well. Landowners even decided to expand the program beyond the initial area which was Antietam Lake Park. Additionally, there was supportive feedback from the public during key person interviews and the public meeting. There were some negative responses, including a couple neighbors who were upset by the lack of deer they were seeing. This type of response represents just a small fraction of the total feedback. Additionally, some public commenters were interested in information about results from the hunting program so that they could have an idea of how it is affecting the deer population and the forest.

One key to successful deer management is understanding how the deer population is changing over time. This can be done by observing forest conditions. A healthy forest that is not overbrowsed will have full herbaceous, shrub, and understory tree layers dominated by native plants. In contrast, a forest that is overbrowsed may have few native species, a lack of plants in the herbaceous, shrub, and understory layers, and a visible browse line up to about 6 feet high which is the highest reach of deer. As forests move from heavily impacted to less impacted, this is a good indication that deer populations are shrinking. Once forests have reached a healthy level,

the deer population can be assumed to be at a sustainable level.

The Mount Penn Preserve can continue to have a managed hunting program overseen by a contractor, either continuing with the USDA or finding a different contract as the land managers determine appropriate. The Mount Penn Preserve partners should continue expanding this program to all appropriate areas, taking into account safety and the appropriateness of allowing people into various areas.

MP3 can also consider adding in culls if the deer population does not decrease as quickly as desired. Under a deer cull program, the Preserve would be surveyed to determine the number of deer present and how many should be removed. Following approval from the Pennsylvania Game Commission, bait stations are set up to lure deer and then sharpshooters remove them at night, generally over the course of a few nights. This would reduce risk to the public while quickly reducing the deer population. Repeated culls are likely to be needed until the deer population within the Preserve reach a sustainable level. They may then be needed periodically to keep the population low. The managed hunting program can supplement the culls, helping to prevent a rebound of the population after culls. Culls would no longer be needed when the managed hunting program keeps the deer population sufficiently low. The feasibility of this option depends on the approval of the Pennsylvania

management strategies - deer

- Continue deer management program.
- If needed and allowed by the PA Game Commission, add deer culls to quickly reduce population.
- Monitor the forest to assess effectiveness of deer management.
- Share results of the deer management with the public, highlighting ecological benefits as they occur such as a higher proportion of young trees or seedlings.

Game Commission, and as such, may not be an option at this time. However, this option may be explored again if subsequent years of the managed hunting program do not lead to low enough levels of deer to support natural regeneration and a healthy forest.

Land managers should monitor the forest to understand if and how it is being impacted by deer. Monitoring programs can include photo points or transects to observe changes in the same area over time. Such monitoring can be carried out by staff or volunteers.

invasive plants

An invasive plant is an introduced species that rapidly spreads and outcompetes native species, chiefly because of the absence of the predators, pathogens, and herbivores that keep it in check in its native range. In contrast, native plants are those species that have evolved in a location over time and are tied to other native plants and the native wildlife. As such, native plants support the complex food web of native wildlife, from pollinators through larger mammals.

Humans have caused the spread of invasive plant species throughout Pennsylvania and much of the world. Even though the occasional immigration of new species into plant communities is a normal process, the current high rate of introduction—fueled by the planting of non-



Invasive plants with the Preserve ranges from scattered, small populations to large, dense patches like the area of Japanese knotweed seen here.

native species for horticulture, wildlife management, and erosion control—is threatening the integrity of native plant communities and the survival of native species. Controlling or eradicating invasive species is a difficult but important task for stewards of natural lands.

Not all introduced species are invasive. Nearly 1,000 introduced species have escaped to the wild in Pennsylvania, where they compete with the 2,000 native species. However, only a few dozen exotic species have become invasive.

Not all introduced species are invasive. Nearly 1,000 introduced species have escaped to the wild in Pennsylvania, where they compete with the 2,000 native species. However, only a few dozen exotic species have become invasive.

Most invasive plants are particularly well adapted to take over disturbed areas. In Pennsylvania, the division and clearing of land associated with agriculture and sprawl development has created countless miles of edge between natural and non-natural areas that is highly suitable to the

proliferation of invasive species. The misguided promotion of several exotic species for erosion and livestock control as well as the state’s rich horticultural legacy, which often used exotic species, have provided plentiful seed sources for regional dispersal of numerous invasive exotic species.

The presence of invasive plant species complicates the goal of maintaining healthy, native forests as invasive plants compete vigorously with preferred native species for “growing space,” the major resources and conditions—light, water, nutrients, temperature, humidity, soil structure, and other factors—that support plant growth in any area. Invasive species can displace native vegetation, halt or subvert the natural process of succession from field to forest, and homogenize the structural and wildlife food resources of a site. They can also alter nutrient cycling, local hydrology, and fire regimes.

These modifications to native plant communities reduce their habitat value for native wildlife, particularly migratory



Invasive barberry pervades the understory in much of the Preserve

songbirds, which nest within different vegetation layers, and insects, which are vital links in many of the food chains that make up the food web in ecosystems. Many native insect species, both terrestrial and aquatic, are specialist feeders relying on just one native plant species or a narrow range of species. Exotic invasive plants rarely serve as a food source for native insect species. Where a community features abundant and diverse native plants, it will also contain greater total insect biomass. Conversely, the more non-native plants present in a community, the scarcer insects will be. Insects are the richest source of fats and protein for birds, fish, and many small animals that, in turn, are food for larger animals. Where non-native plants are abundant, far less of the total plant biomass is converted, via the food chains that make up the food web, into animal biomass. Invasive plants have adverse impacts on virtually all native wildlife populations, both by degrading habitat directly and by reducing the total food supply. Nationally, the destructive impact of invasive species on native biodiversity is exceeded only by direct habitat destruction and forest fragmentation.

creating an invasive plant control program

Creating an invasive plant management program is a critical step in managing invasive plants. The purpose of the program is to understand what invasive plants are present and provide guidelines around how to prioritize different areas and species. This can inform work plans, budgets, and funding requests.

To protect and improve biodiversity, invasive species should be managed to protect critical areas, limit further degradation, reduce the possibility of reestablishment by previously controlled species or invasion by new species, and best utilize staff and volunteer hours and resources.

The following strategies are recommended for an effective invasive species control program.

species identification

The site should be surveyed to identify and locate invasive species, as well as determine the level of degradation and impact caused by invasive species. Mapping the location and extent of a species can help determine effectiveness of control strategies over time.

invasive species characteristics

- few predators, herbivores, and diseases
- adaptation to disturbance
- fast germination
- high population growth
- early reproductive maturity
- vegetative as well as sexual reproduction
- pollination by wind or multiple insect species
- wide tolerance to many habitat types
- fast growth rate
- long-range seed dispersal capability
- fruit used by wildlife or humans

management unit and species prioritization

Management units (or areas within them) should be prioritized based on the level of invasive prevalence. When deciding what areas to address first, a few factors should be considered.

1. Vegetation communities with the lowest density of invasive species should be given priority over heavily degraded areas. Areas that are heavily degraded already have limited biodiversity and low-quality habitats, whereas areas with mostly native species still have high quality habitats with biodiversity to protect.
2. Areas that are least likely to be repopulated with invasive plants should be prioritized. Seeds are more likely to spread downhill, downwind, and downstream, so these locations should be addressed last. Additionally, minimally disturbed areas such as the interior of forests are less likely to be repopulated and should be prioritized over heavily trafficked areas such as trails and wildlife corridors.
3. Areas with high priority resources, such as rare or endangered species, should be prioritized over areas without critical resources.
4. Within each management unit, species should be managed with a top-down approach. Vines impacting trees should be managed first, followed by trees, shrubs, and then herbaceous plants. This prioritizes plants that affect the most growing space and have the greatest effect on habitat. While this is the general rule, other factors may make a species a priority. For example, poison hemlock (which was not identified during the site visits but is in the region) is highly toxic to people and spreads rapidly. Such a risk to human safety and ability to spread prolifically make poison hemlock a top priority for management.

Based on these guidelines, the focus of initial restoration efforts should be to halt the degradation of the canopy layer in the healthiest areas, then moving down through the forest layers. Land managers would then move to the moderately invaded areas, and so on to the most degraded areas. Those areas that are severely invaded should, at first, be left for "dead." Since they essentially cannot degrade any further, their restoration (which will usually require

significant resources, including heavy equipment and years of maintenance) is best left until the healthier, less affected sites are stabilized. This approach is also healthier, psychologically, for the people involved in restoration. Spending the initial phase of a project stabilizing the majority of a site is more rewarding than struggling through a small, highly degraded section.

There are of course exceptions to these guidelines. Invasive plant management and subsequent restoration priorities may need to be modified for best short-term efficiency of labor and long-term results, according to the time of year or availability of labor. For example, the cutting and herbiciding of understory invasive trees is best done during fall and early winter when sap is flowing into the roots, whereas the planting of seedlings is best done in the early spring. Priorities may also change based on funding available. If a large amount of funding is available to clear a dense patch of invasives and then immediately replant the area, that section may become a higher priority.

species management

Species management can be carried out by staff members, contractors, or volunteers, depending on the type of work required and available resources. Volunteers can pull plants or cut them with hand-held tools like pruners and loppers, while properly trained staff or contractors can use larger equipment like chainsaws and mowers. Herbicide must be applied by licensed personnel.

If an invasive species makes up most of a structural layer, full removal at one time is not generally recommended, as this will abruptly remove habitat and food sources. Removing understory shrubs such as exotic shrub honeysuckles, privets, or linden viburnum can transform a forest stand that provided shelter for migratory and resident birds and other animals to one devoid of understory cover and thus no longer a viable refuge from predators, nor feeding or breeding habitat for many species. Removal without replacement has numerous subtle effects but some effects can be dramatic, such as a striking decline in birds that were once common. In general, the restoration of a degraded community, particularly forest, should be done in a manner that removes less than 50% of the total biomass of any vegetation layer (canopy, subcanopy, shrub, ground), leaving wildlife plenty of space to find refuge and time to adjust to changing cover and food conditions. If the

amount of invasive material is light and widely scattered throughout a forested area, the entire forest can be treated at the same time. However, if the shrub layer, for example, is heavily dominated by invasives it is best to treat the area over several years, waiting for existing native shrubs to fill in the available growing space or planting new ones. Invasive vines are the exception to this rule, because they grow on and not in place of native species and can weaken, kill, or topple trees. All invasive vines should be treated as soon as possible.

However, intensive management projects can be undertaken where invasive plants that take up the majority of an area are removed at one time if the land manager is prepared to immediately replant the area with a substantial quantity of native plants to reestablish habitat. The land manager will also have to be prepared to regularly monitor the area and control any invasive plants that try to



The canopy gaps are areas where intensive restoration projects that address a full area of invasive plants at once followed by replanting may be appropriate.

reestablish. While this can impact wildlife habitat, it may be the most efficient way to restore an area if sufficient funds are available.

To prevent new colonies from forming and current populations from expanding, care should be taken to disturb the land as little as possible for any work being done. Deforestation should be avoided. Once a species has been removed, disturbed areas should be replanted with native species to restore habitat and discourage invasive plants from reestablishing. Additionally, areas where plants are removed should be monitored and reestablishing invasive plants should be controlled.

Management techniques for individual species are included in the appendix. The plant communities lists in the appendix include which native species were identified during site visits by management unit. Additionally, the Recommendations by Management Unit section will include further recommendations about prioritization and specific management by area if different than the general recommendations, such as managing multiple species at once within a canopy gap.

monitoring

Invasive species must be monitored to determine whether treatment has been effective and if further treatments are necessary. Treatment efforts often need to be repeated to be successful. Treatment efforts may also need to be reassessed and other treatments pursued if initial efforts are unsuccessful. Ongoing monitoring is necessary to identify any regrowth from the seed bank and to prevent reestablishment of the population. Most importantly, monitoring is necessary to identify newly established invasive species so they can be treated before spreading further. It is easier to control and eliminate a species if it is found early, when the population is small and requires fewer resources to manage. This should include monitoring boundaries to note invasive plants on adjacent properties that are likely to spread.

policies to minimize spread

Several actions can be taken to prevent the further spread of invasive species onto or within a property. First, soil and vegetation disturbance should be minimized for all projects on a property, regardless of whether they relate to invasive plant control. Invasive plants have a



Invasive plants in landscaped areas should be removed and replaced with native plants.

competitive edge when establishing in disturbed areas and can make restoration difficult. Second, forest edge should be minimized, as invasive plants thrive in edge environments. To avoid fragmentation, areas of forest should be connected and edges should be rounded off wherever possible. Third, landowners should not plant invasive species on the property. This includes landscape and recreation areas.

Finally, to further reduce the spread of invasive plants, visitors to a property should be educated on cleaning shoes and clothing to remove invasive plant seeds and other material before entering. A short explanation posted on a kiosk could help make the public more aware of the risks of being unintentional carriers of invasive seeds. Interpretive signage can inform visitors about the threat of invasive plants and call out ones that are visible in the landscape. Additionally, interpretive signage can be posted to explain invasive species control projects, especially ones that create a significant visual change that could be concerning to visitors.

restoration

Any site where plants to be removed comprise more than 25% of the cover within their forest layer will require planting to augment any natural regeneration until the deer population has been sufficiently controlled. Removal should be undertaken at times of year when direct disturbance of wildlife is minimal, preferably late fall or winter. Replanting should be done as soon as possible after invasive plant removal. Planting should also precede the onset of the spring breeding season if possible because many birds return to the same sites year after year to reestablish territories and reneest. To ensure their survival and to maintain ecosystem integrity, replacement plants must be native trees, shrubs, or herbaceous plants carefully selected for soil conditions and the existing plant community. It should be emphasized that successfully establishing native species after treating invasives will hinge on proper deer management—either restricting access to the plantings or establishing and maintaining the appropriate deer density.

Replanting after removing invasive plants accomplishes several objectives. Where invasive species have eliminated entire forest layers, replanting after removal restores long-lost vertical forest structure and bird cover. Where

management strategies - invasive plants

- Implement an invasive plant management program.
- Focus on highest quality areas first and working in a top-down approach within areas.
- Replant areas after invasive plant control.
- Monitor effectiveness of treatments and new populations of invasive plants.
- Educate the public on the importance of invasive plant control and their harm on the environment.

invasive plants are removed from steep slopes, replanting renews protection against soil erosion. In all cases, the planted native species restore lost components of the indigenous food web; invasive species’ leaves and stems are little utilized as food by native wildlife, which is one of the reasons they succeed so well here.

It must be emphasized, however, that planting should be viewed as only one component of forest restoration where invasive species are removed. The goal of maintaining natural lands as a set of natural communities dominated by native species will be met only by reducing the deer population to a level that allows natural regeneration of native species within the Preserve. Once natural regeneration is restored, a healthy crop of seedlings and saplings of native species will be present to fill the growing space vacated by the natural mortality of native species or the deliberate removal of invasive species.

exotic pests and diseases

Similar to invasive plants, exotic pest species have been introduced to the region and are negatively impacting native vegetation. They are often introduced through transportation of lumber products, firewood, and shipping crates. There are some pests and diseases that threaten the sustainability of forests by targeting specific tree species, which often have no effective defenses against these exotic threats. As such, these pests and diseases can cause widespread tree health issues and often mortality, thereby significantly decrease the abundance of specific species within a forest. Two examples are the decline of elm trees in the 1960’s due to Dutch elm disease and the more recent die off of ash trees due to the emerald ash borer.

The exotic pests and diseases impacting the forests of Pennsylvania continue to change over time depending on the cycles of outbreak, introduction of new species or diseases, and decline of impacted tree species. As such, land managers need to be continuously assessing the potential for diseases and pests in their region. For pests and diseases that were introduced outside of southeastern Pennsylvania, there may be opportunities to learn from management efforts and to prepare for the arrival of the pest or disease. Yet there are plenty of times where such proactive steps are not be feasible due to the current understanding of the disease/pest and possible

management actions. Land managers may need to adapt on the fly and stay current on what management options are being tested.

The following are three pests and diseases that have already or may impact the Preserve.

emerald ash borer

Emerald ash borer (EAB), an exotic pest from Southeast Asia, is killing ash trees in the midwestern and northeastern United States. The first sighting within the United States occurred in Michigan in 2002. The pest subsequently spread east to Pennsylvania, and by 2019, EAB had spread to every county in the state. EAB larvae feed on the inner bark of ash trees and kill them essentially by girdling, stopping nutrient flow from leaves to trunk and roots. Trees typically die within 3-4 years of infestation. EAB infestations are typically identified through the symptoms they cause. Signs and symptoms of an infestation include crown dieback, epicormic branching, bark splits and flaking, “D” shaped exit holes, and sinuous larval galleries under the bark.

EAB has been impacting forests throughout the Preserve, resulting in dead ash trees and canopy gaps where ash trees once stood. Since the EAB has already been in the area for years, it is likely too late to save any ash trees through pesticide applications unless applications have already been occurring. Instead of trying to protect ash trees, management should focus on mitigating hazards from EAB infested trees and restoring the forests.

Ash trees should be removed when a tree is a potential hazard, such as if it is near a road, trail, or other gathering area where people or property may be damaged if the tree were to fall (see the Hazards chapter for more information on hazard trees). Where trees are not hazards, the tree can simply be left in place and allowed to become a snag and then fall in due time. An arborist should be consulted to address hazard trees, as ash trees infected by EAB are likely to break in unexpected and sudden ways, making them dangerous to remove.

Where canopy gaps have formed as a result of ash tree die off, land managers can restore canopy gaps by clearing invasive plants and replanting with native tree and shrub species.

beech leaf disease

Beech leaf disease (BLD), associated with the nematode *Litylenchus crenatae mccannii*, was first detected in Pennsylvania in 2016 in Erie County. Since then, it has spread across all 67 counties. BLD is generally fatal for younger beech trees, particularly saplings. In Rhode Island, BLD has caused 90% mortality in infected saplings. Clonal colonies are also more susceptible, likely because of the root connections between trees. The effect on mature beech trees is still being studied, but it appears that mature trees are also susceptible but will take longer to die. Symptoms of beech leaf disease include crispy, dry leaves and dark bands between leaf veins. As of 2024, there is no known cure, but there are some treatments that seem to help protect the trees and more research is being conducted. Possible treatment options include drenching the soil around beech trees with a phosphite fertilizer or injecting the tree with an insecticide.

Beech is only a small proportion of the canopy trees within much of the Preserve, as such their die off would not substantially compromise the health of the forest. The exception to this is the mature forest area with Antietam Lake Park. This area has healthy, large beech that are a dominant part of the canopy.



Beech leaf disease symptoms include dark bands on leaves like those seen here.

Photo credit: Yonghao Li, The Connecticut Agricultural Experiment Station, Bugwood.org

As BLD is already starting to impact the Poconos, it is likely to reach the Preserve soon. In general, the land managers should monitor beech trees for any sign of BLD and notify all other Mount Penn partners if infected trees are found. Land managers can then plan for how to best support the forest. For all areas, this may include planting understory trees that can replace the beech over time.

Within Antietam Lake Park, more direct methods can be taken to protect at least some of the mature beech trees. Because the current treatments are target individual trees and it will likely be cost prohibitive to treat a large area of trees, Berks County can identify a select number of mature beech trees that are likely to produce a large amount of seeds to protect. This will hopefully maintain at least some of the canopy and preserve beech in the seed bank. For beech trees that cannot be protected, Berks County should focus on planting a diverse understory to replace the beech trees. As treatments are still preliminary, more research will likely be needed to decide on a course of action. Berks County should also create a plan of action to remove potentially hazardous beech trees prior to them dying.

sources:

Penn State Extension: Beech Leaf Disease (extension.psu.edu/beech-leaf-disease-in-pennsylvania, as of 2024)

Under the canopy: Penn State researchers study beech leaf disease in PA forests (psu.edu/news/agricultural-sciences/story/under-canopy-penn-state-researchers-study-beech-leaf-disease-pa-forests, as of 2024)

oak wilt

Oak wilt is currently moving through Pennsylvania. This disease is a vascular wilt that is caused by the *Bretziella fagacearum* fungus. The disease affects all oak species, but it is more aggressive for species in the red oak group. Red oak group species can die from infection in a matter of weeks whereas white oak group species may last for years. Oak wilt is spread through underground root grafts between oak trees and through sap beetles. Root graft spread creates more localized infestations. Generally, oak trees within 50 feet of each other are likely to have root grafts. In contrast, sap beetles can create wide-spread infestations. These insects are drawn to fresh wounds, capable of arriving within 10-15 minutes of a wound occurring, and then cause infection of the wounded tree. Uncleaned equipment can also transmit oak wilt from infected to uninfected trees.



Brown, dried out leaves are a symptom of oak wilt.

Photo credit: Joseph OBrien, USDA Forest Service, Bugwood.org

Symptoms of oak wilt include brown and dull leaves. For red oak groups species, brown/dull leaves first appear in the outer and upper branches and then move inward. For white oak group species, leaf browning and dullness appear more scattered.

Due to the large amount of oak throughout the Preserve, this is a significant risk to the future health of the forest. There is no cure, but there are treatments that can help protect individual trees and potentially prevent the spread of oak wilt through a forest. For individual trees, propiconazole can be used to suppress oak wilt before a tree is infected. Trees need to be treated every other year. This is an expensive treatment, so it is not a viable option for a full forest stand. Instead, if land managers decide to pursue this option, they should select a limited number of specimen trees that can be used to continue seed production and/or are a significant specimen tree.

To prevent the spread of oak wilt into an area, oak trees should not be cut or wounded in any way during the growing season to avoid creating fresh wounds that will attract vector insects. This prohibition on cutting should start as soon as temperatures reach 60°F for several

consecutive days, generally April through July. If pruning is needed or wounds occur through damage, applying wound dressing paint or shellac immediately can reduce the likelihood of infection.

If oak wilt is found within a forest area, actions can be taken to reduce spread. One option is to cut a 3-4 foot trench around the infected trees and a buffer of surrounding healthy trees. This can sever root grafts and reduce that means of spreading.

After cutting the roots, infected trees can be cut down. This should be done over the winter prior to April to reduce the spread of oak wilt from tree debris. Tree stumps should be treated with an herbicide to prevent resprouting. Trees that are cut should be destroyed. Alternatively, the material can be left in place for a year covered with a tarp prior to use. Some sources also recommend removing the buffer of seemingly healthy trees in case those trees are also already infected.

Oak wilt can be spread through the transport of wood, particularly wood that was cut in the spring through fall when the disease is active. A cold winter can kill oak wilt in dead wood, making it then safe to transport. However, until that point, the wood should be kept in place and covered with a tarp. Due to the risk of transporting oak wilt, wood should not be used for firewood or transported unless it is more than a year old. If oak wilt reaches the Preserve area, it will be important to convey the risk of transporting the disease through firewood to all neighbors as there has been a history of collecting firewood from the forests. Branches that are less than 6 inches in diameter are unlikely to be infected and are safe to move.

Similar to many other issues, it is also recommended that land managers improve the diversity and abundance of native tree species throughout the forest. Oak seedlings and saplings can be planted, as it will take time to develop root grafts and their will be time for the disease to potentially fade out from the area.

More details about control options from the Minnesota Department of Natural Resources is included in the appendix.

sources:

Penn State Extension: Stay Alert for Oak Wilt! (extension.psu.edu/stay-alert-for-oak-wilt, as of 2024)

management strategies - exotic pests and diseases

Stay current on pests and diseases that are within the region or are likely to reach the region in the near future. Research treatment and preventative options as possible prior to disease or pest arrival. MP3 could designate a point person to conduct this research who could then inform the other partners as to what they should be aware of.

emerald ash borer

- Remove ash tree where they are hazards. Consult with an arborist prior to removal.
- Control invasive plants and replant canopy gaps that have formed as a result of ash tree die off.

beech leaf disease

- Monitor the forest for any signs of beech leaf disease. Alert all partners if infected trees are identified.
- Plant trees in the understory to replace beech trees if they die off.

For Antietam Lake Park:

- Identify select beech trees to treat, choosing trees that will protect the canopy and maintain the seed bank.
- Research possible treatment options for effectiveness, application methods, and cost.
- Identify beech trees that may become hazardous if they succumb to BLD and plan for their removal if BLD is identified within the Preserve or nearby.

oak wilt

- Monitor for the introduction of oak wilt into the region. Stay current with treatment options.
- Avoid cutting or wounding trees from April through July. If wounds do occur, immediately use wound dressing paint or shellac to cover the wound.
- If trees become infected, identify the infected area and a buffer area. Create a 3-4 foot deep trench around this area. Remove infected trees over the winter prior to April.
- Avoid transporting oak wood. Limit use as firewood unless the downed wood has been onsite through the winter.
- Improve the health of the forest by increasing the diversity and abundance of native plants.

climate change

potential impacts of climate change

According to the PA Department of Environmental Protection (DEP), Pennsylvania is already experiencing the impacts of climate change, and effects will continue to worsen into the future. DEP's 2021 Climate Change Impact Statement asserts that Pennsylvania has already warmed 1.8°F in the last century. Temperatures could increase by 5.9°F by 2050 compared to a 1971-2000 baseline depending on continued greenhouse gas emissions and mitigation efforts. This report also states that Pennsylvania is expected to see more extreme temperatures events including more days above 90°F, an increase in droughts, and more severe, though less frequent, rain events. In a

highly developed area like that surrounding the Property, the abundant impervious surfaces will worsen the effects of climate change by further raising temperatures and increasing stormwater volumes resulting from severe storms. These changes have implications for managing natural areas and protecting critical resources.

Not all of the predicted effects will have an immediate negative impact on the Park's flora and fauna. Increased CO2 levels could lead to higher productivity for many species. Although this may be beneficial at first, there could be negative repercussions. Increased bioproductivity causes a parallel increase in nutrient demand. As mentioned above, nutrients may be leached from the soils, counteracting the positive effects of CO2 and leading to die off. Some plants will also benefit more than others from higher CO2 levels (Rustad et al, 2014). Vines in particular are predicted to increase at a rate higher than many other plants as they have no supporting central trunk or stem to feed, freeing energy for growth. An overgrowth of vines could put added stress on canopy trees as vines choke their stems and shade out their crowns.

Native species will likely experience a range of population trends as a result of climate change. Ones at the southern end of their range, highly dependent on specific habitats or hydrologic regimes, or closely tied to phenology of other species are more vulnerable. Those that are more generalized in habitat and food sources, have a high tolerance for drought and flooding, and are in the northern reaches of their range are more likely to be climate change winners. A more complete analysis is possible by vulnerability assessments, as discussed below.

Invasive plants and pests are likely to increase their range with higher temperatures. The factors that allow them to successfully compete with native plants will also help them adapt to climate change: prolific seeding and wide ranging dispersal, ability to colonize disturbed and marginal areas, and rapid growth. Without long cold spells, these species will be less restricted in their range and be able to outcompete natives in more areas. Gaps produced by plant die offs, especially in the canopy, will open more growing space for invasives (USDA Climate Change Resource Center).

resiliency

Having a resilient forest will depend in large part on how well the forest can withstand climate change. In order to cope with increased disturbances and stresses from increased temperatures and changes to precipitation patterns, land managers should focus on the overall health of native plant communities. This can be done by controlling invasive plants, pests, and deer. This will reduce stress to individual plants and improve the structural and species diversity within communities. Healthier plants and communities will better withstand the increasing stresses of climate change.

Additionally, forests should have an abundance of native plants in all structural levels, particularly young trees that can replace canopy trees as they die off. They should also have a diversity of native species to reduce the chances of widespread vegetation loss from disturbance or pests/diseases (which are likely to increase in spread due to milder winters). Finally, forests should include a high proportion of species likely to be resilient to climate change impacts. DCNR and the Northern Institute of Applied Climate Science (NIACS) have a list of projections for tree species that models if trees will increase or decrease in prevalence due to climate change or experience no change. Resiliency at a landscape scale is covered below in the Managing at a Landscape Scale section.

co-benefits to the community

Having a healthy forest will have benefits beyond the extent of the Preserve. Having such a large forest on the edges of a densely developed city can mitigate some of the impacts of the heat island effect, where dark surfaces like roads and roofs absorb sunlight and increase temperatures compared to lighter and natural surfaces. Additionally, forest vegetation is important in managing stormwater. Having a dense forest with an abundance of plants in all forest layers – herbaceous, shrub, understory, and canopy, can intercept rain fall and slow and infiltrate stormwater. This is particularly important on the steep slopes of the mountain, where stormwater can increase in velocity and impact trails along the way and buildings at the base of the mountain. As climate change causes more frequent and severe storms, managing stormwater will become increasingly important. Increasing the density of native plants throughout the forest areas will help mitigate stormwater.

carbon sequestration and storage

The Nature Conservancy's Resilient Land Mapping Tool models the amount of carbon an area stored in 2010 based on 2010 forest data and what an area can store by 2050 if 2010 conditions remain consistent. Based on this tool, the Preserve stored 187,561 metric tonnes (mt) of carbon in 2010 and has the potential to store 224,611 mt of carbon by 2050. To put this into perspective, 187,561 mt of carbon is equivalent to 44,640 gasoline-powered passenger vehicles driven for one year or emissions from the energy use for 24,460 homes over the course of a year. 224,611 mt of carbon is equivalent to 53,458 gasoline-powered passenger vehicles driven for a year or the annual energy use of 29,291 homes (EPA's Greenhouse Gas Equivalencies Calculator).

Such high numbers indicate the importance of the Preserve, and specifically its forests, for mitigating carbon dioxide emissions. As such, the current extent of the forest should be protected to conserve the current carbon sequestration and storage capacity. Beyond maintaining forest extent, land managers should allow for a diversity of forest ages and increase the density of native plants and dead and downed wood to improve carbon storage and sequestration capacity.

As explained by Penn State Extension, different forest ages all contribute to carbon storage and sequestration. As such, allowing for different forest ages to support sustainability does not negatively impact carbon storage and sequestration capacity of the Preserve. Young forests have a high rate of carbon sequestration due to their relatively rapid growth with a lower level of carbon storage, as the carbon has not had a chance to accumulate in the forest over time. Maturing and mature forests still sequester high amounts of carbon as older trees continue to grow and young trees fill in canopy gaps and lower levels. They also have accumulated more stored carbon than young forests. Old-growth forests have a large amount of stored carbon which has accumulated over the years, both in living and dead wood. The rate of sequestration is slower as there are fewer individual trees overall and fewer younger trees growing in these forests. However, disturbance of old-growth forest, such as through timber harvesting, can release large amounts of stored carbon.

At the time of this plan, most of the forests were maturing/mature in age. These forests can be improved to increase carbon storage and sequestration, primarily

by increasing the density of plants in all structural layers. Currently, the oak forests have sparse understory, shrub, and herbaceous layers. There are also areas with canopy gaps. Increasing plant density will provide more biomass to sequester and store carbon. One key step in increasing native plant density is to manage deer. Another option is to add understory plantings where the soil allows. These plantings should be protected from deer with tubes or fencing until the plants are able to withstand deer browsing. Where the soils are too rocky for plantings, land managers can protect natural regeneration with tubes or fencing. All fencing will require regular monitoring and maintenance. The mixed hardwood forests already have a high density of plants in many areas. However, most of the plants in the understory are invasive and need to be controlled. As such, planting will be needed in these areas to fill gaps left after invasive plant removal (unless regeneration of native plants is more successful after continued implementation of the deer management program). These planting should also be protected from deer. Increasing forest resilience by promoting tree species diversity and planting a higher proportion of species predicted to have high resilience will also protect carbon sequestration and storage capacity in the long-term. Additionally, dead and downed trees can be retained as they continue to store carbon as they slowly decompose. Chipping or burning dead wood releases the stored carbon more quickly.

MP3 partners can also look to protect and encourage protection of the forests around the Preserve area and in private properties within the Preserve. This can include acquiring properties or easements where there are willing landowners and creating outreach programs to promote tree protection and planting for private owners.

possible carbon programs

Carbon programs that pay landowners to protect forest stocks, and in some cases improve forests, are still evolving. There are some programs available to Pennsylvania landowners, however there may be no feasible options for municipalities and counties at this type, thereby restricting the applicability of these programs primarily to Berks Nature.

eligibility

Eligibility for participation in carbon credit programs depends on the existing deed restrictions or easements that may be in place as well as the ownership status of each individual parcel. When a property has been protected by a deed restriction or easement, the principle of "additionality" may be violated. Additionality means that only those carbon projects that would not have happened anyway should be counted for carbon credits. In other words, if land is already protected by an easement or deed restriction that prevents the harvesting of timber, it cannot be used as additional protected carbon stock as that carbon is already essentially protected. Carbon credits apply to unprotected land or land that has an easement that permits sustainable harvesting of timber.

Most programs are specifically for privately held land forests, potentially including land trust property. At this time, municipal or county government-owned land is not eligible for participation in any of the carbon credit programs available in Pennsylvania. There may be an exception with the Working Woodlands program (see below), as this program has previously funding water authority property. Programs also have restrictions around the acres enrolled. Restrictions may change over time as programs evolve or new programs are created.

Programs also support or require different types of projects to protect and improve forests. The project types are included below. Not all of the project types are applicable to the MP3 forests, but they were included as a comprehensive review of what landowners may come across while exploring these programs.

project types

improved forest management (ifm) projects

- **Reduced Impact Logging (RIL):** Projects that reduce net GHG emissions by switching from conventional logging to RIL during timber harvesting.
- **Logged to Protected Forest (LtPF):** Projects that reduce net GHG emissions by converting logged forests to protected forests.
- **Low-Productive to High-Productive Forest (LtHP):** Projects that increase carbon sequestration by converting low-productivity forests to high-productivity forests. This is done by improving the stocking density of the forest and/or introducing other tree species with higher growth rates.
- **Reduced Emissions from Deforestation and Degradation (REDD):** Activities that are designed to stop planned (designated and sanctioned) deforestation or unplanned (unsanctioned) deforestation and/or degradation.
- Avoided planned degradation is classified as IFM.

afforestation, reforestation, and revegetation (arr)

- Projects that increase carbon sequestration by establishing, increasing or restoring vegetative cover (forest or non forest) through the planting, sowing or human-assisted natural regeneration of woody vegetation. Eligible ARR projects may include timber harvesting in their management plan.

source:

Kurt Gaertner, Land Policy and Planning Director, Robert O'Connor, Director, Division of Conservation Services. "Forest Carbon Credits: A Guidebook to Selling Your Credits On The Carbon Market." (2018). Accessed July 22, 2024.

programs

The following paragraphs provide an overview of potentially applicable programs available in Pennsylvania. As mentioned above, Berks Nature may be the only Mount Penn Preserve partner currently able to take advantage of any of these programs due to eligibility requirements.

family forest

This program is geared towards private landowners who own 30 acres or more of non-planted, naturally regenerating trees and have the legal right to harvest their land. The landowner must have or be prepared to work with a consultant to develop an active management plan for this property. Enrollment in certain tax discount or funding programs may limit eligibility. Publicly owned land including government/city/county owned properties are not eligible for the Family Forest Carbon Program. The Family Forest Carbon Program supports Improved Forest Management projects, allowing properties that have been logged conventionally to be part of the program. Once enrolled, the property can only be logged in accordance with a forest management plan.

working woodlands

This program is geared towards private landowners who must own a minimum of 2,000 forested acres to be eligible to enroll their property in the program. To enroll in Working Woodlands, a qualifying landowner is required to sign their forested acres into conservation easements or long-term management agreements to prevent conversion into non-forest uses and unsustainable management practices. Landowners must agree to manage their forests with climate-smart practices in return for management assistance that leads to revenue from the sale of carbon credits and forest products. This program may allow the Reading Area Water Authority (RAWA) to enroll if RAWA meets the acreage minimum.

Participation in this program provides the following benefits to the landowner and the forest, including:

- A customized 10-year forest management plan.
- Certification by the Forest Stewardship Council® FSC C008922, which allows the sale of forest products under the FSC-certified label.
- Access to the carbon market, which provides an additional source of revenue.
- A detailed assessment of the forests, wildlife and carbon on their property.
- The Working Woodlands Program supports Improved Forest Management projects enrolling properties that have been logged conventionally. Once enrolled in this program, the property must be protected can only be logged in accordance with a forest management plan.

forest carbon works

This program is geared towards private landowners who must own a minimum 40 acres in size. One major requirement is that all forested lands owned by the landowner at the time of enrollment must be included. Forestland must also be at risk of current or future conversion (i.e., to a land type other than forest), and/or aggressive commercial harvesting. Any commercial harvests that have occurred on the property within 10 years prior to application must be disclosed. Landowners must have the legal ability to conduct commercial timber harvesting on their property. Similar to the Working Woodlands and Family Forest programs, Forest Carbon Works supports Improved Forest Management projects.

LandYield

This program is geared towards private landowners who must own a minimum 40 acres in size. Forestland must also be at risk of current or future conversion (i.e., to a land type other than forest), and/or aggressive commercial harvesting. Landowners must have the legal ability to conduct commercial timber harvesting on their property. Land that is subject to liens and mortgages may require lender approval. Landowners are free to enroll portions of their properties; however, project sites must have between 70-80% merchantable timber by volume.

Landowners are required to make a 40-year commitment, including a 20-year harvest deferral. For the project's first 20 years, commercial timber harvests are prohibited. After the project's first 20 years, the landowner will be permitted to harvest growth in excess of Y20 carbon stocks. If a landowner sells the enrolled forests and the new landowner qualifies and agrees to the assignment of the obligations, the landowner can sell the property without penalty. If the buyer does not agree to participate, the landowner can sell the lands but will be obligated to pay the current value of the offsets associated with the sold parcel to extract the property from the program.

land trust alliance forest carbon offset pilot program with finite carbon

This is the only program we have seen that is specifically geared towards land trust owned properties. The purpose of the Forest Carbon Offset Pilot Program is to assist land trusts that have smaller properties with enrolling forested fee lands in Finite Carbon's program by aggregating their holdings with those of other land trusts. The Land Trust Alliance and Finite Carbon are collaborating to design this pilot program for the benefit of individual land trusts.

These projects increase or maintain forest carbon stocks relative to baseline levels through management actions. These management actions may include extending harvest rotation lengths, maintaining stocks at a high level, widening stream buffer widths and increasing productivity by removing diseased or suppressed trees. Forests that are passively managed or managed for old-growth characteristics are eligible for this program.

management strategies - climate change

- Reduce other stressors such as deer and invasive plants.
- Increase plant diversity and abundance to increase forest resiliency, focusing on adding plants are more likely to be resilient to climate change. This can also increase carbon storage capacity.
- Increase the density of riparian buffers.
- Retain dead and downed wood, as well as large trees to retain and increase carbon storage capacity.
- Support a diversity of forest ages to increase resiliency.
- Continue to stay aware of potential carbon credit or storage programs.

canopy gaps

There are numerous canopy gaps throughout the Preserve, some as a result of ash trees succumbing to emerald ash borer. While canopy gaps are a natural occurrence in forests, the current lack of regeneration means that native trees are not naturally filling in these gaps. Instead, the light encourages growth of invasive plants. If not managed, these canopy gaps can continue to promulgate, and can eventually compromise the sustainability of the forest.

The canopy gaps range from ones that are relatively small and new and have few plants at all in the gaps to large gaps that have been heavily populated by invasive plants. Until native regeneration is restored through controlling deer and invasive plants, active stewardship will be needed to establish native plants in these gaps. Where invasive plants are already present, the invasives will need to be controlled prior to planting. For the large canopy gaps that are heavily invaded, mechanical equipment like a forestry mower could be used to clear large areas of invasives if there is a way to get equipment to the gap. This is likely not feasible in many cases, so hand-held power tools and herbicides can be used to control invasive plants throughout the entire gap. See the invasive plant section and control options



The canopy gaps range from small areas where a few trees have died to expansive gaps such as the one by the Pagoda.

by species appendix for more information. Native plants should be planted as soon as possible after invasive plant control, focusing on native trees and shrubs. Planting the canopy gaps will restore structure for habitat and help prevent reestablishment of invasive plants. Particularly for the areas that are heavily populated by invasive plants, repeated spot treatments will likely be needed over multiple years to fully control the invasive plants.

Restoring canopy gaps will help create patches of different aged forests compared to the surrounding forest. Additionally, planting in canopy gaps presents an opportunity to guide the composition of the forest canopy. As such, land managers should consider plants that are:

1. Important habitat, including oaks and hickories;
2. Projected to be resilient to climate change;
3. More southern species that may be resilient to climate change. This can be done as test plots as this is still a novel approach. Do not use species that may become overly aggressive or invasive.
4. Fill out the forest layers.

management strategies - canopy gaps

- Control invasive plants in existing canopy gaps and prevent establishment of invasive plants in new canopy gaps. Repeat spot treatments as needed.
- After invasive plant control, plant canopy gaps with native trees, favoring species projected to be resilient to climate change.
- As deer and invasive plants are managed, land managers may be able to switch from planting natives to protecting natural regenerating native plants using fencing or tree tubes until the plants are large enough to withstand deer browsing and rubbing.

tree selection and planting

Tree selection should be based on the site conditions – soil, hydrology, sun exposure, and plant hardiness zone. Traditionally, the recommendation has been to recreate native plant communities, selecting trees appropriate for various plant communities found in a region. However, that strategy may need to change in light of climate change, which can make certain tree species less resilient by shifting plant hardiness zones and changing precipitation and temperature patterns.

Use the following guidelines for planting balled and burlapped (B&B), containerized, and bare-root trees.

- Use only native tree species (ordinary, wild-type species rather than hybrids or cultivars) appropriate to site conditions. Ideally, they should be grown from local seeds or cuttings unless intentionally sourcing from warmer climates to address climate change.
- All plants should be nursery grown in accordance with the American Standards for Nursery Stock, latest edition.
- All plants should be typical of their species or variety and should have a normal habit of growth (avoid variegated-, yellow-, or red-leafed, dwarf, “weeping,” or other atypical selections). They should be sound, healthy and vigorous, well branched, and have dense foliage. They should be free of disease and insect pests, eggs, or larvae. They should have healthy, well-developed root systems.
- All plants should be balled and burlapped (B&B), containerized, or properly handled bare-root seedlings or saplings.
- Unless protected from deer browsing, trees should be 6-8 feet tall at planting to help ensure that they can outcompete introduced invasive plants and so that some of their foliage and the terminal bud(s) of the central branch (leader) are above the reach of browsing deer. Bare-root trees are less expensive than container trees but their survival rates are lower, although bare-root trees now are often shipped with their roots coated in a hydrogel—a synthetic water-absorbing compound—to protect them from desiccation. Container trees are easier to plant and have a much greater survival rate than bare-

root trees, especially if soil conditions in the planting area become dry.

- Bare-root stock must be planted in fall or early spring, preferably when most deciduous trees are leafless or nearly so; using container or balled and burlapped trees extends the planting season by several weeks at both times.
- Roots of all transplant plants should be adequately protected from sun, drying winds, and frost. The roots of bare-root seedlings should be kept constantly moist until planting.
- Forest gaps and afforestation areas should be planted with trees on a 10-foot × 10-foot spacing; if resources are limited, spacing can be increased to as much as 15 feet × 15 feet. Spacing can also be increased (up to 20 feet × 20 feet) if resources allow for the purchase of larger plants and protection from deer browsing and rubbing. Plantings should be protected from deer damage with fencing, tree shelters, flexible tree guards, or staked wire mesh cylinders 5 feet tall. Fencing and tree shelters prevent deer from browsing leaves and buds. The tree wraps and stakes minimize damage to the bark and cambium layer of young trees caused by antler rubbing. The wraps should cover the trunk from 1-5 feet above the ground. The stakes should be placed in the ground close to, and on opposite sides of, the trunks. They can be made of wood, metal, or other rigid materials (including bamboo) and should be at least 5 feet tall (above ground level).
- The planting hole should be 2-3 times as wide as the diameter of the root ball or spread of roots, but not deeper than the root ball. As necessary, mound soil in the hole so that the top of the plant's root ball will be at or slightly above ground level.
- All burlap, twine, and wire should be removed from at least the upper half of the ball and laid flat in the hole or cut away completely after the plant has been set in place. It is essential to completely remove all synthetic string and fabric from around the root ball (natural fiber burlap will decompose in time).

- Backfill with soil and lightly tamp the soil surface. Strictly avoid piling any soil (or mulch) against the base of the stem where it meets the top of the root; this can cause decline or death of planted trees and shrubs.
- If space permits, temporarily mound soil into a collar 4-5 inches high surrounding the perimeter of the root ball to help retain water until the tree is established.
- If planting on a slope, mound the soil downslope to level the ground above the root ball and help keep runoff from washing soil away.
- Mulching the soil surface of the backfilled planting hole with wood chips, hardwood mulch, or biodegradable landscape fabric can help retain soil moisture in the rooting zone, reduce soil loss to runoff erosion, and reduce competition from colonizing plants until roots become established. Dyed mulch should not be used. It is essential to avoid placing any mulch in contact with the stem. The so-called “volcano” practice of piling mulch against the stem promotes pathogenic fungal growth, resulting in the decline or death of planted trees and shrubs.
- Watering at the time of planting is recommended, especially if the plant is not dormant or planted during warm or dry weather. If water is easily accessible, water all plants at the time of planting to help remove air pockets from backfilled soil. Ideally, the planting hole should be backfilled ¾ full with soil, watered well, filled the rest of the way with soil after the water has been absorbed, rewatered, and tamped lightly. Monitor the plantings for at least the first summer, watering them if conditions become dry. A little maintenance goes a long way. If available, put a layer of mulch 2-3 inches thick over the planting area, but no closer than 2 inches from planted trees’ trunks. Avoid large mounds of mulch around the trunk.
- Stakes and flexible ties should not be used unless the tree is planted with a loose root ball or later found to be displaced. If they are required, use one or two hardwood stakes, no less than 2 inches x 2 inches across, driven into the ground outside the root ball. The stakes should

be tall enough to provide the firm support necessary for proper root development, but not too tall to permit the tree to flex in the wind. The stakes should all be the same height for uniform support. All stakes and ties should be removed from the tree after one year.

- Heavy equipment should be used only in extreme situations, for instance, when large trees are transplanted using a tractor-mounted tree spade. If it is necessary to use heavy equipment in a planted area, protect trees and shrubs by staying as far away as possible (at least outside the drip line) to prevent soil compaction and trunk scarring.
- Mow or hand-trim as necessary within the drip line to maintain any herbaceous vegetation at a height no greater than 6 inches until areas are permanently reestablished with new plantings. If trees are planted in fields covered by sod (old pasture, meadow), it is best to kill the grass in the planting area before planting trees. This is especially important for small seedlings which have difficulty competing with sod grasses for water and nutrients. If spraying is needed after planting, tree shelters can protect seedlings from herbicides.

changes in management over time

With active management, stewardship needs should decrease over time as the forest becomes healthier, and therefore more sustainable and resilient. Controlling the deer should allow for more successful regeneration, thereby decreasing the needs for plantings. As plantings that do occur mature, there will be less management needs as the native plants fill in growing space. While invasive plants will likely continue to be an issue, controlling those already present will allow land managers to then pivot to spot treatments of invasive plants that are regrowing and preventing incursion of new invasive plants, which takes less resources than removing already established populations.

Having a healthier forest will also allow land managers to focus on habitat improvement projects as needed and quickly addressing new issues as they arise. Though having a sustainable, resilient forest will be more likely to withstand future issues with less intervention.

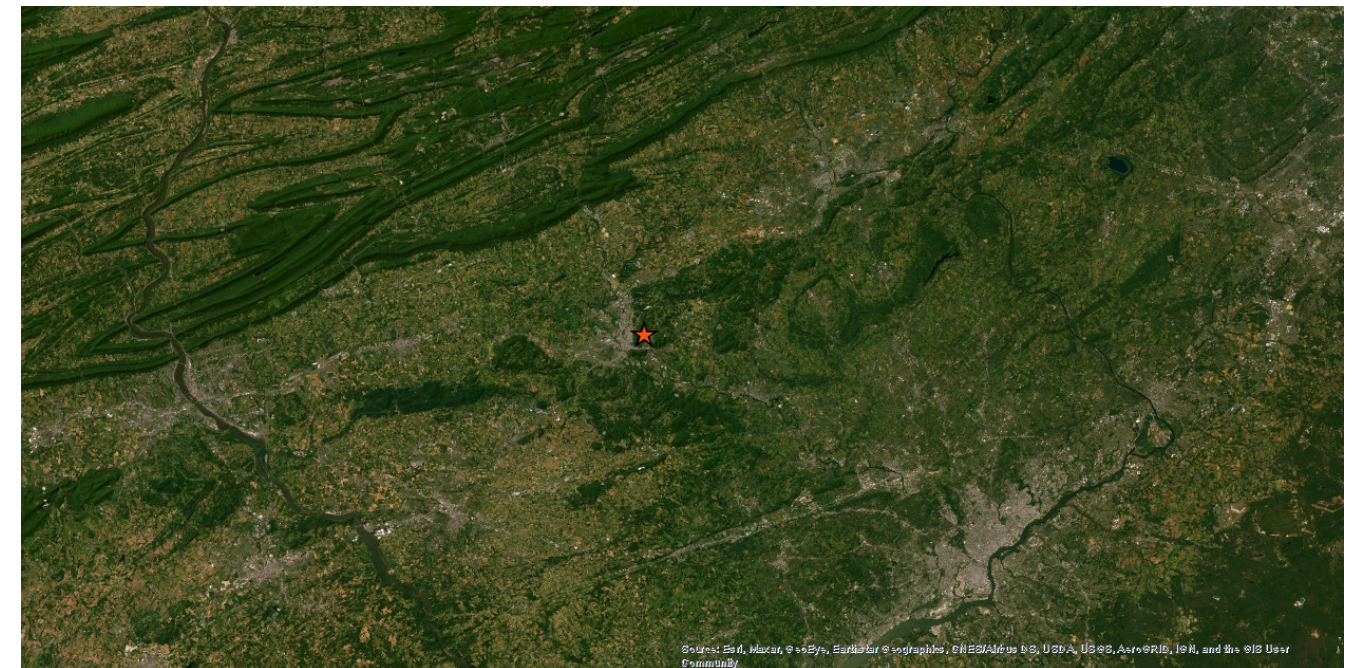
habitat and connectivity

managing at landscape scale

The Mount Penn Preserve Partnership and its collaborative approach to managing the Preserve’s forest presents an opportunity to look beyond just the immediate parcel or park level. Instead, managers can work together to steward the properties through a landscape-scale lens as well. This is important for multiple reasons. First, within the Preserve area, this creates opportunities to have forests of different ages and allow the natural cycle of succession to play out on the landscape scale. Secondly, it provides opportunities to have habitat for a wide range of wildlife. Finally, such a large extent of forest creates opportunities for habitat connectivity across the landscape. This is important for species that need large habitat areas, that migrate as a natural part of their lifecycle, or that are forced to migrate as a result of climate change.

As can be seen in the aerial image below, the Preserve is part of a greenway of forested land, seen in dark green. The Preserve’s forest is an important connection north to south from southern Chester County up to the Kittatinny Ridge. It is also part of a large greenway for forest from west to east from York County to the New Jersey Highlands.

Looking within these possible greenways, the Preserve is just across the City from Neversink Mountain. Just to the east is a large forest patch which is partially owned by St Laurence Boro. It is also less than 10 miles from the Hopewell Big Woods and the Blue Marsh Lake area, and less than 25 miles from the Swamp Creek area in Montgomery County. These areas are all relatively large patches of forests that could be used as migration corridors. Additionally, the Preserve is in close proximity to the Schuylkill River. This is important as waterways can also serve as migration corridors.



The Preserve, marked here with a red star, lies along a greenway of forest land stretching from the southwest to the northeast. North of this band of forests is the Kittatinny Ridge, another prominent forested greenway.

connectivity

The connections described above and the size of the Preserve’s forests is especially important in light of climate change. These connections up to the Kittatinny Ridge and along the Highlands are critical for species migration. The Nature Conservancy’s Resilient Land Mapping Tool models a range of climate factors, including resilience, connectivity, biodiversity value, and carbon storage. As part of this analysis, it analyzes climate flow, which looks at “the gradual movement of populations in response to changes in climate.” Within the Preserve are areas that range from Slightly Above Average Flow (“areas of high landscape permeability” for species movement and “moderate flow”) to Far Above Average (“areas of highly concentrated flow where movements will accumulate or be channeled”).

This means that these areas can be important for species movement in response to climate change. Within the Preserve, these areas are in less disturbed forest areas and along waterways. However, the Tool also recognized that the Preserve is in a landscape that is poorly connected when looking at natural areas. This translates to low identified importance by the Tool for “Connectivity & Climate Flow.” Overall, this indicates that there is potential for the Preserve in supporting species migration, but this depends on how connected the forests can be to other natural areas.

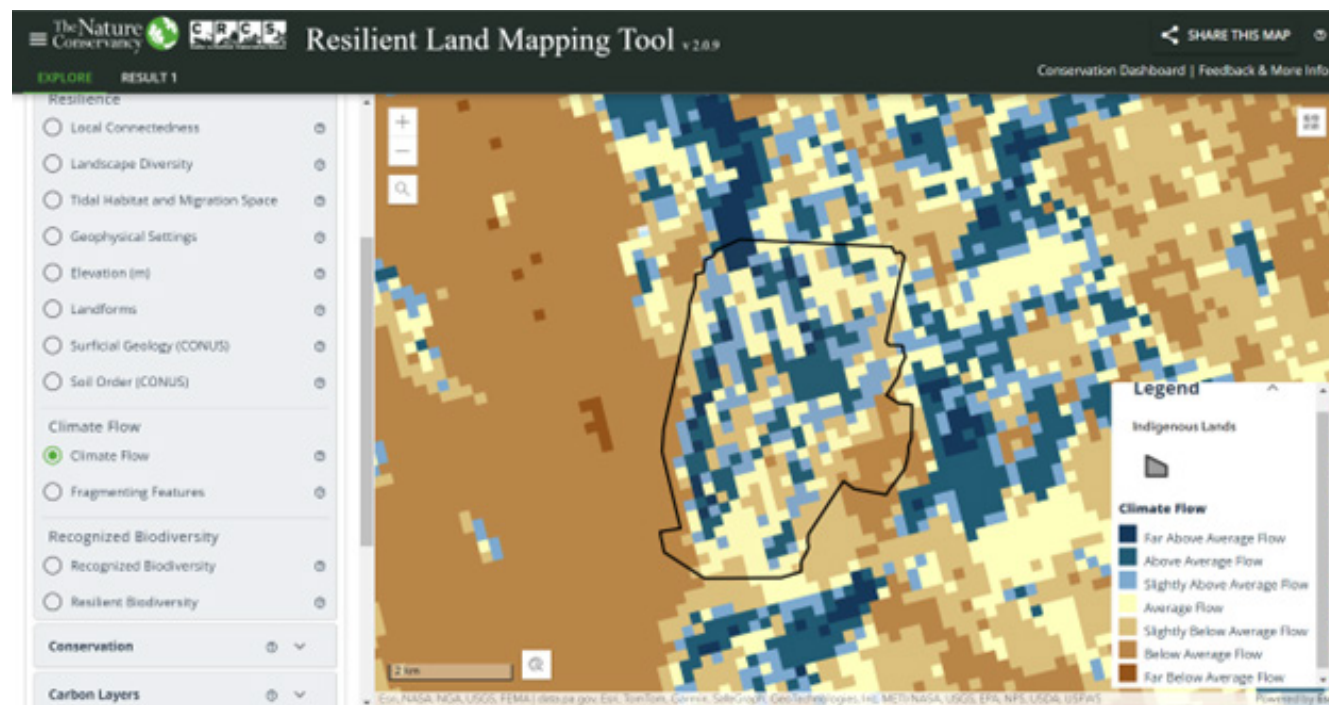
Within the Preserve, maintaining the extent of the forest is critical. Fragmentation of the forest will reduce habitat area and potentially impede migration of species, particularly species that are migrating as a result of climate change.

In addition to supporting species migration, the large, forested expanse stores and sequesters carbon, maintains water quality, reduces flooding, provides habitat, and provides recreational opportunities. As such, the extent of the forest is important to maintain. Timbering should be avoided and the forests should be maintained and improved to support sustainability (see Invasive Plants, Deer Management sections).

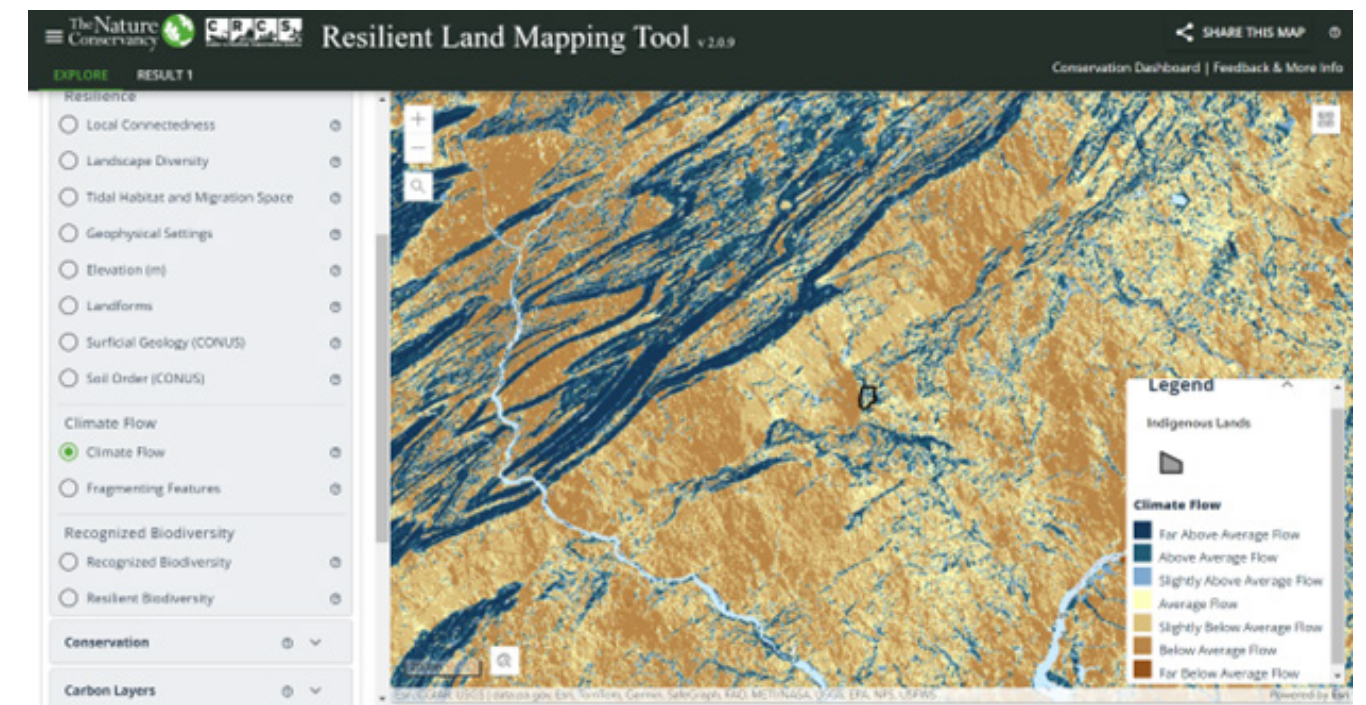
Looking beyond the Preserve, the County, municipalities, Berks Nature, and other conservation groups in the area can look to protect land through easements or fee acquisition that would either add to the Preserve and other large patches of forest or would create greenways between such areas. This of course depends on landowner willingness and funding.

management strategies - habitat and connectivity

- Maintain current forest extent, avoiding timber harvests.
- Explore options for fee land acquisition or conservation easements with willing landowners around the Preserve and other central forest areas like Neversink Mountain, as well as connecting natural areas between large forest areas.



A large portion of the Preserve is important for the flow of species that may migrate due to climate change.



The Preserve, seen here in a black outline in the center, lies along a southwest to northeast corridor of land important for the flow of species.

forest ages

Having a diversity of forest ages instills resiliency, as discussed previously. It also provides habitat for a wider range of species. Species have preferences for where they shelter, hunt, and breed that can be associated with different forest ages. For instance, some songbirds like the black-throated blue warbler will nest in mature forests but then also rely on young forests with a high abundance of fruits and insects during the post-nesting period to feed themselves and their young.

Currently the forest is primarily maturing to mature aged forest. Generally, young forests and old-growth forests are lacking. This is common in Pennsylvania as many forests were previously cleared for timber or agriculture, thereby limiting the possibility of old-growth forest. Young forests are less common as people have greatly reduced natural disturbances such as fires. At the same time, where disturbance has resulted in large open areas, young forests are not filling in these gaps due to deer and invasive plants. The exceptions to this are one small patch of young birch poles near Rotary Park and a small area with younger trees between List Road and Skyline Drive in the northern portion of the Preserve.

The canopy gaps present opportunities to create young forest by controlling the invasive plants and planting native trees (see Canopy Gaps above). Additionally, natural disturbances may create areas of blow down or tree loss. Land managers should prevent invasive plants from taking root in these areas to allow for regeneration of native plants. Native seedlings should be protected from deer as needed.

To support the transition from mature to old-growth forests, land managers should protect the existing trees. They can also plant understory trees to create the multi-layered canopy which is characteristic of old-growth forest. Snags and downed wood should be retained as an abundance of dead wood is also characteristic of old-growth forest. The downed wood provides shelter for wildlife and insects, and its decomposition reintroduces nutrients and organic material into the soil. Currently, the oak forests are the most likely to transition to old-growth as they have fewer pressures from invasive plants and already have an accumulation of dead wood. Controlling deer and invasive plants will benefit all forest ages.

management strategies - forest ages

- Manage canopy gaps to prevent establishment of invasive plants and support native plants. Plant native plants as necessary to fill canopy gap. Protect natural regeneration and/or plantings from deer with fencing and tree tubes.
- Protect existing mature trees.
- Plant understory trees and shrubs to support mature forests.
- Retain dead and downed wood to support transition to old-growth forest.

habitat enhancement

Currently, the Preserve offers a range of habitat types, from dense forests to open forests, meadows, riparian areas, and palustrine forests. The quality of habitat varies throughout, generally with a lower diversity and abundance of native plants than would be ideal. Management can focus on maintaining the diversity of habitat and improving quality.

Habitat enhancement can entail both active and more passive management strategies. Looking at active management, two of the strategies that can have the greatest impact are to control deer and invasive plants. As discussed previously, this will help restore native plants which provide greater benefits to wildlife. Additionally, some areas within the oak forest, particularly in the low-lying areas off List Road, have large patches of hay-scented fern. While this is a native plant, it can become overly competitive and prevent regeneration of other native species when it forms such dense patches. If these areas keep increasing in size and prohibit the regeneration of native species, land managers can manage the ferns. PennState Extension recommends a foliar glyphosate application between July to early October, not treating before fronds have unfurled or after 25% of the fern has turned yellow in the fall. PennState Extension also



Dense patches of hay-scented fern, which can suppress regeneration of other native plants, were present throughout the oak forests.

recommends applying sulfometuron during the same time period to control grasses if they threaten to overtake the area as the ferns die off. While sulfometuron does not affect hardwood seedlings, particularly if applied in August, it does control wildflowers during the lifespan of the herbicide.

Having a range of native plants within the various plant communities and their associated structural layers will create many niches to support a diversity of wildlife. If this does not occur naturally after deer and invasive plant control, land managers can carry out planting projects designed to fill structural layers and increase plant species diversity. This will be less feasible on the very rocky slopes of the front side of the mountain. In rock areas, land managers can protect naturally regenerating seedlings with tree tubes or fencing until the plants are able to withstand deer browsing.

In some instances, habitat enhancement projects may include thinning forests to create young stands or adding to the density of native plants to aid in the creation of an older forest with all forest layers present. These tactics can also boost the diversity of forest ages. However, any intentional efforts to thin forests to create younger forest ages should only be done after further invasive plant and deer management and when there are sufficient resources to control invasive plants in the project area and protect it from deer. As such, these types of projects are not a high priority at this time. Instead, land managers can focus on

addressing existing forest gaps to create young forest or shrublands to boost habitat diversity. Land managers can also reach out to the utility that manages the powerline ROW to improve their management and create a native meadow or shrubland.

More passive approaches involve protecting what is already present. This includes enacting no-disturbance buffers around wetlands, springs, and seeps (see Water Resources), maintaining the existing forest extent (discussed above), and leaving in place dead and downed wood. Dead, standing trees provide important nesting, foraging, and perching sites for birds. They are also part of the food web for insects and fungi. Downed, dead wood can provide shelter for a range of wildlife, protecting them from predators.

Specific species or categories of species may warrant further management efforts, see below.

management strategies - habitat enhancement

- Land managers should continue to take measures to identify and protect any wildlife species of special concern. Additional surveys (beyond the scope of this plan) could be undertaken to determine the presence of other species of concern.
- Control deer and invasive plants.
- Control hay-scented fern if patches continue to increase in size and prevent natural regeneration of native trees.
- Plant additional native plant species in areas where the soil allows to increase native species abundance and density and to fill canopy layers. Where planting is not feasible, protect naturally regenerating native seedlings with tree tubes or fencing.
- Retain dead and downed wood where not hazardous.

birds

According to the Cornell Lab of Ornithology’s crowdsourcing platform, eBird, 166 bird species have been sighted within the Preserve. These sighting range from common residential birds like American robins to migratory species like Scarlet tanagers. Two “near threatened” species, according to The Cornell Lab of Ornithology, were identified within the Preserve – the Cerulean warbler and the Blackpoll warbler. Evening grossbeak, a “vulnerable” species, was also identified. A full list of bird species from eBird is included in the appendices.

Healthy, structurally diverse forests with native plants provide not only the structure needed to support resident and migratory birds, but also provide food including caterpillars, a main source of food for nestlings. Keystone species like oak trees in particular are important habitat for caterpillars. However, having a diversity of native plant species is also important to provide a range of food sources and shelter options.

Having a range of forest ages across a landscape is also important for habitat. The type of habitat required by birds can vary across both species and between lifecycle stages for individual species. Therefore, having a range of habitat including shrublands, young forest, maturing, and mature forests can best support birds.

Bird surveys can also be a way to engage community members and support positive uses of the Preserve. Visitors can be encouraged to participate in crowd-sourcing projects like eBird and guided bird walks can be held.

management strategies - birds

- Increase native plant diversity and abundance.
- Have a range of forest ages and shrubland across the landscape.
- Encourage or hold bird walks to collect more information on what species are present and to support positive use of the Preserve.

bats

The Pennsylvania Natural Diversity Inventory (PNDI) report for the Preserve identifies the area as being potential bat habitat and lays out recommendations for protecting

such habitat. No confirmed species are present at this time, but the Park is within the range of the Indiana bat, an endangered species, and the Northern long-eared bat, a threatened species. Bat species in general are facing declines as they lose habitat and are threatened by White Nose Syndrome.

Currently, the forest communities have a good representation of potential roosting trees, particularly oak trees, and an abundance of snags. These bats hibernate in snags and under the peeling bark of trees. Antietam Lake Park’s Fruit Farm contains bat boxes, which are part of a monitoring as part of the Pennsylvania Game Commission’s Appalachian Bat Count Program.

Shagbark hickory is a preferred roosting tree due to its naturally flaky bark. Other appropriate roosting trees include:

<i>Acer rubrum</i>	red maple
<i>Acer saccharum</i>	sugar maple
<i>Carya cordiformis</i>	bitternut hickory
<i>Carya glabra</i>	pignut hickory
<i>Carya laciniosa</i>	shellbark hickory
<i>Carya ovata</i>	shagbark hickory
<i>Carya tomentosa</i>	mockernut hickory
<i>Fraxinus americana</i>	white ash
<i>Fraxinus nigra</i>	black ash
<i>Fraxinus pennsylvanica</i>	green ash
<i>Platanus occidentalis</i>	sycamore
<i>Populus deltoids</i>	eastern cottonwood
<i>Quercus alba</i>	white oak
<i>Quercus coccinea</i>	scarlet oak
<i>Quercus prinus</i>	chestnut oak
<i>Quercus rubra</i>	northern red oak
<i>Quercus velutina</i>	black oak
<i>Robinia pseudoacacia</i>	black locust
<i>Sassafras albidum</i>	sassafras
<i>Ulmus americana</i>	American elm
<i>Ulmus rubra</i>	slippery elm

Currently, the forest communities have a good representation of potential roosting trees and/or have a high number of snags. Many of these species may be vulnerable to climate change according to DCNR and NIACS. As such plantings should include some of these

species that may be more resilient to climate change such as white oak, black oak, shagbark hickory, and mockernut hickory. Additional bat boxes can be added to create roosting areas if there is a decline in appropriate tree species. The boxes should be 10-15 feet off the ground, SE facing with sun exposure, and near water.

management strategies - bats

- Leave snags where they are not a hazard to provide roosting sites.
- When doing plantings, include tree species that support bats and a less vulnerable to climate change.
- Install additional bat boxes to create roosting areas. The boxes should be 10-15 feet off the ground, SE facing with sun exposure, and near water.
- Avoid removal of shagbark hickory as possible as well as other flaky bark trees.
- Do not cut trees near potential hibernacula sites from April 1st – November 14th. Do not cut trees in potential summer habitat area from April 1st – September 30th.

sources:

Conserve Wildlife Foundation of New Jersey. Building a Bat Roost. <http://www.dukefarms.org/siteassets/documents/making-an-impact/stewardship-at-home/building-a-bat-roost.pdf>

U.S. Fish and Wildlife Service. Guidance on Developing and Implementing an Indiana Bat Conservation

Plan. April 4, 2012. https://www.fws.gov/northeast/pafo/pdf/IBATconservationplanguidance_PAFO_040412.pdf

amphibians

Amphibians rely on wetlands and vernal pools for breeding habitat and on upland areas for other stages of their lifecycle. It is important to protect and restore these areas to support amphibian populations. Specifically, a 300-foot non-disturbance buffer should be created around all wetland areas that can support amphibians.

Land managers should take care to not change the microtopography within this buffer as that could impact how much water the vernal pool retains. No vehicles should be used within this buffer, trails should be avoided as possible, and any restoration activities should be carefully managed to avoid creating lasting disturbance. Based on the site visits, this primarily affects a wetland area north of Hill Road and a vernal pool off Haag Road (see Water Resources map). In addition to the buffer around the vernal pool, a 1,000ft upland buffer should be enacted to protect habitat. This buffer would restrict conversion from forest to another cover type or timbering the forest. These recommendations are based in part on recommendations included in the PNDI report to protect wetlands within the Preserve.

It is also important to avoid creating small depressions such as tire ruts that can accumulate water in the early spring but do not retain water through the summer and full development period for tadpoles. These depressions can be used by amphibians to lay egg masses, but the juveniles die off as the water dries up. Land managers should avoid creating ruts, particularly when using heavy equipment, and repair any ruts greater than 6” in depth.

Monitoring amphibian populations, such as by egg mass counts, in wetlands can increase understanding of what species are using the wetland, how the populations are changing, and if additional efforts are needed to protect amphibians.

management strategies - amphibians

- Create a 300-foot non-disturbance buffer around vernal pools and other wetlands.
- Protect the forest within 1,000 feet of the vernal pool/wetland.
- Avoid creating tire ruts deeper than 6” during the early spring.
- Monitor amphibian populations.

brief overview of different cover types

meadows

The forests are not the only cover type present within the Preserve area. There are also meadows and wetlands. These areas also provide important habitat for wildlife and can provide additional benefits including water quality protection and carbon storage. These areas are located primarily within Antietam Lake Park. As such, the guidance from the 2018 Antietam Lake Park Natural Resources Stewardship Plan still apply.

For the meadows, these areas can either be maintained as meadows or converted to forests. This decision is based on if the meadows fragment surrounding forests and if resources available for management. If a meadow is within a forested area, such as the grassland leading up to the Pagoda or the meadow in the center of the old orchard area, the meadow should be converted to forest. This can be done by planting trees and controlling invasive plants. In the future, it may be possible to allow the meadows to naturally transition to shrublands and then forests, but this depends on control of deer and invasive plants.

Those meadows at the edges of forests can provide important habitat variability without having such a significant fragmenting effect. Retaining these meadows next to forests also supports species that require both forest and meadow areas over their life cycle. This includes the meadows buffering Hill Road. These meadows can be managed by mowing the whole meadow once a year around mid-March. Invasive plants should be managed. This can be done by spot treatments of specific plants and/or through a second mowing in July of 1/3 to 1/2 of the meadow area, rotating areas each year.



The meadow to the north of Hill Road has a high proportion of native plants and could be retained for habitat diversity.

management strategies - meadows

- Convert the meadows/grasslands near the Pagoda and within the old orchard area to forest.
- Maintain the Hill Road meadows as meadows.
- Mow the entire meadow once a year around mid-March.
- Spot treat invasive plants and/or mow 1/3 to 1/2 of the meadow annually, rotating areas annually.

basin

The wet basin area around the parking lot of Egelman's Park can be further improved beyond the current tree plantings. Namely, this involves spot treatments of the invasive plants. As these are controlled and the trees mature, native understory trees and shrubs can be added. This area can be used to showcase native plants as it is right next to the picnic area at Egelman's Park.



The basin at Egelman's Park provides habitat diversity. Controlling the invasive plants and adding more native plants can improve its habitat value.

management strategies - basins

- Control invasive plants.
- Replant with native plants.

landscape areas

The landscape areas are opportunities to showcase native plants while still maintaining a managed appearance. Any plantings in these areas should be of native species. Invasive plants should be controlled and hazard trees managed.

management strategies - landscape areas

- Remove any invasive plants.
- Manage hazard trees.
- Plant native plants that can also increase the scenic beauty.

water quality and quantity

riparian buffers

Riparian buffers are important for streams as they help lower water temperature through shading, promote infiltration and groundwater recharge, filter nutrients, and provide food and habitat for aquatic organisms through detritus. A healthy forested riparian buffer along all waterways will be of increasing importance as the effects of climate change surface. Climate change is predicted to increase temperatures and change current precipitation patterns, with higher overall rainfall and more intense storm events, but with rainfall concentrated in the spring and fall and potential drought conditions over the summer. A riparian buffer can help maintain lower water temperatures and mitigate flooding and droughts through stormwater infiltration into groundwater reserves.

For riparian buffers to adequately perform these functions, the Stroud Water Research Center recommends a forested buffer of at least 100-feet in width on both sides of a stream. Stroud Water Research Center has found that this width is effective in shading waterways, protecting streambed habitat, adding large woody debris, maintaining appropriate stream width and velocity, and removing pollutants including nitrogen and phosphorous. A width of 100 feet is the minimum recommendation. A wider forested buffer can provide even greater benefits.

The waterways within the Preserve are mostly concentrated in Antietam Lake Park and in the Egelman's Park through Pendra Park area with Rose Valley Creek. The buffer is of sufficient width along Rose Valley Creek, though the density could be improved. As noted in the 2018 Antietam Lake Park Natural Areas Stewardship Plan, most of the waterways within the Park were well buffered by forests and wetlands, with the exception of areas adjacent to parking areas and roads. The County has made progress with adding buffers in these areas where possible. A tall, herbaceous buffer was created using native plants in the Mudcatcher parking lot to protect the stream through that area. This was an effective way to create a buffer in an otherwise limiting location.

Going forward, land managers can focus on improving the quality of the riparian buffers by managing invasive plants to support the sustainability of the forests, managing deer to support natural native plant regeneration, and planting native species to increase the density of the understory and shrub layers. This will create a sustainable forest with a greater density of vegetation and roots to better intercept, slow, filter, and infiltrate stormwater. These recommendations to improve the riparian buffers to protect water quality directly connect to the City of Reading Climate Resiliency Plan's recommendation to "Prioritize protection and restoration of floodplains, wetlands, streams, and other surface waters."

management strategies - riparian buffers

- Ensure that all riparian buffers remain forested for at least 100 feet from waterways.
- Increase the density of riparian buffers by planting native trees and shrubs.

seeps, springs, wetlands, and vernal pools

These areas are susceptible to changes in water volume that can dry out areas or cause flooding. Changes in microtopography that can redirect water away from the wetland is one way that water volume can change. Other risks include increases in impervious surfaces in the area and/or loss of a vegetative buffer. Both of these risks can cause flashier flooding and introduce pollutants to water resources.

Any disruption or alteration to the hydrology should be avoided or mitigated as possible. Land managers should establish a 300-foot non-disturbance buffer around wetlands, vernal pools, seeps, and springs, meaning that any activities within 300 feet of the water resource should be avoided except for critical actions. Habitat management may be carried out within the 300-foot buffer but should be carefully planned to avoid disturbance. All tasks should be completed by hand if possible, without heavy motorized equipment. Any natural debris such as leaves or branches that fall into the wetland or vernal pool should be left in place to provide food and shelter for wildlife. Smaller, less

established trails should be rerouted out of the 300-foot buffer where they currently exist as possible. This will also help protect trails by moving them out of wet areas where they would be more likely to flood and erode. Trails like the Gravity Trail or Ferndale Trail that are already firmly established can be left in place. Further trail construction should be avoided in these areas.



Skunk cabbage is an indicator of wet conditions, like those that form around seeps and springs.

Additionally, it is important to protect and restore the upland forest area within 1,000 feet of the wetland or vernal pool. This will protect habitat for amphibians who rely on the wetland or vernal pool for breeding. Additionally, loss of vegetation within this 1,000 feet would allow large volumes of fast-moving stormwater to reach the wetland or vernal pool and cause negative impacts such as erosion and pollution loading. Any removal of vegetation for invasive plant control should be immediately followed by planting of native vegetation.

management strategies - seeps, springs, wetlands, and vernal pools

- Enact a 300-foot non-disturbance buffer around seeps, springs, wetlands, or vernal pools.
 - o Avoid use of heavy equipment.
 - o Reroute smaller trails as possible outside of this buffer area. Avoid additional creation of trails within the buffer.
- Protect vegetation within 1,000 feet upland of wetlands or vernal pools. Replant area after invasive plant control.

cold water fisheries

The streams branching out from Antietam Lake Park are PA DEP-designated Cold Water Fisheries. As such, maintaining cool water temperatures is very important for these waterways. They should be a priority for maintaining and improving the forested riparian buffer. This will become increasingly important as climate change causes higher temperatures and more intense volumes of stormwater.

management strategies - cold water fisheries

- Maintain the existing riparian buffer and increase the density of native plants.

flooding and erosions

Flooding and erosion are critical issues within the Preserve, and indeed, southeastern Pennsylvania in general. More frequent and severe storms, which is a sign of climate change, are causing greater impacts to both recreational infrastructure and natural areas. The trails section will cover flooding and erosion along trails. For the natural areas, stewardship can be focused on improving the quality of the plant communities to better manage flooding and prevent erosion.



Concentrated areas of stormwater flow can lead to areas of bare soil that erode over time to create channels.

The oak forests could provide better stormwater management if they had denser understories.

This can be accomplished through planting understory trees and shrubs where feasible and through deer and invasive plant control to support natural native plant regeneration. In rocky areas that make planting difficult, fencing or tree tubes can be used to protect natural regeneration where it is occurring.

The mixed hardwood forests already have dense structural layers in many areas that can more effectively manage stormwater compared to the less dense areas. However, the majority of the understory trees and shrubs are invasive. This puts the long-term sustainability of the forest, and its associated benefits for managing rainfall, at risk. As such, the invasive plants should be controlled and the area immediately replanted. See above for invasive plant and deer management, as well as individual management units below.

Areas on steep slopes and where flooding has often been an issue in the past should be prioritized for plantings.

management strategies - flooding and erosions

- Where feasible, add understory trees and shrubs to help slow and infiltrate stormwater. Prioritize steep slopes and areas that typically flood.
- Where natural regeneration is occurring, protect young shrubs and trees with fencing or tree tubes.

access

Currently, water access is only possible at Antietam Lake Park. The 2018 stewardship plan lays out recommendations for formalizing access to allow for use while still protecting the natural resources from trampling and informal trails.

management strategies - access

- Create formal access points along Antietam Lake.

firewood program

Currently, there is some removal of wood from the Preserve for firewood by private individuals. This can promote positive relations with the community, but it should be balanced against ecological benefits such as wildlife habitat and reintroducing nutrients into the forest soils. At the time of the site visits, there was not an abundance of dead, downed wood noted. However, that could change periodically based on disturbances to the forest.

Firewood removal has the potential to transport pests and diseases that impact trees. This is evidenced by restrictions around the movement of ash trees that were in areas impacted by emerald ash borer or prohibitions on moving firewood of any species to prevent spreading spotted lanternfly. Oak wilt is another, newer disease that could be unintentionally spread through transporting firewood.

If the property owners want to continue allowing individuals to remove firewood, the property owners can implement regulations to protect the forest and restrict the spread of pests and diseases. Many of these suggestions are modeled off regulations for firewood collection for state parks by Pennsylvania and New Jersey.

1. All individuals collecting firewood must have a permit. Permits are not transferable.
2. Individuals/households are restricted to a certain amount of firewood and are charged a fee. Pennsylvania restricts firewood collection to 3 standard rough cords; New Jersey restricts collection to 5 cords.
3. The property owner should set a total harvest limit based on the available downed wood.
4. Firewood cannot be sold and is for the personal use of the permittee.
5. No live trees may be cut or removed; only dead, fallen wood may be used.
6. All local, state, and federal quarantine regulations for firewood must be followed.

Property owners should also be prepared to end a firewood permit program if there is a risk of transferring a pest or disease. Additionally, any firewood program should respect the restrictions of the Earl Trust properties within those parcels.

management strategies - firewood

- If property owners want to allow for firewood collection by private individuals, enact regulations to protect the forest and prevent the spread of tree pests and diseases.

safety

These recommendations would all be supported by expansion of the ranger program. See the Ranger Program section for more information.

hazard trees

All landowners are required to make a reasonable effort to prevent trees within their property from causing injury or property damage. This is best accomplished through a regular program of monitoring areas of high use such as public roads, adjacent properties with structures, and sites used for recreational (play areas, benches, boardwalk, bird blind, sleeping platforms, cabins) or educational (pavilion, bleachers, rustic amphitheater) activities. These areas should be monitored at least once each year and after major storm events. The landowner should hire a certified arborist to perform the inspection or train one or more staff members in the identification of hazard trees to reduce monitoring costs.

Once a hazard tree is identified the landowner should make a reasonable effort to address the hazard as soon as possible. The first course of action is to make sure that the tree is within your property boundary. Along public roads, trees within the public right-of-way are usually the responsibility of the municipality or state, depending on

who is responsible for the road. For this purpose, it is the base of the tree that matters. If the tree is completely within the right-of-way, the municipality or state is responsible for the hazard tree. For identified hazard trees, the landowner should engage a qualified contractor or staff to eliminate the hazard through pruning or felling the tree.

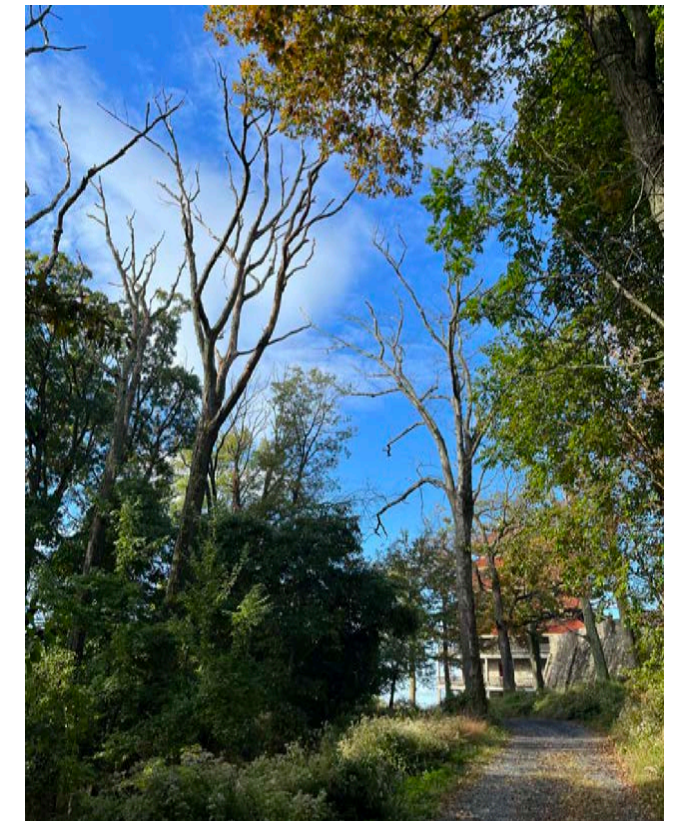
For trees along a common boundary, landowners with any part of the base within their property are jointly responsible for the tree. A tree with its base entirely within one property is, of course, that landowner's sole responsibility.

Many hazard trees are typically identified at the outset of a hazard tree program. This reflects the maturing of the forests in our region and the fact that few landowners are aware of their responsibility and as a result have not addressed hazard trees in the past. Unless resources are unlimited, the landowner should prioritize removing the most hazardous trees first.

Regular monitoring followed by reasonable action will not only prevent potential injury or damage, it may help to significantly reduce the landowner's liability if a tree does cause injury or damage. Although the landowner is responsible for any injury or damage regardless of the actions taken, showing that you have made a reasonable effort to identify and address hazard trees will help preclude any charge of negligence.

The final key to an effective hazard tree program is documentation. All activities related to the program should be cataloged, including monitoring and actions taken, noting when, where, and by whom. This will be the proof that the landowner made a reasonable effort to identify and address hazard trees in the unfortunate occurrence of injury or property damage.

Currently, the County, municipalities, and Berks Nature manage for hazard trees. Continuing this practice, and documenting efforts, can help reduce risk and liability. Land managers should work together along common property boundaries to monitor for and address hazard trees.



Dead, standing trees like these along roads or trails are hazards that need to be addressed.

management strategies - hazard trees

- Continue hazard tree monitoring programs.
- Monitor for hazard trees by foot once a year and after severe storms. Contract an arborist as needed or train staff to carry out monitoring.
- Prune or remove hazard trees to eliminate risk. Hazard trees within the forest areas can simply be dropped and allow to decay in place.

boundary encroachment and illegal use

Boundary encroachment and illegal use are major concerns for the Preserve based on input from the study committee, observations during the site visits, and public input. Issues range from trash dumping to illicit activities. These activities harm the natural resources by damaging vegetation. They can also deter potential visitors from using the Preserve as they do not feel safe.

posted boundaries

Clearly posting boundaries is one typical recommendation for helping manage encroachment and illegal use. Posting boundaries can help deter illegal use by clearly identifying what is county/municipal/Berks Nature land. It also shows that there is an active presence along the boundary. Signs marking boundaries should be installed every 50-100 feet along all boundaries. The signs should be uniform with a logo and/or standardized text. Natural Lands uses a combination of two sign types, a 3.25"x3.25" diamond with our logo and a 6"x12" sign with additional language about ownership. The signs should be monitored once yearly to make sure they are still in place and in good condition. With the extent of the issues at the Preserve, this would only be a first step.

management strategies - boundaries

- Install and maintain boundary postings every 50-100 feet along boundaries.
- Monitor Park yearly for encroachment. Ensure that boundary signs are properly maintained and clearly mark property boundaries.

trash cleanup

Trash and lawn debris piles were primarily restricted to along the roadways. Trash of any kind decreases the aesthetic value of the Park and can be hazardous to people and animals. Piles of lawn debris add excess nutrients to the system, which can flow into waterways, and can introduce invasive plants, as is evident by the invasive plants along Oak Lane. The presence of the piles also sets a poor precedent and encourages more dumping.

While further monitoring and patrols can help deter future dumping, there are currently areas with trash dumping, primarily in the form of roadside debris and scattered larger debris like oil drums. These existing trash areas should be cleaned up to eliminate associated hazards. Cleaning up the trash also makes it less likely that others will see dumping and think that it is alright for them to do the same. Trash cleanups have been carried out by volunteers in the past, but key person interviews indicated that there is some fatigue with this as volunteers see trash quickly returning and do not see much value in their work.

Going forward, volunteers will likely still be needed to carry out trash cleanups. Hopefully, with added ranger patrols, their efforts will have a more long-term impact. However, staff should be conscientious of this negative impression volunteers may walk away with if areas are not carefully monitored after a cleanup. Increased monitoring by staff of areas previously cleaned up and enactment of the above recommendations can help reduce the chance that more dumping will quickly occur.



Dumping of lawn debris, common along roadways and neighborhoods, can add invasive plants to natural areas.

management strategies - trash

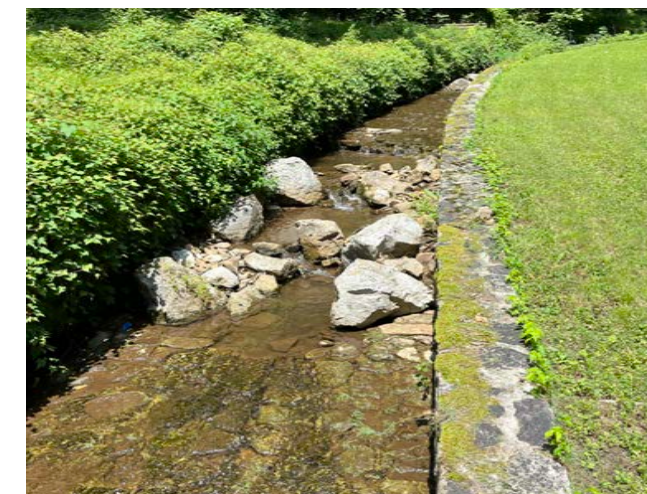
- Remove trash, prioritizing debris accessible to visitors, especially children.
- Monitor the Park for new dumping, particularly in areas that have already had volunteer cleanups.
- Inform neighbors of Park regulations regarding dumping.

protection of historic resources

There are historic resources present that tie to the cultural history of the site and are part of the history of the City. These structures should be protected while carrying out stewardship of the natural resources. At the same time, any maintenance work done to the historic features should minimize impacts to the surrounding natural resources. Additionally, native plantings can be used to enhance the scenic beauty around some of these features, as many are currently surrounded by invasive plants. Interpretive signage and guided walks can showcase the history of the mountain for community members and visitors.

One important consideration when caring for both historic and environmental resources is how climate change may affect the resources and potentially create

situations where environmental and historic resource protection may be in conflict. For the Preserve, this type of conflict may occur in the stream reaches that are channelized with stone walls and stone beds. These streams may not handle the increased stormwater from more severe storms, which could compromise the stone structures. Additionally, the disconnect from the natural floodplain can create flooding issues. If these stream stretches prove to be vulnerable to the more frequent and severe storms or fail to mitigate flooding like a natural stream channel would, land managers may need to consider how to manage the stone structures, including possible removal. Berks County is currently in the planning phase of removing one side of the stone walls along Antietam Creek due to damage to the area from storms.



Controlling increasing stormwater may require altering historic resources like the stone sluiceways to better protect natural resources and downstream buildings and infrastructure.



There may be opportunities to reduce the mown areas around historic resources and add more native plants to enhance the ecological and scenic value of these areas.

management strategies - historic resources

- Protect historic resources while carrying out stewardship work. Conversely, protect natural resources when doing any maintenance work to historic features.
- Create interpretive signage and/or hold guided walks to showcase historic resources.

forest stewardship recommendations

All stewardship recommendations in this section are included in the Table of Tasks and Priorities for a comprehensive view of recommendations and priorities.

preserve-wide strategies

As discussed previously, collaboration through the Mount Penn Preserve Partnership provides unique opportunities to coordinate management activities across the Preserve. We recommend the following strategies and actions for preserve-wide stewardship:

1. continue deer management recommendations *priority recommendation

- Continue to expand deer management program where safety zones and ownership allow.
- Monitor the effectiveness of deer management. Consider culls, if allowed by the Game Commission, if the deer population remains too high.
- Share information with the community about the results of the program, such as changes in the health of the forest or number of deer and vehicle collisions.
- Continue posting prominent signage about the deer hunting program leading up to and during hunting season.

2. create an invasive plant management program

- Prioritize invasive plant control based on quality of management area, impact of invasive species, and resources available.
- Reduce the spread of invasive plants by cleaning equipment between areas, minimizing soil disturbance, reducing fragmentation and edge areas, and educating visitors about cleaning personal gear and not planting invasive species in their properties.
- Replant areas where invasive plants have been removed until natural regeneration of native plants has been sufficiently restored.
- Monitor the Preserve at least annually during the growing season to identify new invasive plants.
- Monitor control efforts to determine effectiveness and prevent reestablishment.

3. monitor for and manage damaging pests

- General protocols
 - Stay current on possible incursion by exotic pests that could damage plants within the Preserve, research both already introduced pests and diseases that may be moving into the area as well as novel pests and diseases. Stay current on best management practices as they develop. MP3 could designate a point person to conduct this research who could then inform the other partners as to what they should be aware of.
- Emerald ash borer
 - Remove ash tree where they are hazards. Consult with an arborist prior to removal.
 - Control invasive plants and replant canopy gaps that have formed as a result of ash tree die off.
- Beech leaf disease
 - Monitor the forest for any signs of beech leaf disease. Alert all partners if infected trees are identified.
 - Plant trees in the understory to replace beech trees if they die off.
 - For Antietam Lake Park:
 - Identify select beech trees to treat, choosing trees that will protect the canopy and maintain the seed bank.
 - Research possible treatment options for effectiveness, application methods, and cost.
 - Identify beech trees that may become hazardous if they succumb to BLD and plan for their removal if BLD is identified within the Preserve or nearby.

- Oak wilt
 - Monitor for the introduction of oak wilt into the region. Stay current with treatment options.
 - Avoid cutting or wounding trees from April through July. If wounds do occur, immediately use wound dressing paint or shellac to cover the wound.
 - If trees become infected, identify the infected area and a buffer area. Create a 3-4 foot deep trench around this area. Remove infected trees over the winter prior to April.
 - Avoid transporting oak wood. Limit use as firewood unless the downed wood has been onsite through the winter.
 - Improve the health of the forest by increasing the diversity and abundance of native plants.

4. account for climate change in management

- Account for additional time and budget needed for restoration after more frequent and intense storm events when developing work plans and budgets.
- Establish extreme heat adaptation protocols such as adjusted work hours, cooling stations and other adaptations as needed (taken from City of Reading Climate Resiliency Plan).
- Monitor for canopy loss from storms and control invasive plants in gaps. Replant with native species if they do not naturally regenerate. Protect seedlings from deer with fencing or tree tubes.
- Maintain the current extent of the forest to support habitat and migration routes as well as retain carbon storage and sequestration capacity.

- e. When doing plantings, include species projected to be resilient to climate change (see DCNR's Climate Adaptation and Mitigation Plan for species vulnerability; updated list from DCNR pending).
- f. Allow for and support varying forest ages across the Preserve.
- g. Monitor impacts from climate change on both historic resources and surrounding natural resources and assess how that might change management of the resources.

5. land protection and connectivity

- a. Maintain current forest extent, avoiding timber harvests.
- b. Explore options for fee land acquisition or conservation easements with willing landowners around the Preserve and other central forest areas like Neversink Mountain, as well as connecting natural areas between large forest areas.

6. bird habitat

- a. Increase native plant diversity and abundance.
- b. Have a range of forest ages and shrubland across the landscape.
- c. Encourage or hold bird walks to collect more information on what species are present and to support positive use of the Preserve.

7. bat habitat

- a. Leave snags where they are not a hazard to provide roosting sites.
- b. When doing plantings, include tree species that support bats and a less vulnerable to climate change.

- c. Install additional bat boxes to create roosting areas. The boxes should be 10-15 feet off the ground, SE facing with sun exposure, and near water.
- d. Avoid removal of shagbark hickory as possible as well as other flaky bark trees.
- e. Do not cut trees near potential hibernacula sites from April 1st – November 14th. Do not cut trees in potential summer habitat area from April 1st – September 30th.

8. amphibians

- a. Create a 300-foot non-disturbance buffer around vernal pools and other wetlands.
- b. Protect the forest within 1,000 feet of the vernal pool/wetland.
- c. Avoid creating tire ruts deeper than 6" during the early spring.
- d. Monitor amphibian populations.

9. age diversity

- a. Use existing large canopy gaps to create young forests or shrublands.
- b. In areas of new disturbance, control invasive plants to allow for natural succession of plant communities. Until deer are controlled, this may require fencing naturally regenerating plants if this occurs and/or planting trees or shrubs and protecting them from climate change.
- c. Support progression to mature and old-growth forests by retaining mature trees, retaining dead and downed wood, and planting young canopy trees if they do not naturally regenerate after deer and invasive plant control.

10. water quality

- a. Riparian Buffers
 - i. Ensure that all riparian buffers remain forested for at least 100 feet from waterways.
 - ii. Increase the density of riparian buffers by planting native trees and shrubs.
- b. Seeps, Springs, Wetlands, and Vernal Pools
 - i. Enact a 300-foot non-disturbance buffer around seeps, springs, wetlands, or vernal pools.
 1. Avoid use of heavy equipment.
 2. Reroute smaller trails as possible outside of this buffer area. Avoid additional creation of trails within the buffer.
 - ii. Protect vegetation within 1,000 feet upland of wetlands or vernal pools. Replant area after invasive plant control.
- c. Flooding and Erosion
 - i. Where feasible, add understory trees and shrubs to help slow and infiltrate stormwater. Prioritize steep slopes and areas that typically flood.
 - ii. Where natural regeneration is occurring, protect young shrubs and trees with fencing or tree tubes.

11. firewood program

- a. If property owners want to allow for firewood collection by private individuals, enact regulations to protect the forest and prevent the spread of tree pests and diseases.

12. hazard trees

- a. Continue hazard tree monitoring programs.
- b. Monitor for hazard trees by foot once a year and after severe storms. Contract an arborist as needed or train staff to carry out monitoring.
- c. Prune or remove hazard trees to eliminate risk. Hazard trees within the forest areas can simply be dropped and allow to decay in place.

13. boundary encroachment and illegal use

- a. Install and maintain boundary postings every 50-100 feet along boundaries.
- b. Monitor Park yearly for encroachment. Ensure that boundary signs are properly maintained and clearly mark property boundaries.

14. trash cleanup

- a. Remove trash, prioritizing debris accessible to visitors, especially children.
- b. Monitor the Park for new dumping, particularly in areas that have already had volunteer cleanups.
- c. Inform neighbors of Park regulations regarding dumping.

15. historic resources

- a. Protect historic resources while carrying out stewardship work. Conversely, protect natural resources when doing any maintenance work to historic features.
- b. Create interpretive signage and/or hold guided walks to showcase historic resources.

management unit recommendations

Natural Lands divided the Preserve into management units based on forest species, conditions, management needs, and location. Such divisions help to prioritize stewardship tasks and more directly connect them to a location.

unit 1: oak lane

property owner(s):

- City of Reading

current condition

This unit encompasses most of the forest on the front (north) side of the mountain. It is primarily comprised of oak forest that has a native canopy dominated by oak trees. The understory is very sparse, with some black birch, mountain laurel, barberry, and Japanese stiltgrass. The invasive plants are light and scattered, but generally concentrated along the trails.

Mixed hardwood forests can be found along the lower elevations near roads. These mixed hardwood forests have a more diverse canopy and a higher proportion of invasive plants. Along Oak Lane, this higher proportion of invasive plants is due in part to lawn debris dumping by neighbors. Invasive plants are also common along Skyline Drive. The mixed hardwood forest areas are included in this management unit due to their high potential to impact the oak forest. This area is heavily populated by invasive plants, and without control will creep into the oak forest.

There are multiple areas of disturbance throughout this management unit. There are two areas along Skyline Drive that were cleared of vegetation for views over the City. These areas are highly disturbed and are being populated by tree-of-heaven. The Quarry is another area of disturbance.

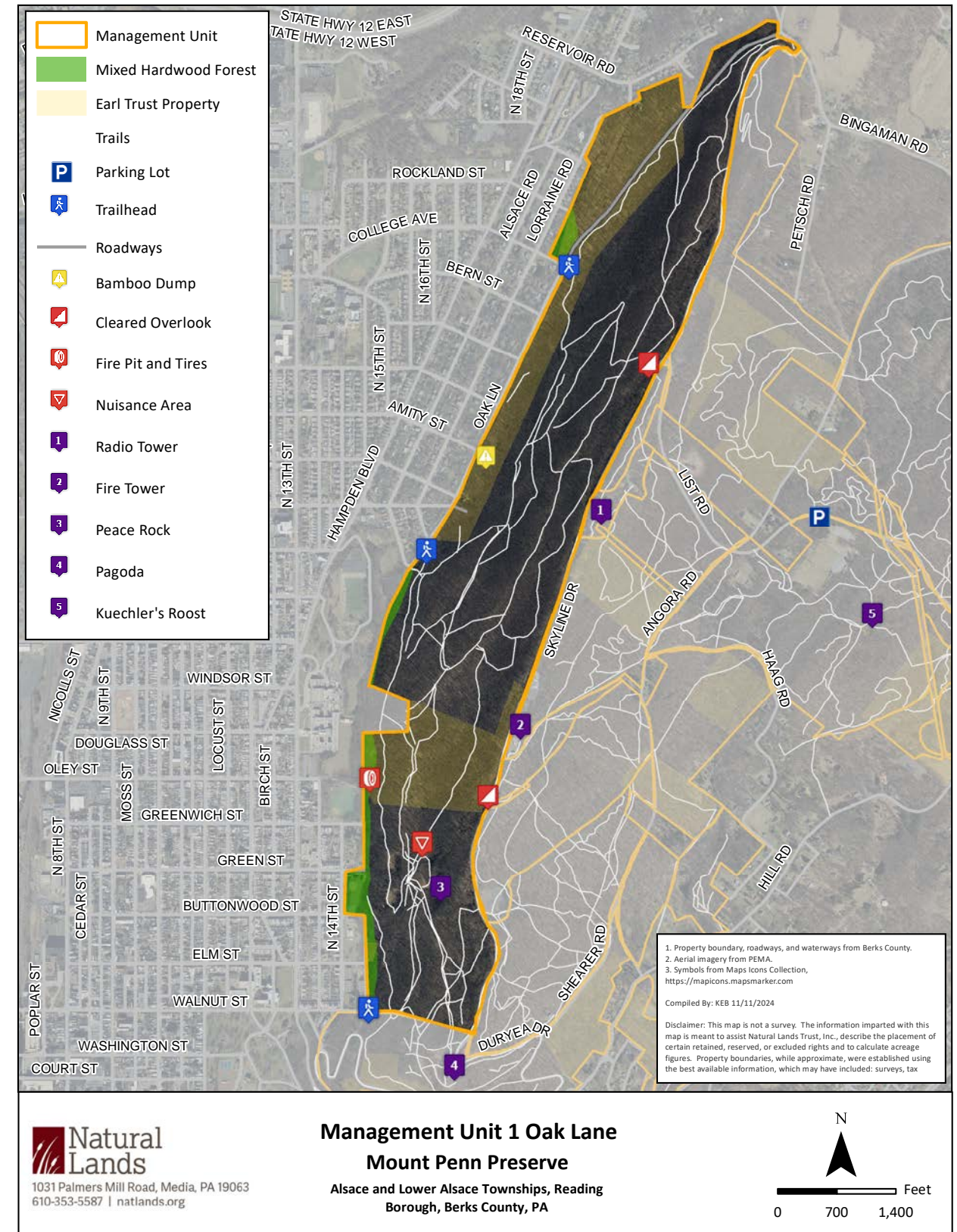
The vegetation is impacted here by the recreational uses, both the sanctioned use of trails and illicit activities like fires. Lastly, there is an area where there is a historic reservoir underground. This area is largely mown lawn. The border around the lawn has a higher proportion of invasive plants.

Trails cross through this management unit, and there is a trailhead on Oak Lane. This trailhead provides a close connection to the houses on that street. There is also a high school at the edge of the Preserve next to this management unit, however, there is a fence blocking access to the Preserve.

A portion of this management unit includes an Earl Trust property. Within these areas, the primary drivers of management are to protect the land for “the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources”. As such, stewarding the natural and historic resources are of the highest importance. Any trails through these areas should be assessed to determine their necessity and carefully maintained to prevent damage to natural resources. No further trail building or other recreational infrastructure should be allowed in these areas.

current and potential stressors

- Deer
- Invasive plants
- Oak wilt
- Climate change
- Dumping by neighbors
- Trail building



goal

The goal for this area is to restore a healthy oak forest that can sustain itself overtime with natural regeneration of native plants and a more abundant and diverse understory. Invasive plants, particularly in the oak forest area should be fully controlled. For wildlife habitat, the forest should have a healthy population of canopy trees that provide significant mast such as oaks, dense forest structural layers, and dead and downed wood. Over time, this area can develop to include more old-growth forest characteristics if not significantly impacted by a disturbance. Characteristics would include a multi-tiered canopy with younger trees filling in canopy gaps, older trees, and dead and downed wood. Additionally, the area could be better connected to the adjacent neighbors and high school.

priority level

High - This is a high priority area as it is the largest expanse of minimally impacted forest within the Preserve. Except along the road, the canopy is healthy and there are few invasive plants. Oak trees are keystone species in that they are critical for providing seed mast and shelter for wildlife. Additionally, oaks support an abundance of caterpillars, which are foundational for the food web, feeding birds, amphibians, and other wildlife.

management strategies and activities

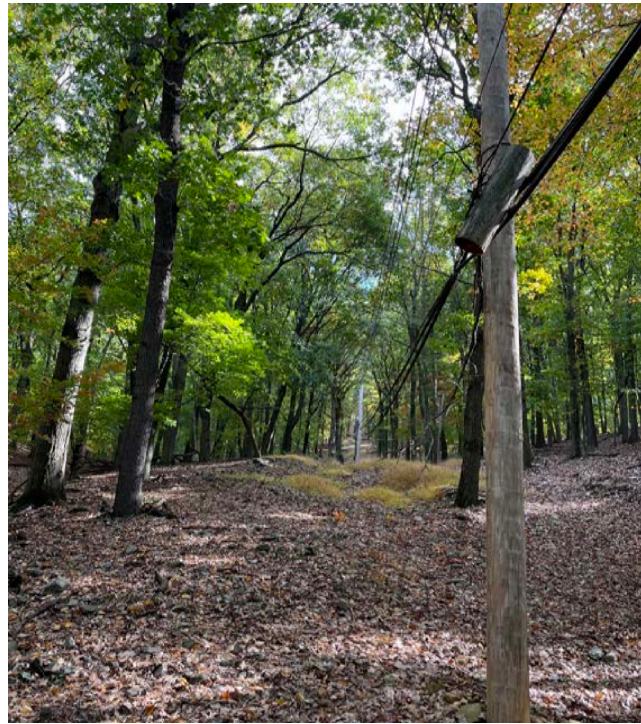
1. **Invasive plants**
 - a. Start with controlling barberry and Japanese stiltgrass within the oak forest using spot treatments.
 - i. Monitor periodically throughout the growing season after treatment to determine treatment effectiveness and prevent reestablishment. Conduct follow up treatments as needed.
 - ii. After invasive plants have been effectively controlled, monitor the area annually during the growing season to identify any new patches of invasive plants; control as identified.
 - b. Control invasive plants along Skyline Drive.
 - i. Control tree-of-heaven.
 - ii. Control invasive shrubs along roadway.
 - c. After initial control efforts in the oak forest, begin efforts to control plants in the mixed hardwood forest area.
 - i. Reach out to neighbors to share the issues with dumping yard waste in the forest and provide alternatives for how to dispose of yard waste.
 - ii. Start with vines and canopy trees, then working down the forest layers for management.
 - iii. Once enough invasive plants have been controlled that growing space has been opened, replant with native species.
2. **Deer management** – see Preserve wide strategies.
3. **Restoration** – The lack of regeneration and younger canopy trees means that any impacts to the canopy, such as oak wilt disease or climate change, can have significant repercussions for forest sustainability. However, much of this management unit may be difficult to plant due to the rocky terrain. Where planting is not an option, land managers can protect naturally regenerating tree seedlings with tree tubes or fencing until they can withstand deer browsing or rubbing.
4. **Sightline cutting areas** – The most sustainable option would be to restore the forest within these areas by controlling invasive plants and protecting naturally regenerating tree species. However, this does not seem like a desired option at this point. Instead,
 - land managers can plant shrubs, as feasible with soil conditions, to create a shrubland. Having this vegetation cover will protect soil from erosion, take up growing space to help deter invasive plants, and add wildlife habitat diversity. To retain a shrubland, land managers will need to cut 1/3-1/2 the shrubland approximately every 3-10 years to prevent tree growth or the land managers can go in and selective cut back trees to retain the sight line if desired.
5. **Quarry** – This area will require additional oversight from a volunteer ambassador program or ranger program to deter unwanted uses such as fires.
6. **Recreation**
 - a. In general, carefully assess the need for new trails before moving ahead with new trail building. While this area has fewer native plants in the understory to disturb and no water resources, a proliferation of trails could still impact the trees by compacting soil over roots. Additionally, trails have proven to be pathways of invasive plant spread within the Preserve and take up space that could otherwise be utilized by native plants.
 - b. Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.
 - c. Neighbors and high school may be good resources for an ambassador or other volunteer program.
 - d. This area could be used as an outdoor classroom for the high school. Any activities should be carefully planned to, at the least, not damage the natural resources and, in the best case, improve the natural resources.
7. **Potential for oak wilt impact** – Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
8. **Climate change** – According to DCNR's and NIACS' projections for individual tree species in the Piedmont region, the trees in this management unit may be resilient under a low emissions future. However, under a higher emissions future, the majority of native tree species present within the management unit are likely to be vulnerable to climate change. Any plantings in this management unit should favor tree species that are more resilient to climate change and that add diversity to the area.



The forest within this unit is characterized by oak trees in the canopy and sparse understory, shrub, and herbaceous layers.



The edge of the forest, such as along Skyline Drive, have greater densities of invasive plants compared to the interior of the management unit.



The powerline through this unit provides a pathway for invasive plants, like the Japanese stiltgrass seen in the center of this photo, to spread.



The quarry and peace sign, the red of which is just visible above the lower trees, are popular points of interest for visitors.



The areas that were cleared along Skyline Drive to create viewing points are now being repopulated by invasive plants like tree-of-heaven.

unit 2: list road to skyline drive forest

property owner(s):

- Berk County
- City of Reading Water Authority
- City of Reading

current condition

This management unit spans from List Road to Skyline Drive near Antietam Lake Park. It is primarily made up of an oak forest with a high diversity of native plants in the canopy and understory. There is a moderate amount of young trees in the understory. This is in contrast to most of the oak forests throughout the Preserve which typically have few young trees. The shrub and herbaceous layers are generally sparse. There is a moderate to low level of invasive plants in these areas.

There are also two pockets of forest that are much more heavily invaded. The first is a mixed hardwood forest patch located between List Road and Angora Road. The second is part of the oak forest along Skyline Drive in the northern arm of this management unit. These areas have a wide variety of invasive plants that create denser shrub and herbaceous layers. The invasive plants in the area between List Road and Angora Road are especially abundant, creating a dense, nearly impenetrable wall of invasive plants aside from the trail that goes through it.

Portions of this management unit appear to have been covered in a lower growing vegetation in 1937 according to historical aerial photography, primarily in the southern and central areas. The area was fully forested by 1971.

Multiple trails are present throughout this unit, with high densities of trails in the central and southern portions. This includes a trail through the area with younger trees. A portion of this management unit includes an Earl Trust property. Within these areas, the primary drivers of management are to protect the land for “the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources”. As such, stewarding the natural and historic resources are of the highest importance. Any trails through these areas should be assessed to determine their necessity and carefully maintained to prevent damage to natural resources. No further trail building or other recreational infrastructure should be allowed in these areas.

current and potential stressors

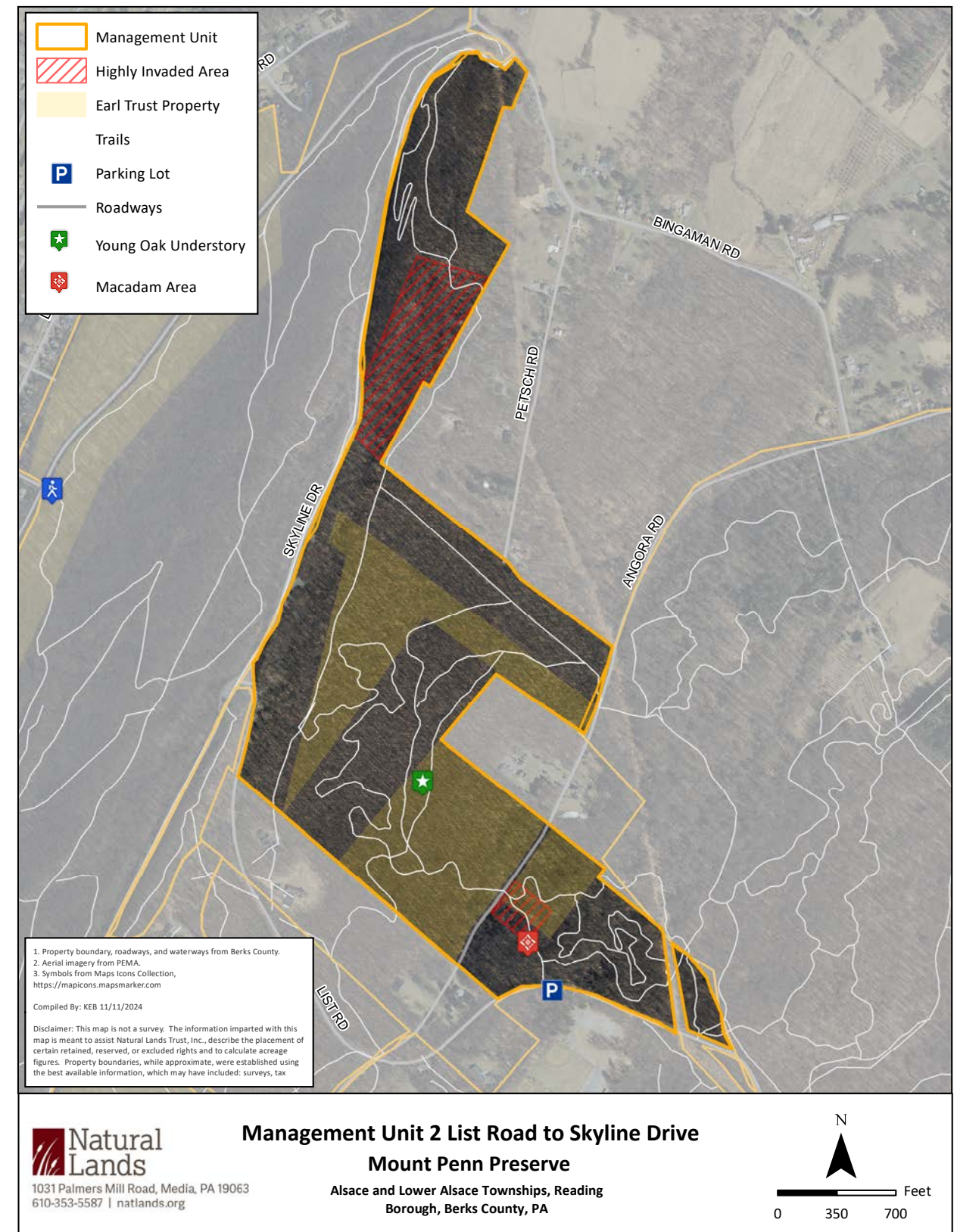
- Invasive plants
- Deer
- Hay-scented Fern
- Beech leaf disease
- Oak wilt
- Trails

goal

Support the forest area with younger trees by controlling invasive plants throughout the management unit and deer. This area is important as young trees are critical for the sustainability of a forest and are rare throughout the Preserve.

priority level

High – This area overall has a healthy forest canopy with native plants. There is also an area with younger native trees, which is important for a sustainable forest and not common throughout the Preserve.

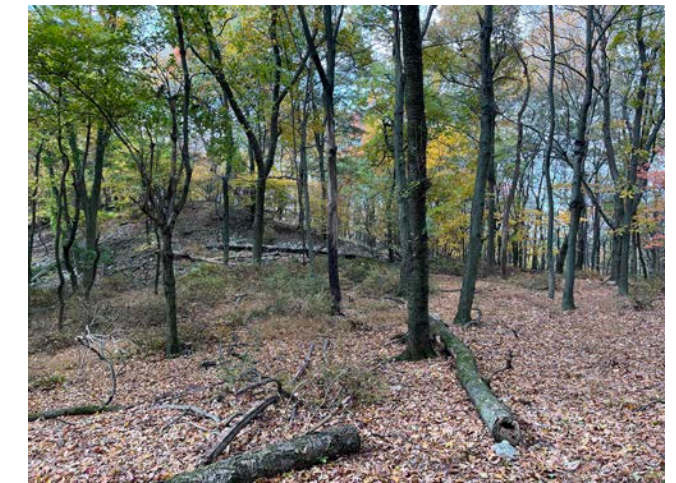


management strategies and activities

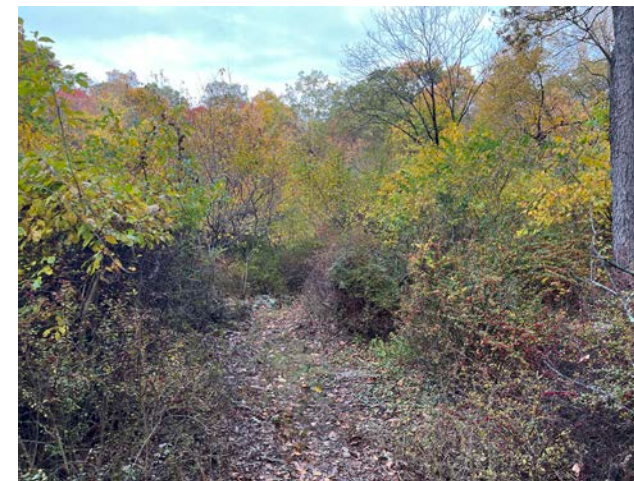
1. Invasive plants

- a. Prevent further spread of invasive plants from heavily invaded areas into less invaded areas.
- b. Within the less invaded areas, manage invasive plants using a top-down approach.
 - i. Control winged euonymus and barberry.
- c. Control invasive plants in the northern degraded section.
 - i. Control oriental bittersweet.
 - ii. Control Norway maple.
 - iii. Control shrub honeysuckle, privet, barberry, and winged euonymus.
 - iv. Control mile-a-minute.
 - v. Control Japanese stiltgrass.
- d. Control invasive plants in the degraded area between List Road and Angora Road.
 - i. This may be able to be done using a forestry mower due to the close proximity of the roads. In this case, the invasives can all be addressed at once, with follow up treatments for herbaceous plants and any other invasive plants that regenerate.
 - ii. If a forestry mower or other similar large-scale tactic is not an option, control plants in a top-down approach.
 - 1. Control oriental bittersweet and porcelain berry.
 - 2. Control tree-of-heaven and Japanese princess-tree.
 - 3. Control barberry, shrub honeysuckle, wineberry, winged euonymus, autumn olive, multiflora rose, and privet.
 - 4. Control garlic-mustard.
 - 5. Control mile-a-minute.
 - 6. Control periwinkle and Japanese stiltgrass.
 - iii. Once invasive plants are controlled, replant the area with native plants to reestablish habitat and reclaim growing space.

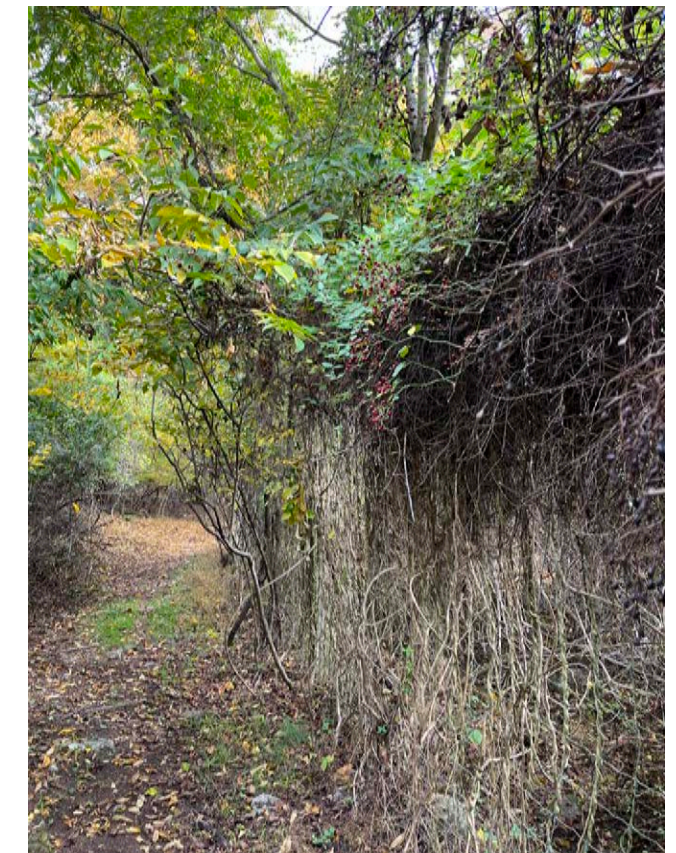
- 2. **Deer management** – see Preserve wide strategies.
- 3. **Control hay-scented fern** – Use a foliar application of glyphosate, or a combination of glyphosate and sulfometuron-methyl, between full leaf expansion and start of yellowing, typically July to mid-September. After control, plant native shrubs or trees to fill growing space. Protect plants with tree tubes or fencing.
- 4. **Beech leaf disease** – Monitor for beech leaf disease. Remove infected trees if they may become hazards. If canopy gaps occur and native plants do not naturally regenerate, plant trees to restore the canopy.
- 5. **Potential for oak wilt impact** – Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
- 6. **Recreation**
 - a. Make sure all trails area carefully planned and necessary prior to creation to reduce impact to natural areas. Avoid excess trails through area that has younger trees.
 - b. Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.



The forest within this unit is dominated by oak. The understory, shrub, and herbaceous layers are generally sparse, though there are areas with dense patches of invasive plants and another area with a greater density of young trees.



There is a dense patch of invasive plants along List Road, degrading the immediate area and threatening the adjacent forest areas that the invasive plants could spread to.



An area with dense invasive plants, including the Japanese honeysuckle seen here, is present in the northern portion of this management unit.

unit 3: list road oak forest

property owner(s):

- City of Reading
- City of Reading Water Authority

current condition

This area includes an oak forest with a healthy canopy, open understory, and limited native plant diversity. Most of this unit is located south of the Radio Tower. There is also an isolated patch of dry oak forest at the top of the ridge that is also included in this unit. The lower elevation areas have moist soils; this community gets drier as elevation increases. The highest elevation areas have plants that survive even drier conditions, including chestnut oak and mountain laurel. In general, there are few invasive plants throughout much of the management unit. However, there are pockets of barberry and a greater density of invasive plants closer to the Radio Tower. Dense patches of hay-scented fern are also present. While native, this plant can limit regeneration of other plants. There is dead and downed wood within the forest, offering habitat and retaining carbon. There is a paved trail that runs through the lower elevation area. The lower areas were cleared of vegetation prior to the 1930s and was covered in a low vegetation by 1937 according to historical aerial photography. The 1937 historical aerials also show that the upper ridge area was forested in 1937.

current and potential stressors

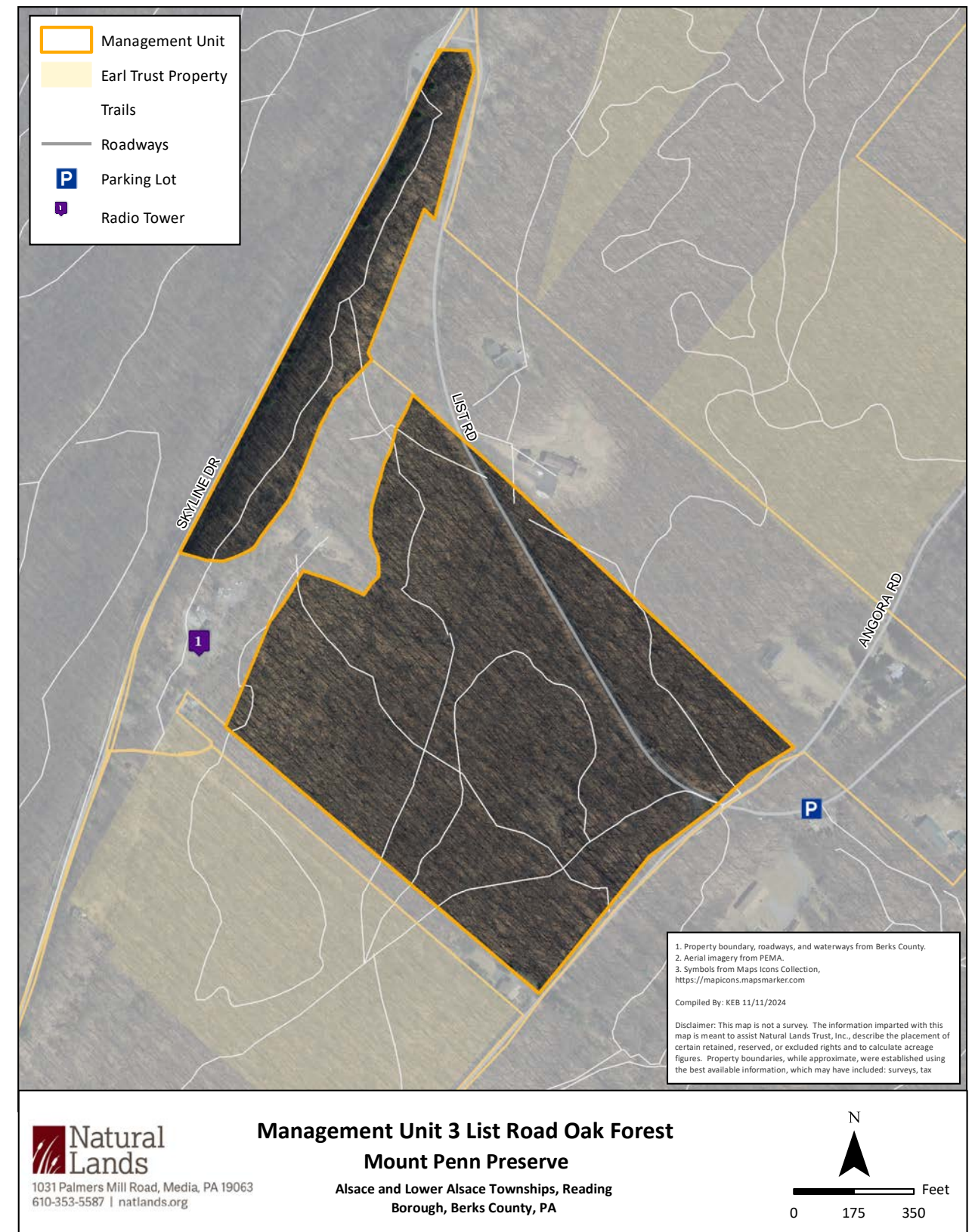
- Invasive plants
- Deer
- Hay-scented fern
- Oak wilt
- Proximity to Radio Tower and Skyline Drive
- Climate change

goal

Create a climate-resilient forest that is high quality habitat for wildlife. This This will involve retaining climate resilient species such as white oak and increasing plant species diversity. For wildlife habitat, the forest should have a healthy population of canopy trees that provide significant mast such as oaks, dense forest structural layers, and dead and downed wood. Over time, this area can develop to include more old-growth forest characteristics if not significantly impacted by a disturbance. Characteristics would include a multi-tiered canopy with younger trees filling in canopy gaps, older trees, and dead and downed wood.

priority level

High – This area has an intact canopy with native plants, few invasive species, and important habitat elements like downed wood.



management strategies and activities

1. **Invasive plants** – Implement a top-down strategy and prevent further incursion of invasive plants from Radio Tower area
 - a. Prevent incursion of invasive plants from radio tower area. Monitor for new invasive plants moving into the management unit.
 - b. Control invasive shrubs, working from List Road and moving up to the Radio Tower.
 - c. Control Japanese stiltgrass, again working from List Road and moving up to the Radio Tower.
2. **Deer management** – see Preserve wide strategies.
3. **Habitat improvement**
 - a. Maintain seed mast by retaining oaks. Increase plant diversity by adding hickories and seed-producing canopy trees.
 - b. Increase plant species diversity across all structural layers. This can be done by planting understory trees, protecting natural regeneration from deer browsing where it occurs, and controlling the deer population.
 - c. Leave dead and downed wood in place where not a nuisance or hazard.
 - d. When choosing species to plant for any restoration projects, consider species that support bats (see Bats section). This could include, among other species, white oak and shagbark hickory. Cross reference the bat habitat tree list with DCNR's climate change vulnerability index of tree species in the Piedmont region.

4. **Littering impacts from Skyline Drive** – see Preserve wide strategies.
5. **Potential for oak wilt impact** – Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
6. **Climate change** – Climate change is likely to cause a decrease in the prevalence of over half the native species in the canopy in understory. Of particular concern are the projected vulnerability of red oak, black birch, and tuliptree, all dominant species within the management unit and Preserve in general. Any restoration plantings should favor climate resilient species to bolster the sustainability of this management unit.



This forest has a healthy, native canopy and a moderate density of understory trees. This area also has downed wood throughout, which can provide shelter and food for wildlife and introduce nutrients back into the soil.



The dense areas of hay-scented fern within this forest can prevent regeneration of other native plants.

unit 4: radio tower

property owner(s):

- **City of Reading**

current condition

This unit includes the Radio Tower, buildings for a TV station, and a private parking area. Clearing of this area for structures was in progress by 1958 according to historical aerial photography. The resultant disturbance from creating these buildings and the ongoing use of the site have created a plant community that is entirely dominated by a variety of invasive plants. The herbaceous and shrub layers are primarily invasive plants, creating dense areas of forest that compromise survival of native plants and prevent their regeneration. Being along Skyline Drive and encompassing multiple buildings and a parking lot, this area will continue to see human activity that could introduce invasive plant material or even pests. There are some native trees in the canopy. However, overall, this area currently has poor ecological quality.

current and potential stressors

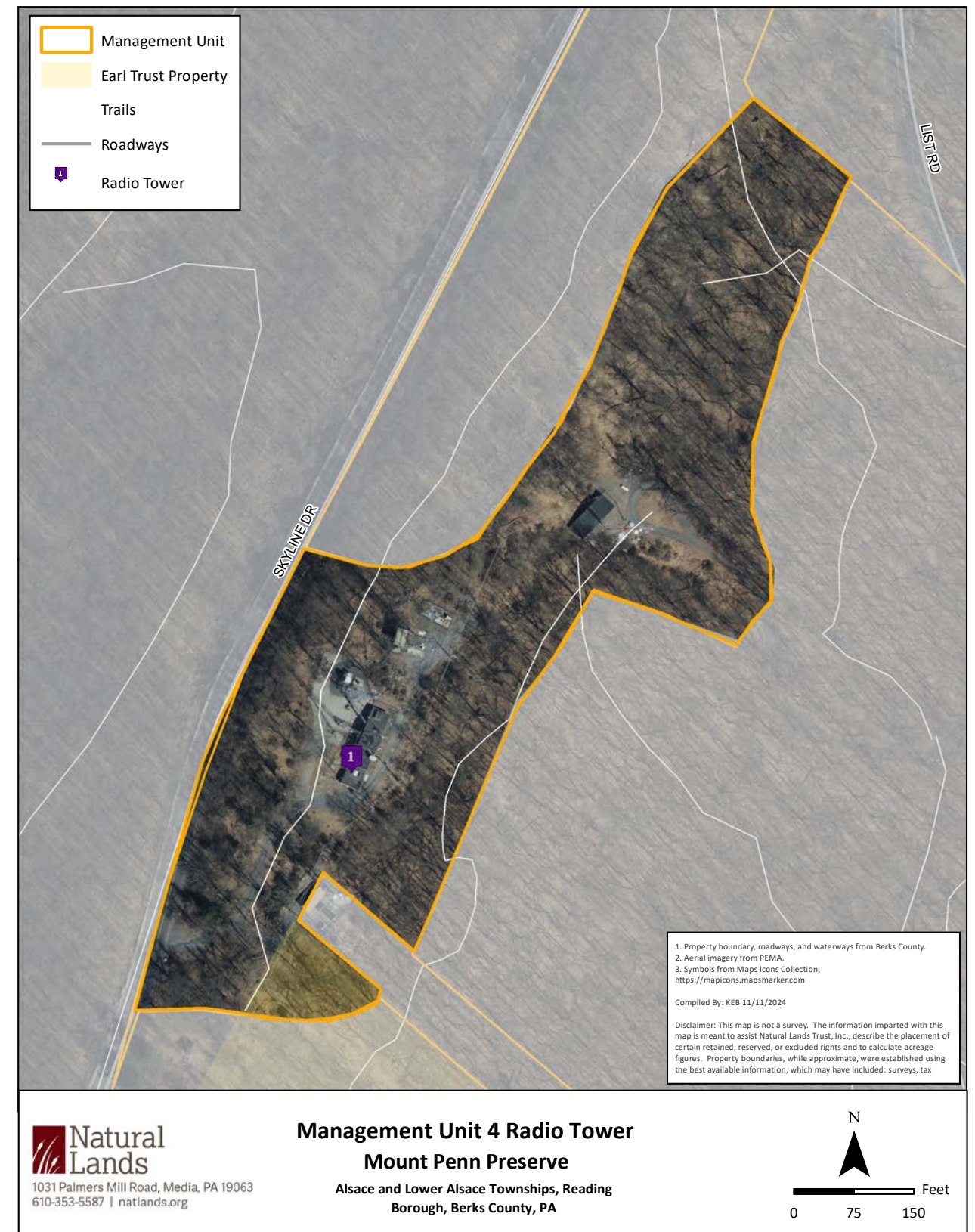
- Invasive plants
- Deer
- Human-caused disturbance

goal

The short-term goal is to prevent further spread of invasive plants into adjacent areas. Long-term, the goal is to fully control invasive plants and restore a native plant community, trees where feasible. Closer to the buildings, native plants can be used for landscaping. Additionally, land managers should be proactive in controlling new invasive plants that are more likely to arrive in an area with continuous disturbance like the radio tower and parking lot.

priority level

Low – Invasive plants are already well-established in this area and native plants are being outcompeted. As such, this area is of low ecological quality, and there is less habitat value for wildlife, aside from shelter.



management strategies and activities

1. Invasive plants

a. Carry out a large-scale restoration project to remove invasive plants and immediately replant with native species. This will require mechanical and chemical control of all invasive plants. Depending on resources available, this can be done across the entire management unit at once. Alternatively, sections of the unit can be done at a time, focusing first on the outer northern, southern, and eastern edges of the unit that abut other forest areas (excluding the areas next to Skyline Drive) and then moving uphill towards the buildings and the road. This will help prevent further spread of the invasive plants into the adjacent forest.

- b. For replanting, chose native species that are likely to be more resilient to climate change, particularly for the trees. All plantings will have to be protected from deer unless they are species that are truly unpalatable such as buckeyes.
- 2. **Deer management** – see Preserve wide strategies.
- 3. **Landscaping** – Utilize native shrubs, herbaceous plants, and small trees to add landscaping around buildings after invasive plant control.
- 4. **Disturbance** – Monitor the area for trash and introduction or reestablishment of native plants.



While there are still oak trees and other native plants present in the canopy like the adjacent areas, this unit also has an abundance of invasive plants like the Japanese stiltgrass seen here covering the forest floor.



The clearing of the area and construction of the radio tower created a highly disturbed area that is now dominated by invasive plants, including Japanese knotweed, barberry, and tree-of-heaven as seen in these pictures.

unit 5: radio tower to tower road

property owner(s):

- **City of Reading**

current condition

This area contains an oak forest. There is a building with a parking area and the fire tower area along Skyline Drive. The canopy is mostly oak trees with some hickory and tuliptree. The understory is a mix of sparse, open areas and dense patches of pawpaw, a native plant that deer do not browse. The shrub and herbaceous layers are primarily invasive plants, particularly Japanese stiltgrass and barberry. Their path of spread can be traced to the trails, radio tower, and powerline that runs along the northern part of this management unit. These areas of disturbance are prime areas of invasive plant spread. The invasive plants also increase in prevalence closer to Tower Road and within scattered canopy gaps. Historical aerial photography shows that this area was largely forested in 1937. Hay-scented fern is also present in large patches. This is problematic because hay-scented fern, while a native plant, can grow densely enough to prevent regeneration of other plants.

A portion of this management unit includes an Earl Trust property. Within these areas, the primary drivers of management are to protect the land for “the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources”. As such, stewarding the natural and historic resources are of the highest importance. Any trails through these areas should be assessed to determine their necessity and carefully maintained to prevent damage to natural resources. No further trail building or other recreational infrastructure should be allowed in these areas.

current and potential stressors

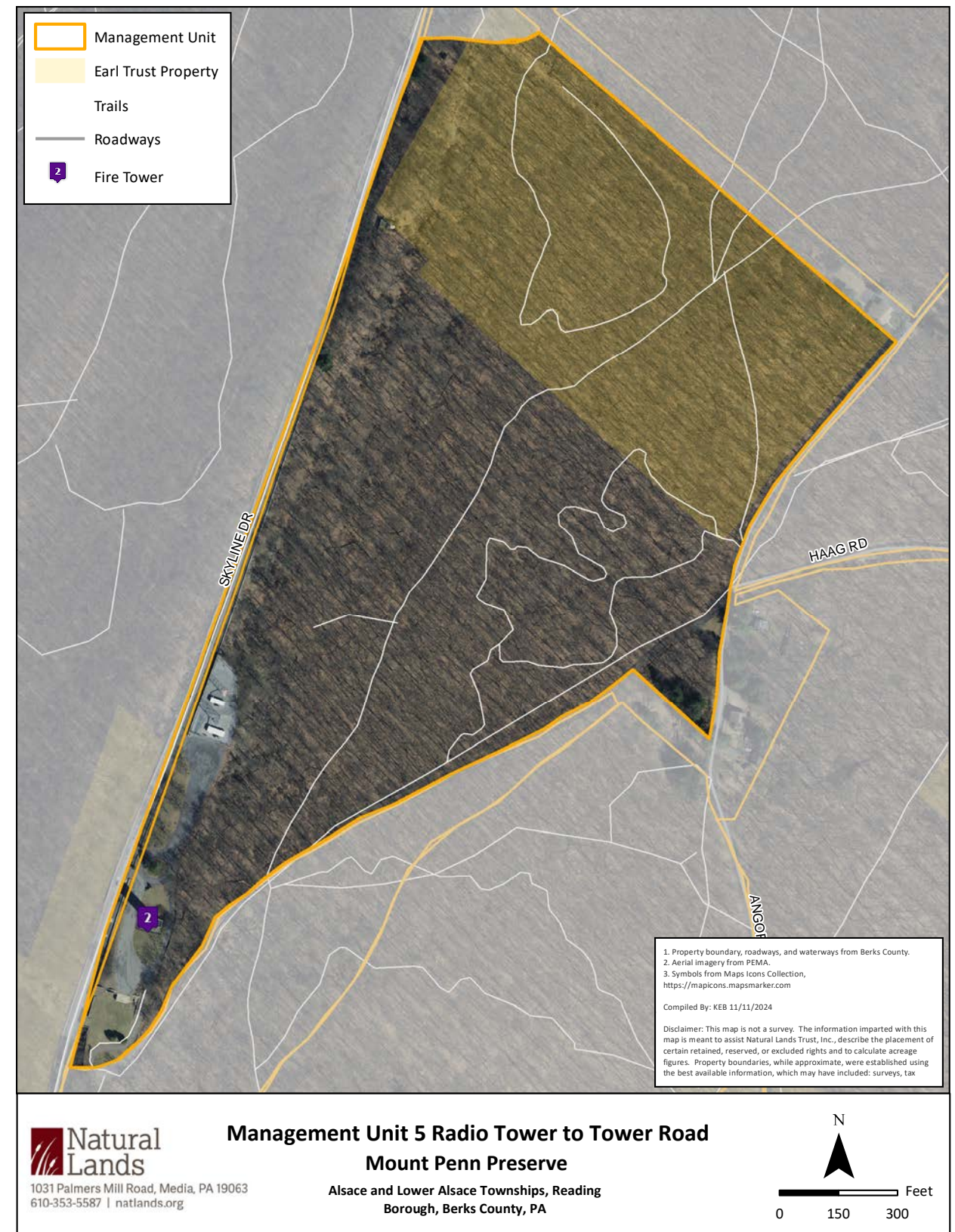
- Invasive plants
- Deer
- Canopy gaps
- Hay-scented fern
- Oak wilt
- Climate change

goal

Support a sustainable oak and hickory dominated forest, or other similar native plant dominated forest that can support important wildlife such as bats through provision of food and shelter.

priority level

Medium – This area has a moderate diversity of native plants and a denser understory in sections. However, there area invasive plants present, particularly along the powerline and near the roads.



management strategies and activities

1. **Invasive plant control** – Utilize a top-down approach starting at the less invaded lower elevations and then moving up toward the powerline.
 - a. Control oriental bittersweet and Japanese honeysuckle.
 - b. Control barberry and multiflora rose.
 - c. Control garlic-mustard.
 - d. Control mile-a-minute.
 - e. Control periwinkle.
 - f. Prevent further establishment of invasive plants from the powerline.
2. **Deer management** – see Preserve wide strategies.
3. **Control hay-scented fern** – Use a foliar application of glyphosate, or a combination of glyphosate and sulfometuron-methyl, between full leaf expansion and start of yellowing, typically July to mid-September. After control, plant native shrubs or trees to fill growing space. Protect plants with tree tubes or fencing.
4. **Potential for oak wilt impact** – Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.

5. **Climate change** – Climate change is likely to cause a decrease in the prevalence of over half the native species in the canopy in understory. Of particular concern are the projected vulnerability of red oak, black birch, and tuliptree, all dominant species within the management unit and Preserve in general. Any restoration plantings should favor climate resilient species to bolster the sustainability of this management unit.
9. **Recreation** – Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.



Groves of pawpaw, a native understory tree that is deer resistant, are present within the forest, creating dense patches of habitat to shelter wildlife.



This forest is characterized by Japanese stiltgrass, seen here as a ground cover, and barberry in the shrub layer are spreading from the powerline along the northern border of this management area south downhill to higher quality areas.

unit 6: tower road to haag road

property owner(s):

- **City of Reading**

current condition

This area is a small patch of mixed hardwood forest with a moderate to high level of invasive plants within a larger matrix of oak forest. The canopy is dominated by tuliptree and also contains red oak, Norway maple, and mockernut hickory. The understory contains patches of pawpaw, a native plant that deer do not browse, as well as sassafras and red maple. The shrub and herbaceous layers are primarily invasive plants, particularly Japanese stiltgrass and barberry. As seen in historical aerial photographs, this area was a patchy forest in 1937 and transitioned to fully forested by 1958.

current and potential stressors

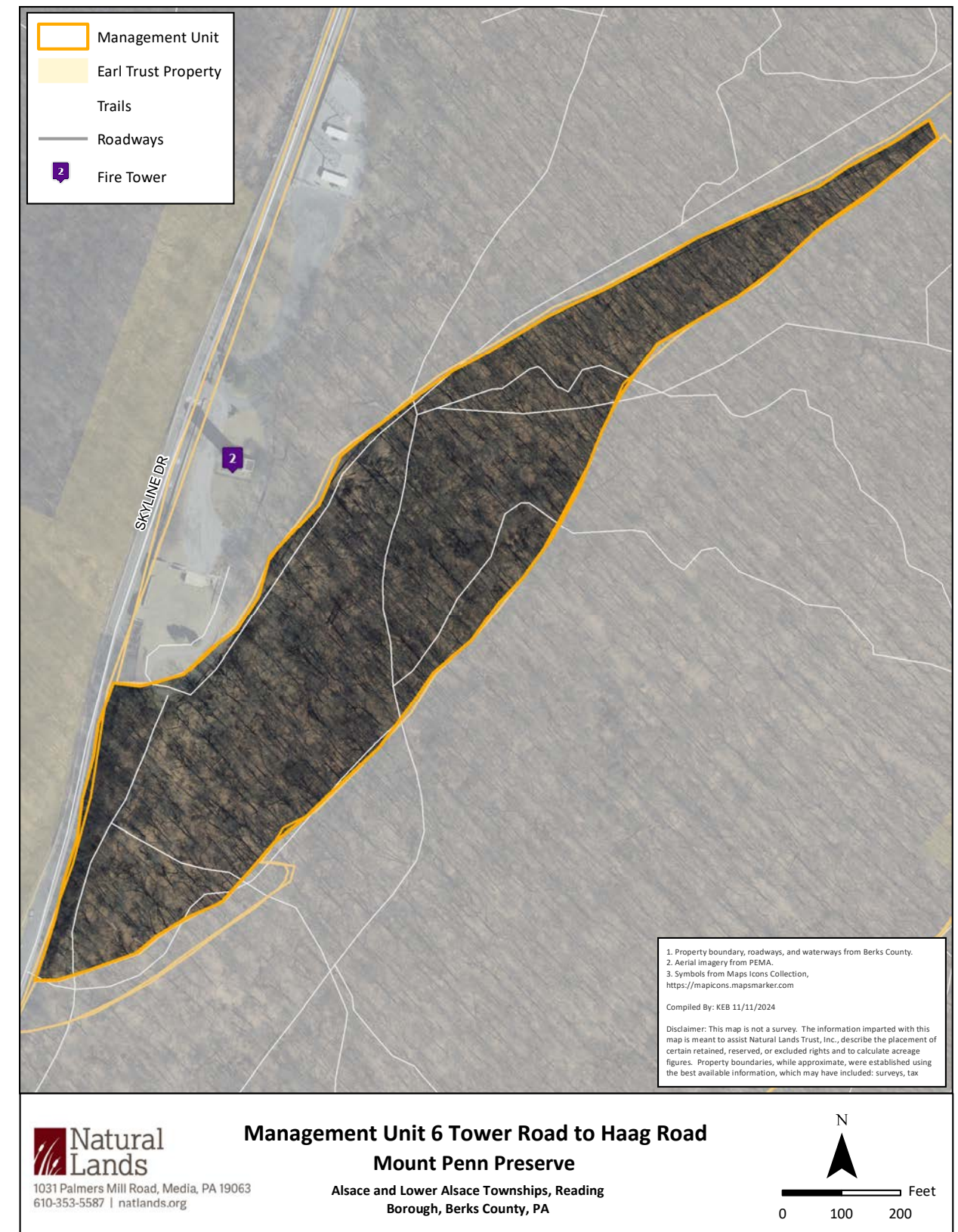
- Invasive plants
- Deer
- Climate change

goal

Create a continuous forest with the surrounding oak forests that has a high prevalence of native plants and low invasive plant pressure. Control invasive plants that may be introduced from the roads and trails surrounding this management unit.

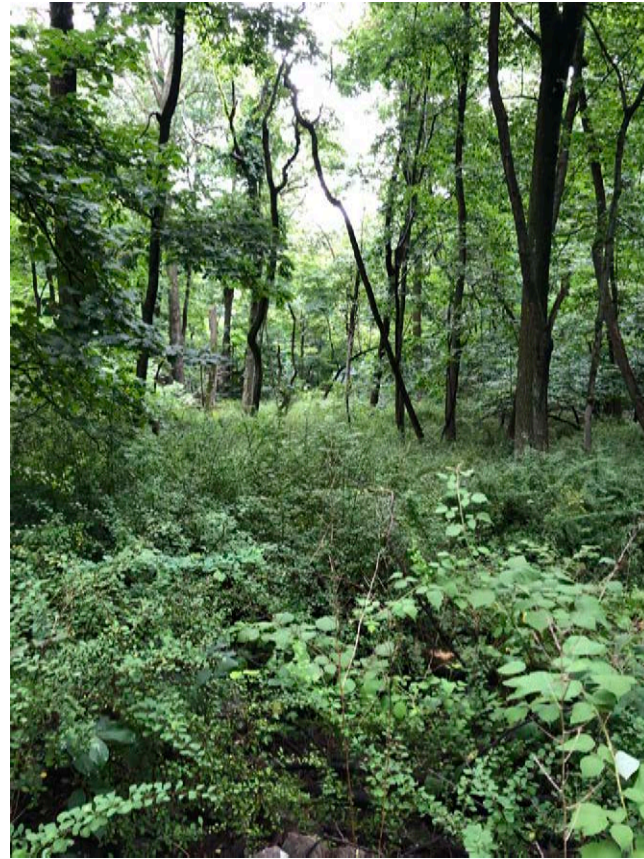
priority level

Medium - While this area is degraded by invasive plants, it is a medium priority of management as invasive plants from this unit can easily spread into the adjacent oak forests if not controlled.

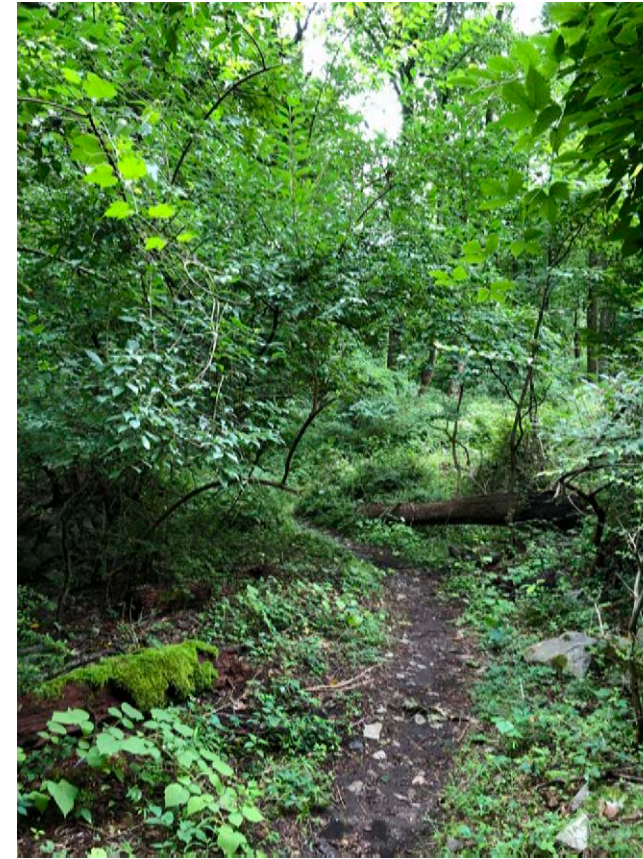


management strategies and activities

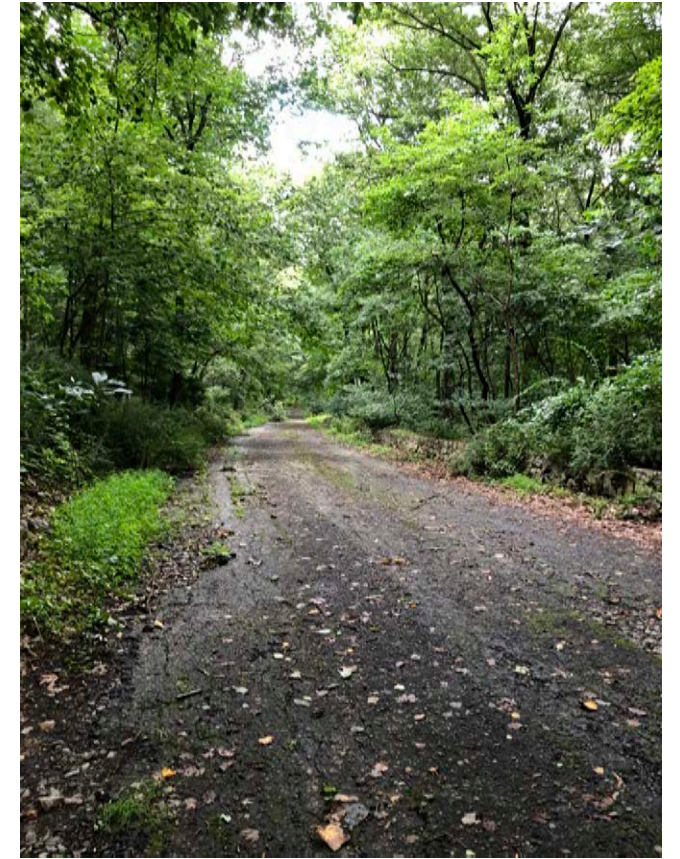
1. **Invasive plant control**
 - a. Control Norway maple, oriental bittersweet, and porcelain berry.
 - b. Control shrubs – burning bush, wineberry, and barberry.
 - c. Control Japanese stiltgrass.
 - d. Prevent reestablishment of invasives or introduction of new species.
2. **Deer management** – see Preserve wide strategies.
3. **Restoration** – After controlling invasive plants, efforts will likely be needed to restore the forest with native plants.
 - a. Add a diversity of understory trees and shrubs.
 - b. Protect all plantings with tree tubes or fencing. Regularly maintain these structures until plants are able to withstand deer browsing and rubbing.
4. **Climate change** – The limited diversity of canopy and understory trees, combined with the possible vulnerability of tuliptree, red oak, and red maple, means that this plant community may be highly stressed by climate change. Over time, the existing tree species may fail to regenerate or thrive, even with deer and invasive plant control. Any restoration plantings should focus on adding diversity and selecting species that may be more resilient to climate change.



While the canopy is comprised of native plants, the shrub layer is filled with invasive plants.



Invasive plants are especially dense along the trail and Tower Road, as these areas are regularly disturbed and have more light than the interior areas.



unit 7: haag road to ferndale trail

property owner(s):

- City of Reading

current condition

This management unit is comprised of an oak forest. According to historical aerial photography, a large portion of this area was cleared prior to 1937. Trees in the area had largely regrown by the late 1950s. This legacy of clearing is reflected in the presence of invasive plants, which is moderate to heavy throughout. The unit has few young trees. It also has a moderate amount of canopy gaps. These canopy gaps do not have native plants regenerating, creating more opportunities for invasive plants to gain a foothold. This area also includes Drenkel Field. The border along this park area has a more diverse array of invasive plants, including invasive canopy trees and vines.

current and potential stressors

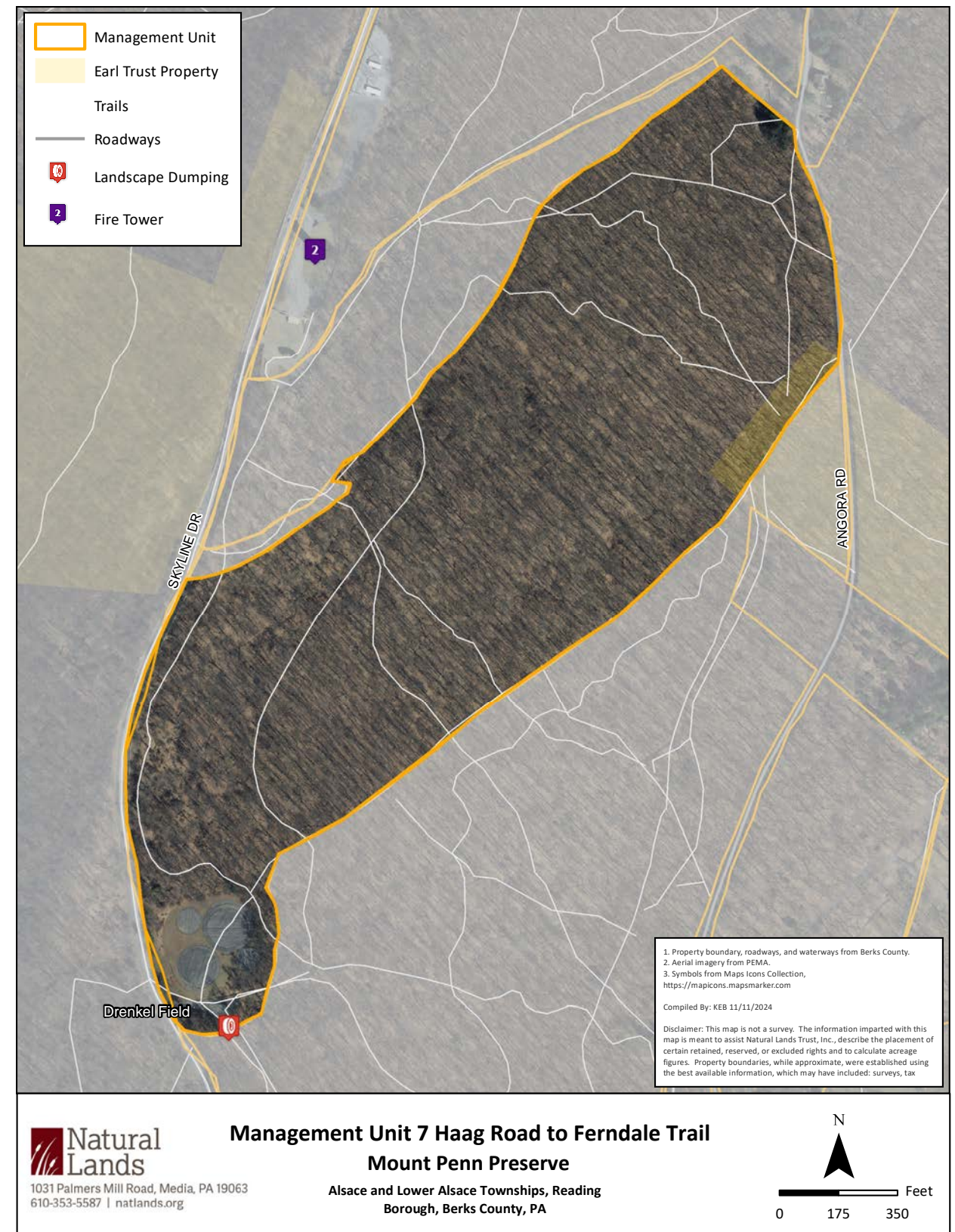
- Invasive plants
- Deer
- Drenkel Field and proximity to Skyline Drive
- Climate change
- Canopy gaps with a lack of natural regeneration
- Oak wilt

goal

Support a sustainable oak and hickory dominated forest, or other similar native plant dominated forest that can support important wildlife such as bats through provision of food and shelter.

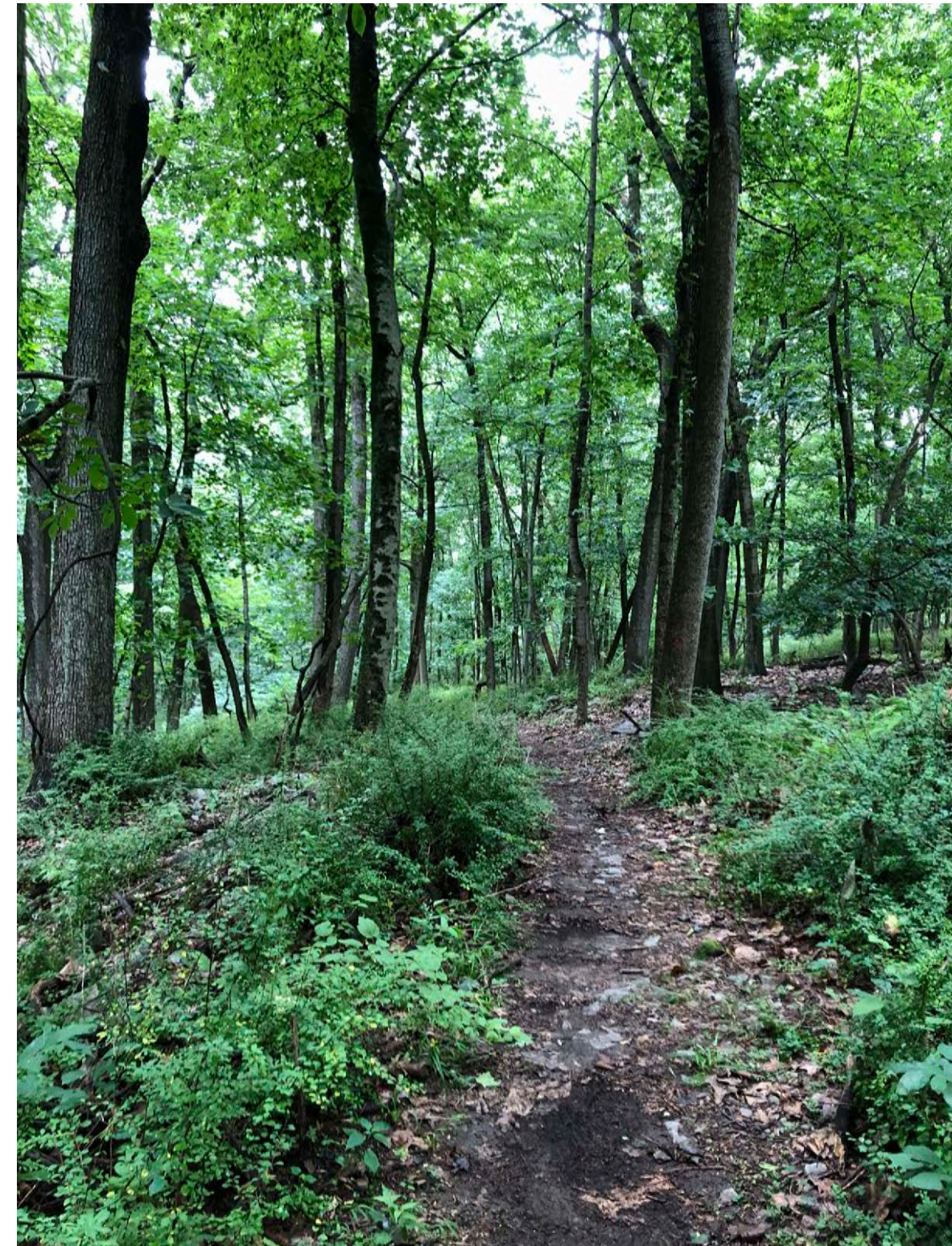
priority level

Medium – This area is compromised by invasive plants, but has a moderate diversity of native plants. It also abuts a higher quality oak forest area. This makes it more important to improve ecological quality of this management unit.



management strategies and activities

1. **Invasive plants**– the invasive plants are generally denser near Drenkel Field, Skyline Drive, and Haag Road. As such management efforts should be carried out starting from Ferndale Trail and then moving northwest. Drenkel Field can be addressed last as it is already heavily invaded. Until ready to address invasive plants around Drenkel Field, land managers should focus on preventing further spread of these invasives into the surrounding forest. The one exception to this is wisteria; this plant should be a high priority for management due to its incredibly aggressive spread and ability to rapidly degrade a forest.
 - a. Control wisteria around Drenkel Field.
 - b. Control oriental bittersweet.
 - c. Control invasive barberry, privet, and wineberry
 - d. Control garlic mustard.
 - e. Control Japanese stiltgrass, prevent further spread along trails.
 - f. Control spread of invasive plants around Drenkel Field into adjacent forest areas until ready to manage. The one exception to this is wisteria, which should be a high priority for management.
 - g. Control invasive plants around Drenkel field.
 - i. Control oriental bittersweet and porcelain berry.
 - ii. Control Norway Maple and Japanese princess-tree.
 - iii. Control shrub honeysuckle, barberry, multiflora rose, and wineberry.
 - iv. Control mile-a-minute.
 - v. Control Japanese stiltgrass and periwinkle.
 - h. Prevent reestablish of invasive plants or incursion by new invasive plant species.
2. **Deer management** – see Preserve wide strategies.
3. **Canopy gaps** – in the short term, control invasive plants in existing and new canopy gaps. Replant with native plants and protect from deer with fencing or tree tubes. Over time as deer and invasive plants are managed, native plants should more readily establish or already be present when these gaps form. At that point, the only management needed will be to prevent the establishment of invasive plants.
4. **Potential for oak wilt impact** – Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
5. **Climate change** – Climate change is likely to cause a decrease in the prevalence of over half the native species in the canopy in understory. Of particular concern are the projected vulnerability of red oak and tuliptree, both dominant species within the management unit and Preserve in general. Any restoration plantings should favor climate resilient species to bolster the sustainability of this management unit.



This management unit is one oak forest within the Preserve that has a moderate level of invasive plants throughout.

unit 8: stiltgrass savanna

property owner(s):

- **City of Reading**

current condition

This area is highly degraded. It is primarily stiltgrass and mile-a-minute with scattered mature trees. A portion of the trees have died and fallen over. These areas have subsequently been overrun by mile-a-minute.

current and potential stressors

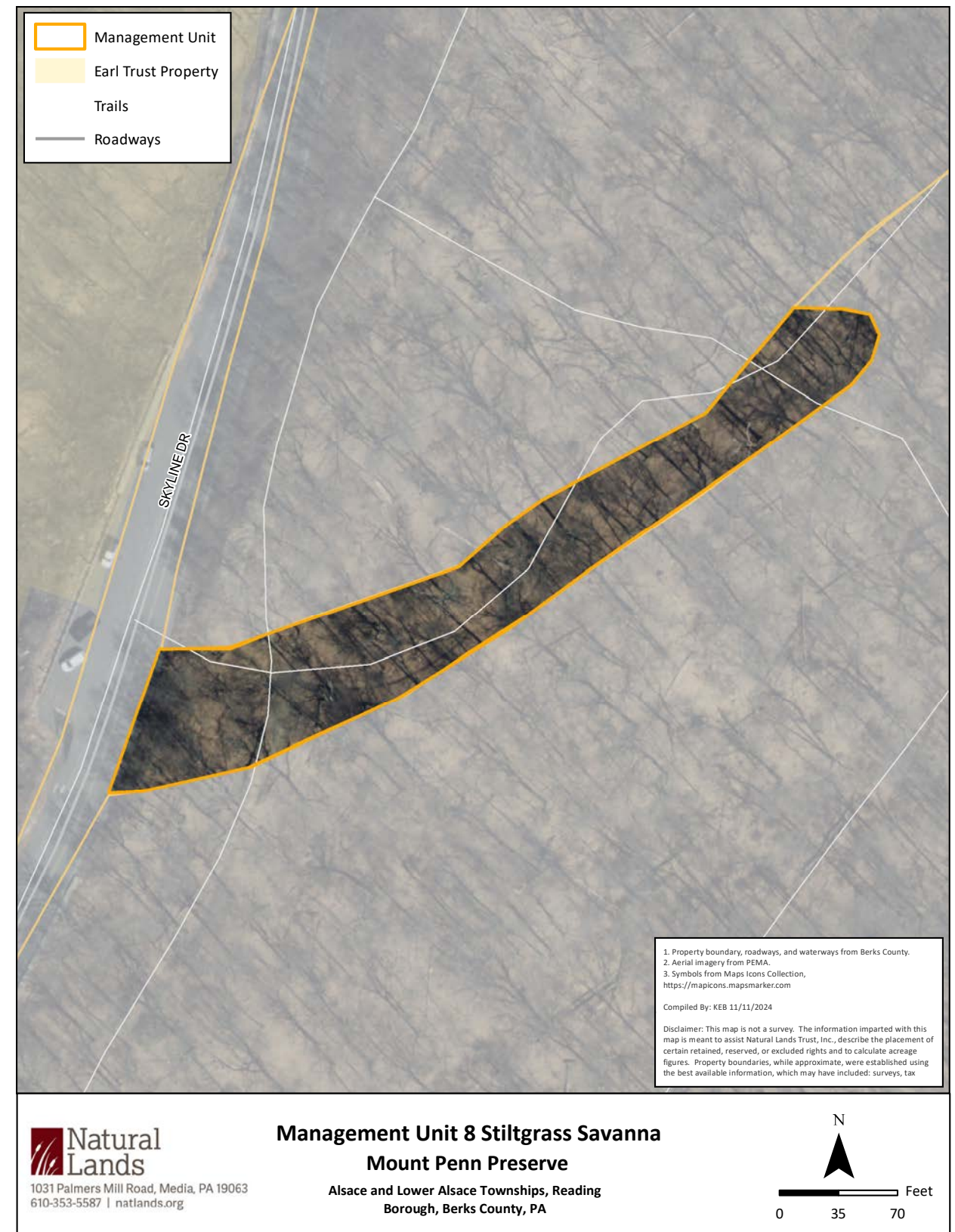
- Japanese stiltgrass and mile-a-minute
- Tree loss
- Deer

goal

Create an early-successional area that can transition into a maturing forest over time with increased native plant diversity and density.

priority level

Low – This area is dominated by invasive plants and is already losing its canopy trees. As such, it has low ecological value and therefore is a low priority for management.



management strategies and activities

1. **Invasive plants**
 - a. Control tree-of-heaven.
 - b. Control Japanese stiltgrass and mile-a-minute.
 - c. Control any newly establishing invasive plants as the native plants become established.
2. **Deer management** – see Preserve wide strategies.
3. **Restoration** – Immediately after invasive plant control, replant the area with native species. The area can be planted with either trees to create a young forest or shrubs to create a patch of shrubland. In either case, protect plantings with fencing or tree tubes until established. The shrubs will require more long-term management until deer populations reach a sustainable level. The shrubland can be allowed to transition over time to a forest.
4. **Succession management** – Allow for natural succession to proceed, controlling invasive plants. Natural disturbances may reset this area to a younger plant community. If this occurs, continue to support the area through invasive plant control and allow for natural succession. If at any point deer browse threatens the sustainability of the area, protect native species, either planted or naturally regenerating, with fencing or tree tubes until they are able to withstand deer browsing and rubbing.



The core part of the stiltgrass savanna has few remaining alive canopy trees. Japanese stiltgrass and mile-a-minute cover the ground layer, and the mile-a-minute is growing over the trees.



The southern boundary of the stiltgrass savanna has more canopy trees, though these are still sparse and Japanese stiltgrass is filling the ground layer.

unit 9: ferndale trail to pagoda oak forest

property owner(s):

- **City of Reading**

current condition

This oak forest is in relatively good condition with a healthy canopy and low to moderately invaded understory. There is a high diversity of native plants in the canopy and understory. The shrub and herbaceous layers have a mix of native and invasive plants. There is a higher proportion of invasive plants in the northeast section of this unit and along the eastern boundary, an area which was cleared prior to 1938. There are scattered canopy gaps within the unit.

Drenkel Field is adjacent to these areas and can also be a source of invasive plants in this management unit. This area has a high number of trails crisscrossing throughout the unit and contribute to the spread of invasive plants. It also includes a mountain biking area within a depression in the forest, a remnant of its historical use for the railroad, known as "The Bowl." A portion of this management unit includes an Earl Trust property. Within these areas, the primary drivers of management are to protect the land for "the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources". As such, stewarding the natural and historic resources are of the highest importance. Any trails through these areas should be assessed to determine their necessity and carefully maintained to prevent damage to natural resources. No further trail building or other recreational infrastructure should be allowed in these areas.

current and potential stressors

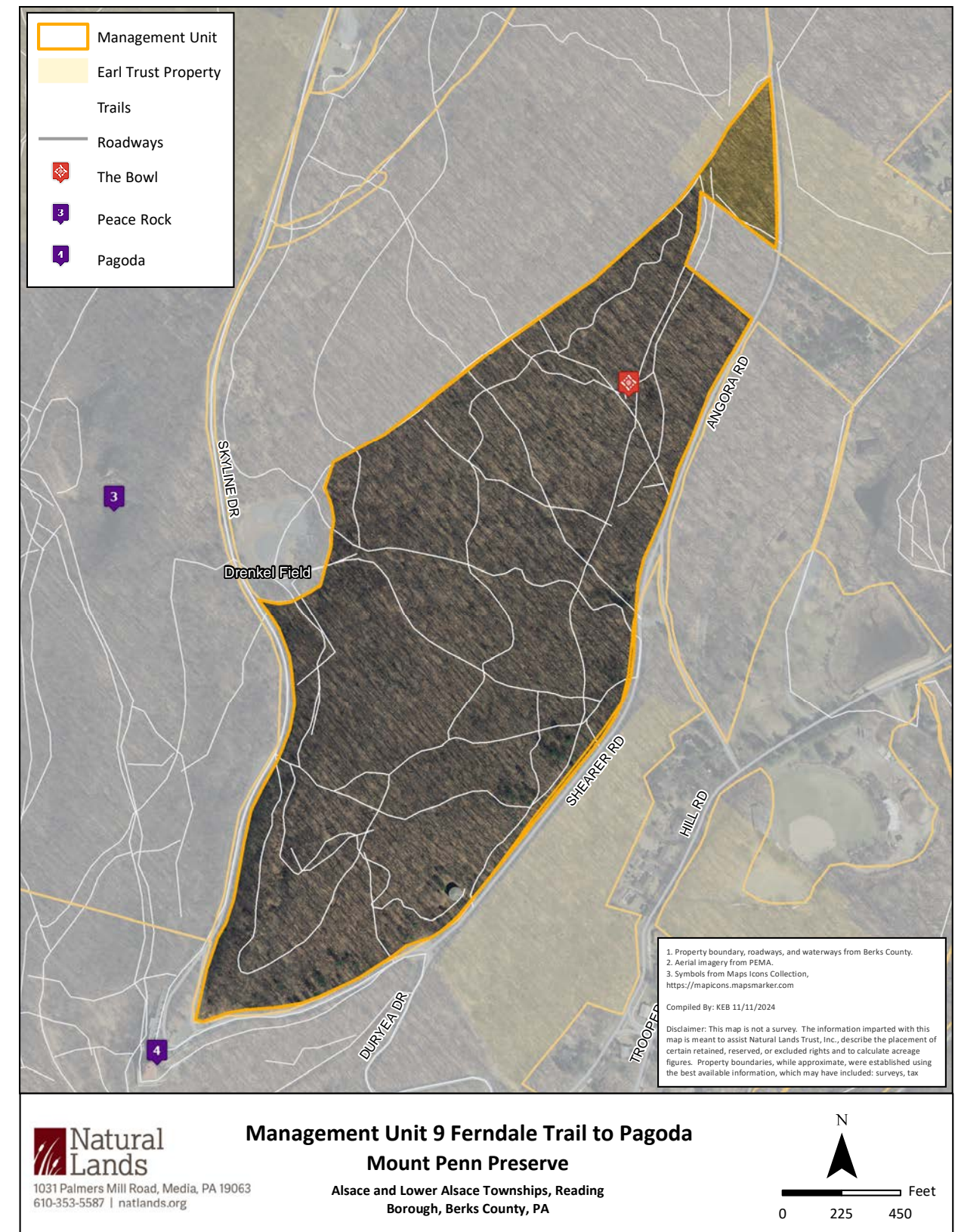
- Trails and The Bowl
- Invasive plants
- Deer
- Canopy gaps
- Oak wilt
- Climate change

goal

Establish a balance between a sustainable forest with native plants that can support wildlife and trails for visitors.

priority level

Medium-High – This area is relatively good quality forest. However, there are more impacts already from recreational use as compared to the north side oak forest.



management strategies and activities

1. **Invasive plants** – Prevent further encroachment of invasive plants from Drenkel Field. Control invasive plants using a top-down approach.
 - a. Prevent encroachment of invasive plants from Drenkel Field area, particularly wisteria.
 - b. Control Norway maple.
 - c. Control barberry and wineberry.
 - d. Control Japanese stiltgrass.
2. **Deer management** – see Preserve wide strategies.
3. **Canopy gaps and Restoration** – This area has a high diversity of native plants. However, there is minimal regeneration of native plants. This is particularly problematic where there are canopy gaps. Until invasive plant control and deer management allow for sufficient regeneration, plant native trees in canopy gaps. Protect plantings with tree tubes or fencing. In the rest of the management unit, land managers can wait and see how native plants respond to deer and invasive plant control. If natives do not fill all structural layers over time, plantings can be used to boost native plant diversity and abundance. Climate change may also influence the need for active restoration. See below.
4. **Potential for oak wilt impact** – Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
5. **Climate change** – A high proportion of the existing canopy and understory species are projected to be vulnerable to climate change. As such, these species may decrease in prevalence over time. If natural regeneration and survival of young trees remains low even with invasive plant and deer management, add a diversity of native plants, choosing species that are more likely to be resilient to climate change.
6. **Recreation**
 - a. In general, carefully assess the need for new trails before moving ahead with new trail building to protect the forest trees and avoid further spread of invasive plants.
 - b. Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.



Mountain biking trails and a biking feature known as “The Bowl” cut throughout this management unit.

unit 10: pagoda

property owner(s):

- City of Reading

current condition

This area has a mix of oak forest and mixed hardwood forest that alternates around the winding road. The oak forests ranges from good condition with low invasive pressure to more invaded areas. The mixed hardwood areas area generally more invaded. The mixed hardwood forest around the Pagoda has a slightly different composition than the other mixed hardwood forest areas, with less diversity in the canopy and a higher proportion of Japanese princess-tree. The changes between forest quality are distinct, with the forest becoming more invaded as one moves downhill. There were also areas of trash dumping noted during the site visit, as well as an area near the large canopy gap that was cleared of soil and leaves which were dumped next to the small cleared area.

This area is a key connection between the City and the Preserve. In addition to the roads winding through this unit, there are also multiple trails, including ones that head towards the Pagoda and ones to the Quarry, both popular points of interest for visitors. Additionally, the area of the Preserve connects to City Park and is in close proximity to an elementary school and private residential properties.

A portion of this management unit includes an Earl Trust property. Within these areas, the primary drivers of management are to protect the land for “the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources”. As such, stewarding the natural and historic resources are of the highest importance. Any trails through these areas should be assessed to determine their necessity and carefully maintained to prevent damage to natural resources. No further trail building or other recreational infrastructure should be allowed in these areas.

current and potential stressors

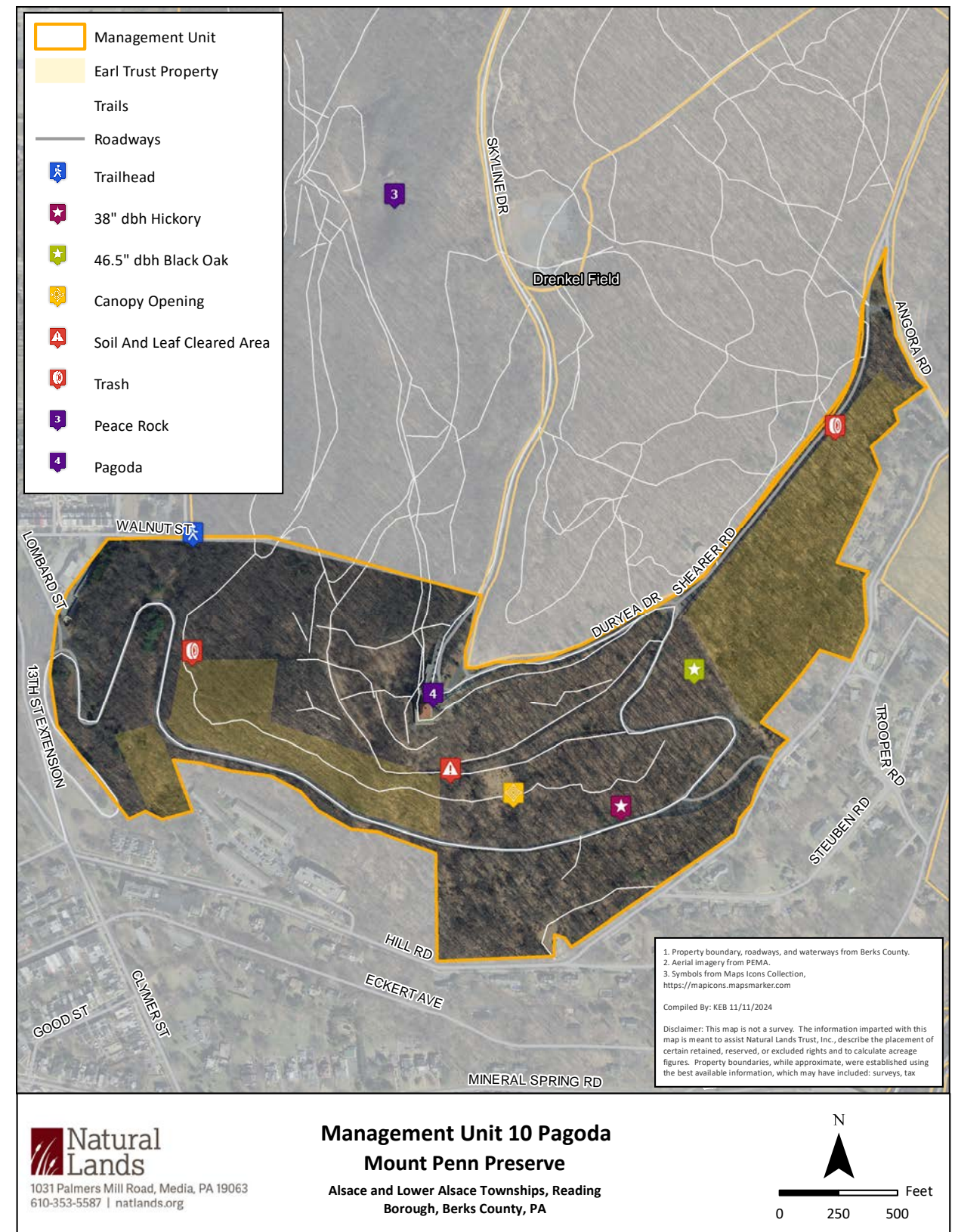
- Invasive plants
- Deer
- Edges
- Canopy gap
- Oak wilt

goal

The goal for this area to create a multi-aged, diverse, and sustainable forest. The large canopy gap creates an opportunity to create a young forest by controlling the invasive plants and planting saplings. In the existing forest areas, the focus should be on controlling deer and invasive plants to create a more sustainable forest. Additionally, this area can become a place to showcase native plants and improve the connection between the Preserve and the City.

priority level

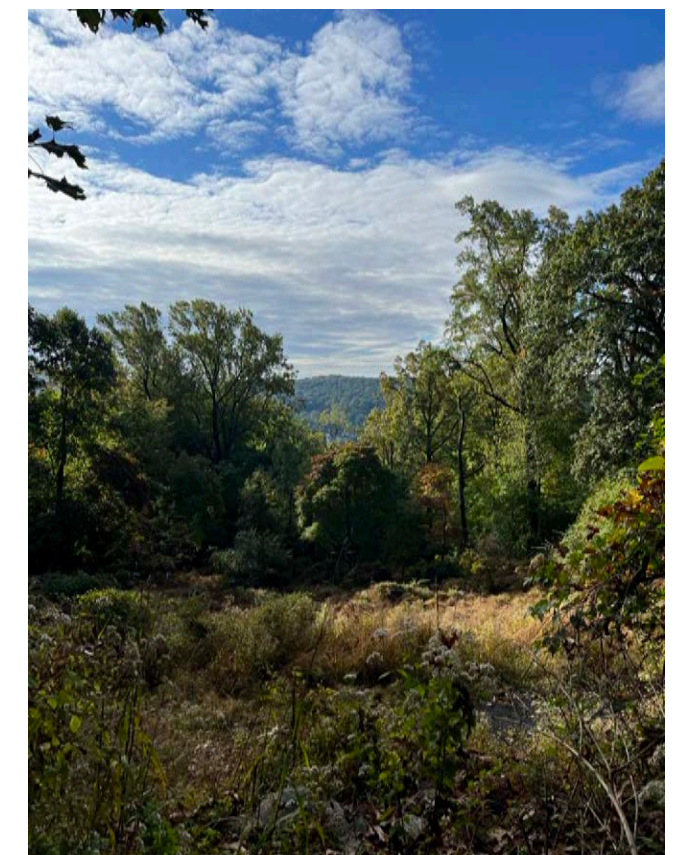
Medium – This area will take significant effort to restore the forest. While there are some higher quality areas, much of this unit is already degraded by invasive plants.



management strategies and activities

1. **Invasive plants** – the level of invasive control varies throughout this management unit, with much of the i nvasive plants concentrating along the roads and generally increases moving downhill from the Pagoda.
 - a. Start with controlling invasive plants at higher elevations, then moving downhill through the central portion of this management unit and then moving out to the edges. This follows the guidelines of working in lesser impacted areas first and starting uphill to help prevent reestablishment of invasive plants.
 - i. Start with vines and canopy trees, then working down the forest layers for management.
 - ii. Once enough invasive plants have been controlled that growing space has been opened, replant with native shrub and/or tree species if there are gaps in native plant cover. This will likely be more necessary in the most heavily invaded sections.
 - iii. Monitor periodically throughout the growing season after treatment to determine treatment effectiveness and prevent reestablishment. Conduct follow up treatments as needed.
 - iv. After invasive plants have been effectively controlled, monitor the area annually during the growing season to identity any new patches of invasive plants; control as identified.
2. **Deer management** – see Preserve wide strategies.
3. **Plantings** – In the areas with high proportions of invasive plants, replanting with native plants after invasive plant control can improve the health of the forest and restore habitat. This will likely be needed most in the lowest elevation areas and the forest gap.
4. **Forest gap**
 - a. Control invasive plants.
 - i. Control the shrubs.
 - ii. Control mile-a-minute and Japanese stiltgrass.
 - b. Protect naturally regenerating native tree species with fencing or tree tubes.
 - c. Plant tree saplings after invasive plants have been treated, see appendices for possible species and planting techniques and maintenance.

- d. Add understory plantings after original saplings are established and tree tubes removed.
 - e. Monitor the area for return of invasive plants or die off of planted trees.
5. **Potential for oak wilt impact** – Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
6. **Climate change** – The high diversity of native plants throughout this management unit will help support resiliency in the face of climate change. However, as with other areas throughout the Preserve, most of the native tree species may be vulnerable to climate change under a high emissions future. Additionally, there is little native regeneration. As such, land managers will likely need to replant native plants as invasive plants are controlled. Plantings will also be needed to restore the large canopy gap area. These plantings should favor species projected to be resilient to climate change.
7. **Recreation**
 - a. It is likely that a trail to the Pagoda will be reestablished in this area. Any trail creation should minimize impacts to native plants and the soil to protect the natural resources. Trails are also vectors of spread for invasive plants and create disturbance when they are installed. Any new trails should be monitored for invasive plants, particularly in areas that are currently less impacted.
 - b. Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.
8. **Interpretive signage**- This area includes a trail from the City to the Pagoda. As such, visitors are likely to note the changes to the landscape as work is done. Signage describing the work being done and its purpose can inform visitors as to the importance and reasons behind the work being done.
9. **Trash and debris**
 - a. Clear trash when found and monitor for new dumping.
 - b. Avoid clearing areas of soil and leaves to protect ecological value unless necessary for approved infrastructure. Only dump soil or leaves into designated areas to minimize impact on natural areas.



The forests within this management unit vary from oak forests with open understories (1), forests with native mountain laurel in the shrub layer (2), and forests that are dominated by invasive plants (3).

The large canopy gap presents an opportunity to create a young forest to diversify the forest ages and habitat within the Preserve.

unit 11: rotary park

property owner(s):

- **City of Reading**

current condition

This is a large management unit with a mix of forest conditions throughout. While this unit has more variety than the others, it makes sense to manage this area as a whole as the variations create many small areas that would be difficult to different when managing and all interact with the surrounding areas.

Starting from the BAMBA parking lot, the area is crisscrossed by trails. There is a moderate diversity of native plants in the canopy, including oaks and tuliptrees. The shrub and herbaceous layers have a mix of native and invasive plants.

The abundance and diversity of invasive plants, which are primarily in the shrub layer, varies across this management unit. The invasive plants increase moving out from the BAMBA parking lot, along the baseball fields, and along the trails. This initial area was cleared prior to 1937 and did not fully reforest until after 1971. There is also a young pole stand of birch trees near the baseball fields due to a past disturbance event. This pole stand has a variety of invasive plants including tree-of-heaven.

The invasive plants significantly decrease moving to the center of the park until the top of the hill. This area has a higher proportion of oak in the canopy and sparser, more open layers under the canopy. This area had less disturbance in the past, remaining largely forested since 1937. Additionally, some seedlings of oaks were noted in the eastern part of this area between the baseball fields and the powerline ROW.

At the top of the hill is a dense patch of invasive plants with some native trees in the canopy. This area was cleared as part of the development of the mountain priori to 1937 and is known as the Cellar. From this area going south and

east until about mid-slope, the invasive plants are also moderate to heavily impacting the ecosystem. Around mid-slope the forest canopy changes to have a higher proportion of oaks and hickories. There are also fewer invasive plants in this area. At the bottom of the slope, tuliptrees increase in prevalence again. Invasive plants are also low in this area.

A skunk cabbage wetland with seeps is present along the northwestern portion of Haag Road. This area has red maples, skunk cabbage, and barberry.

A portion of this management unit includes an Earl Trust property. Within these areas, the primary drivers of management are to protect the land for “the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources”. As such, stewarding the natural and historic resources are of the highest importance. Any trails through these areas should be assessed to determine their necessity and carefully maintained to prevent damage to natural resources. No further trail building or other recreational infrastructure should be allowed in these areas.

current and potential stressors

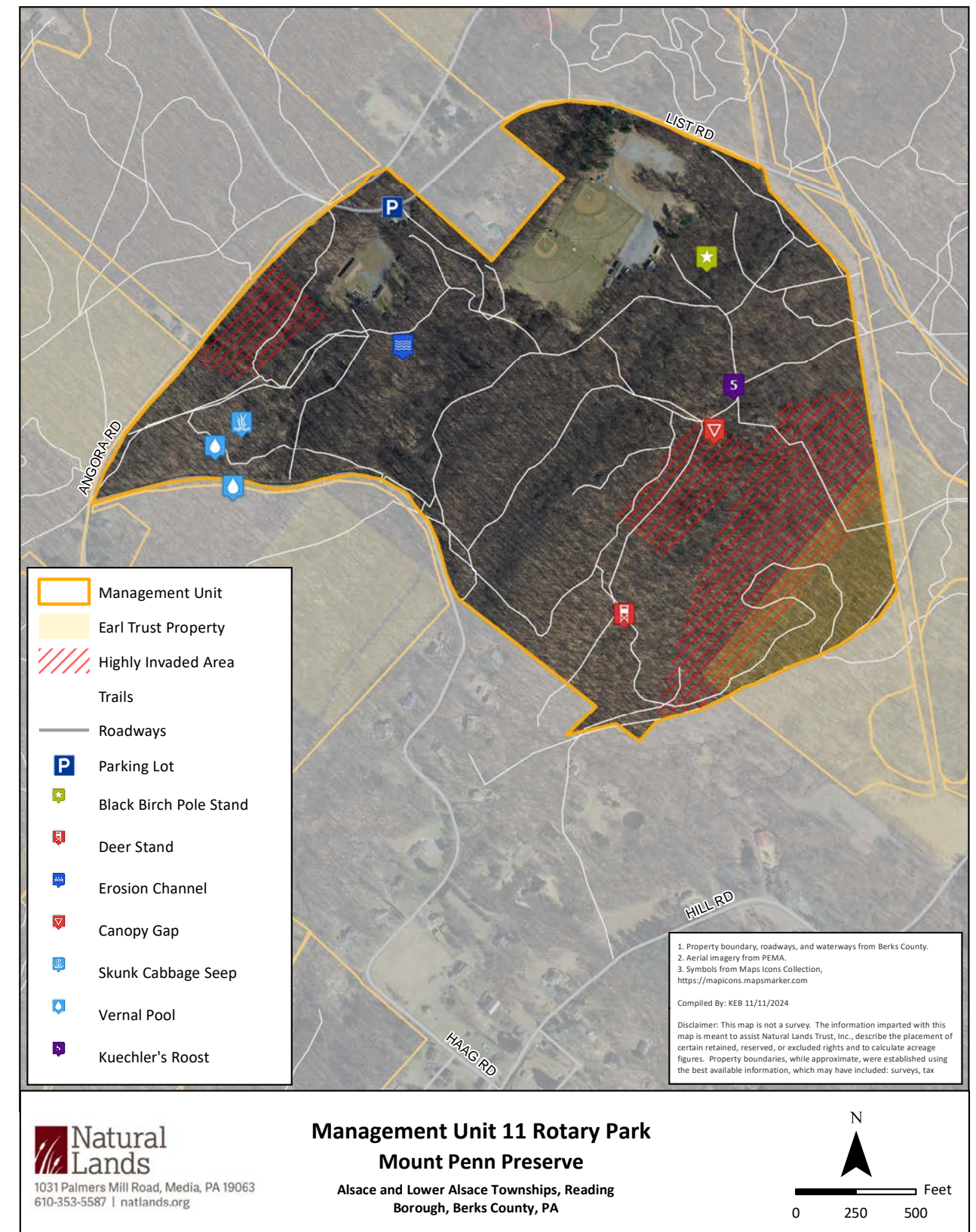
- Invasive plants
- Deer
- Trail development
- Oak wilt
- Climate change

goal

Create a diverse, multi-aged, sustainable forest.

priority level

Medium-High – This management unit, while having areas that are highly invaded, also has a large acreage of higher quality forest with a high proportion of native plants.



management strategies and activities

1. **Invasive plants** – Start with the least invaded areas, then move out to the more degraded areas. This also generally coincides with working from the least to most disturbed areas. Within each area, work from the canopy down to the herbaceous layers.
 - a. Higher quality forests – north central forest, pole stand, and lower elevations of north-facing slope.
 - b. Medium quality forests – upper slope of north-facing slope and area leading out from the BAMBA parking lot.
 - c. Invasive plants throughout higher quality and medium quality include in priority order:
 - i. Control oriental bittersweet, Japanese honeysuckle.
 - ii. Control grape – while not an invasive plant, this plant can become overly aggressive and should be cut back when they threaten trees.
 - iii. Control Norway maple.
 - iv. Control Japanese barberry, autumn-olive, winged euonymus, and shrub honeysuckle.
 - v. Control garlic mustard.
 - vi. Control mile-a-minute.
 - vii. Control Japanese stiltgrass.
 - viii. Control multiflora rose and wineberry.
 - d. Plants in the birch pole stand include in order of priority:
 - i. Control oriental bittersweet.
 - ii. Control tree-of-heaven.
 - iii. Control shrub honeysuckle and wineberry.
 - iv. Control garlic-mustard.
 - v. Control mile-a-minute.
 - vi. Control Japanese stiltgrass.
 - e. Prevent further spread of invasive plants from the central patch of invasive plants.
 - f. Control invasive plants in central invasive patch (the Cellar).
 - i. Control oriental bittersweet.
 - ii. Control Norway maple.
 - iii. Control Japanese barberry, shrub honeysuckle, jetbead, wineberry.
 - iv. Control garlic-mustard.
 - i. Control periwinkle.

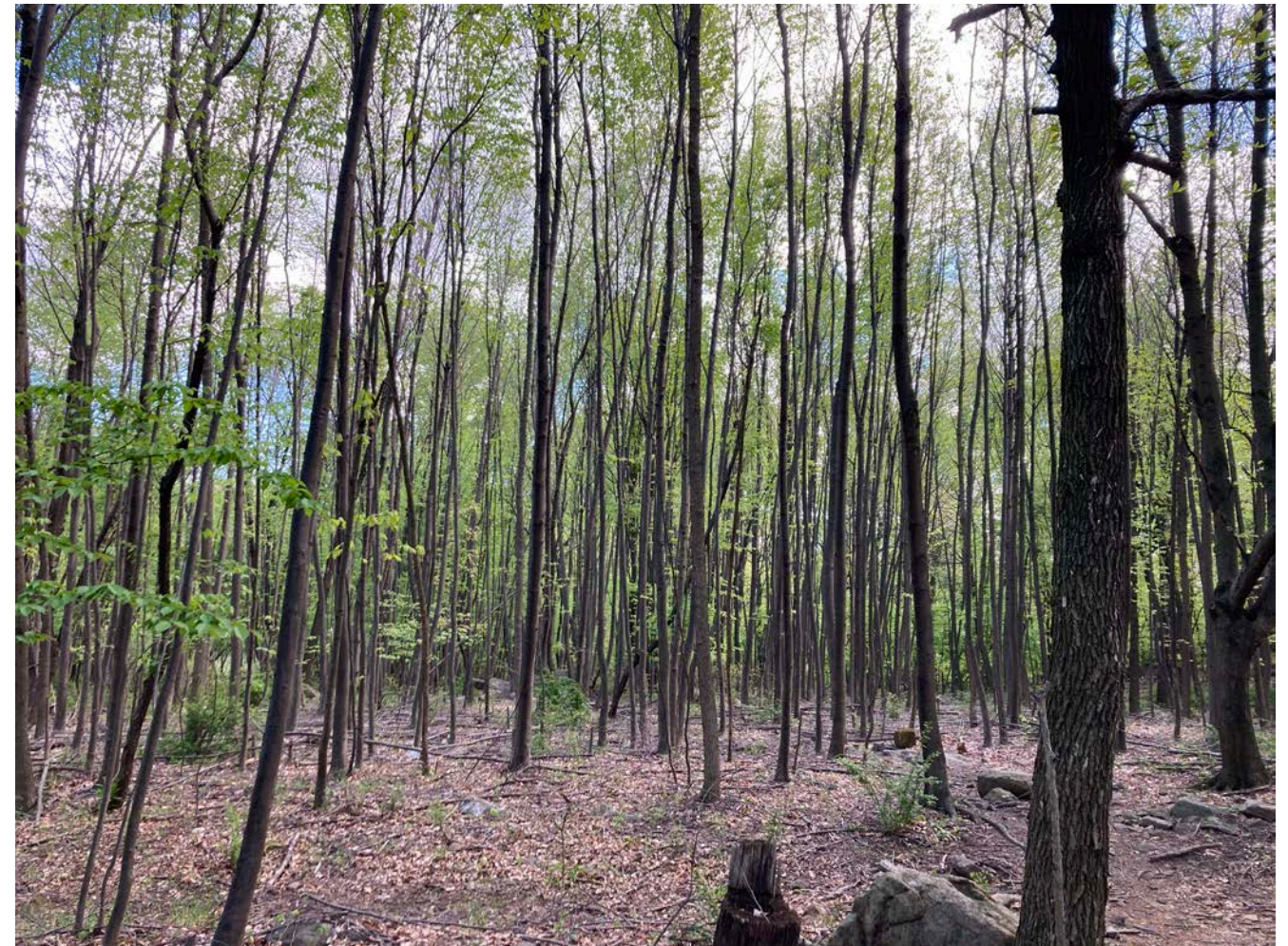
2. **Deer management** – see Preserve wide strategies.
3. **Trails**
 - a. Make sure all trails area carefully planned and necessary prior to creation to reduce impact to natural areas. Avoid areas with native seedlings and saplings to allow for forest regeneration.
 - b. Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.
 - c. Install interpretive signage near BAMBA lot explaining how trails impact the forest and using Leave No Trace language to encourage positive use of trails and discourage social trails.
4. **Potential for oak wilt impact** – Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
5. **Climate change** – The majority of trees species in this management unit are potentially vulnerable to climate change. As such, the sustainability of the forest in the long-term may be put into question because of the current species composition. Any planting projects within this management unit should focus on including a high proportion of native tree species that may be more resilient to climate change.
6. **The Cellar Restoration** – After invasive plant control, it is likely that native plants will need to be planted to restore this forest area. This can include both trees and shrubs as resources allow, prioritizing trees first. Species chosen should increase species diversity and be resilient to climate change.



There are areas within this management unit of oak forest with a native canopy and few invasive plants.



Where the shrub layers are dense within this unit, the shrubs are overwhelmingly invasive species.



The pole stand within this unit is comprised of numerous young birch trees. With a scattering of invasive plants.

unit 12: palustrine forest

property owner(s):

- Berks County

current condition

This management unit is located near Hill Road and includes two sections of palustrine plant communities on either side of the powerline ROW. The western side has a stream running through it and has multiple seeps and springs. The eastern side is consistently wet throughout and also has seeps and springs. The canopies of these areas have a moderate diversity of native plants, with tuliptree, oaks, beech, and birch. The understory is also comprised of native species. Blueberry is common throughout. The herbaceous plants also reflect the mesic nature of the area with skunk cabbage, ferns, sedges, jewelweed, and arrow arum among the native plants present. There is a low level of invasive plants, with multiflora rose, barberry, and Japanese stiltgrass being the most common. The understory is sparser in the eastern side and there is a higher proportion of Japanese stiltgrass. The powerline through the center of this management unit can be a source of invasive plants, as can the nearby meadows and adjacent mixed hardwood forest to the west which has a high proportion of invasive plants. These areas have been forested since at least 1937, likely due in part to the wet soils, seeps, and springs.

This entire management unit is part of the Earl Trust. Within these areas, the primary drivers of management are to protect the land for “the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources”. As such, stewarding the natural and historic resources are of the highest importance. Any trails through these areas should be assessed to determine their necessity and carefully maintained to prevent damage to natural resources. No further trail building or other recreational infrastructure should be allowed in these areas. This restriction is also supported by the presence of the natural resources.

current and potential stressors

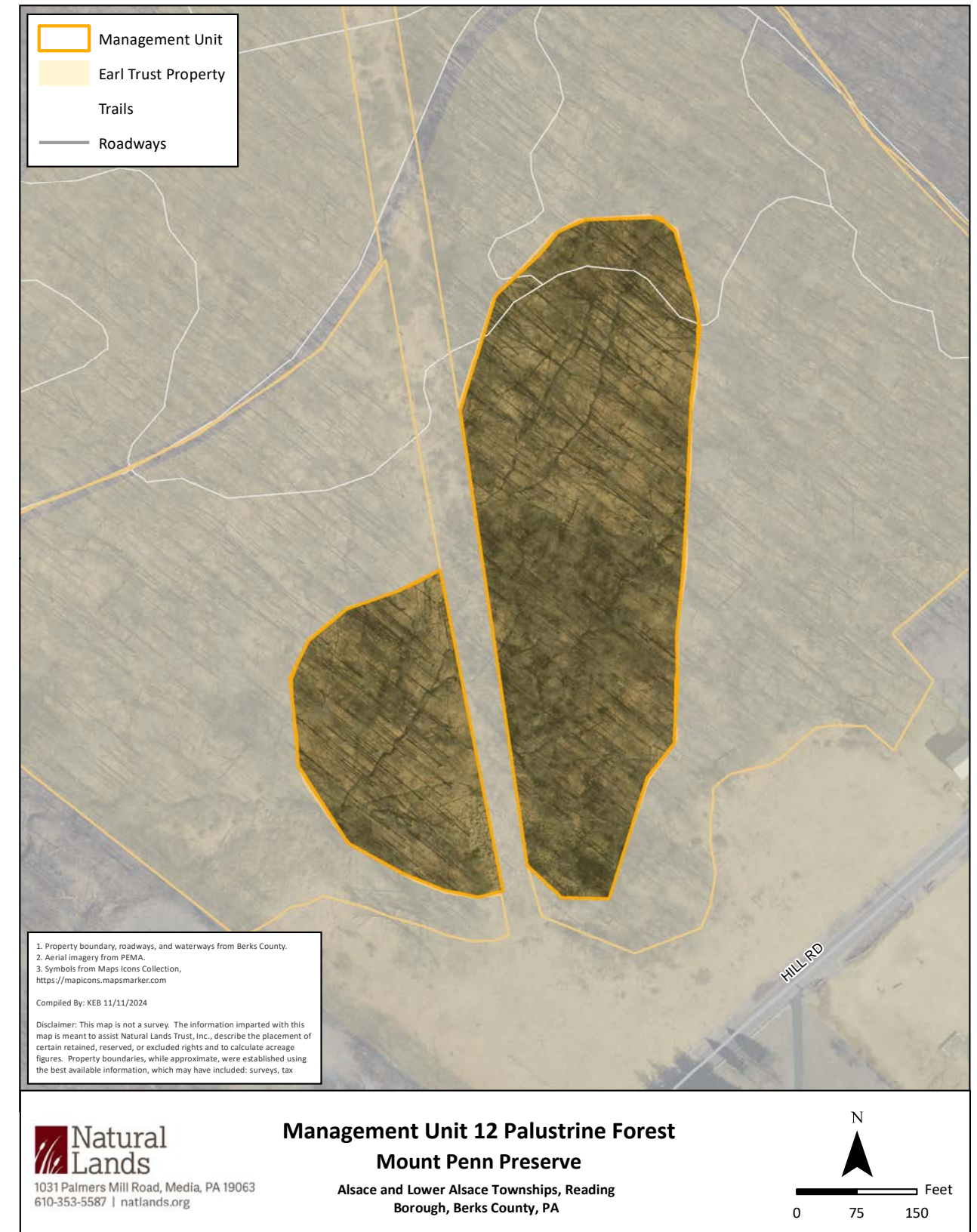
- Invasive plants
- Powerline
- Deer
- Climate change
- Recreation
- Beech leaf disease

goal

Support a sustainable palustrine forest that is resilient to climate change and protected from encroachment from recreational infrastructure.

priority level

High – The water resources make this a high priority area for conservation and stewardship.



management strategies and activities

1. **Invasive plants** – Take a top-down approach to control invasive plants. All management will have to be carefully carried out to avoid disrupting the stream, seeps, and springs. Any herbicides used will have to be approved for use near water resources.
 - a. Control Japanese knotweed.
 - b. Control Japanese hops, porcelain berry, and oriental bittersweet.
 - c. Control Norway maple.
 - d. Control multiflora rose and barberry.
 - e. Control mugwort and Japanese stiltgrass.
 - f. Prevent reestablishment of invasive plants after management and establishment of new invasive species.
2. **Deer management** – see Preserve wide strategies.
3. **Climate change** – Climate change is likely to change precipitation trends, as is already being seen in more frequent and severe storms and periods of decreased rainfall and drought during the summer. To protect the hydrology of this area, create a 300-foot non-disturbance buffer around these areas, making sure to include all seeps, springs, and areas with hydric soils. No mechanical equipment should be used in these areas and trails should also be avoided. Equipment and trails can disrupt the microtopography of the area, redirecting water through ruts or small changes to the topography. This can be enough to dry out areas, stressing plants already established. Maintaining the health of this area will also protect the capacity of this wetland to retain and infiltrate stormwater.

4. **Recreation** – As mentioned above, avoid creating trails within this management unit to protect the sensitive water resources and abide by the Earl Trust restrictions.
5. **Beech leaf disease** – It is likely that the beech trees will be affected by beech leaf disease in the near future. Without treatment, which would like be expensive, they are likely to die. Land managers should be prepared to plant native trees to replace the beech trees if they die.
6. **Restoration** – This area should be monitored to see how native plants respond as deer and invasive plants are controlled and as the impacts of BLD and climate change are felt. If there is die off in the canopy and/or no to minimal regeneration of native plants, planting may be needed to support the canopy and improve resiliency.



A stream, seeps, and springs support the mesic plants within this community.

unit 13: hill road west mixed hardwood forest

property owner(s):

- Berks County

current condition

This area is a mixed hardwood forest with a moderate diversity of native plants in the canopy and understory. It runs from the property boundary to the west and the dry oak forest to the east. This area has a canopy of native species dominated by tuliptree and black birch. There are infected ash trees present in the canopy. The shrub and herbaceous layers are heavily populated by invasive plants. Of particular note is the dense patch of Japanese knotweed at the southern boundary of this management unit. There are also invasive vines reaching into the canopy. This management unit has been forested since at least 1937, however the area just south of this unit was cleared of vegetation prior to 1937 and is now a meadow, creating an area of disturbance and edge that is prime habitat for invasive plants. Additionally, the powerline abuts cuts through the center of the unit. This can also introduce invasive plants into the management unit.

Only one trail crosses through this management unit, cutting across the northeast corner. This entire management unit is part of the Earl Trust. Within these areas, the primary drivers of management are to protect the land for “the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources”. As such, stewarding the natural and historic resources are of the highest importance. Any trails through these areas should be assessed to determine their necessity and carefully maintained to prevent damage to natural resources. No further trail building or other recreational infrastructure should be allowed in these areas. This restriction is also supported by the presence of the natural resources.

The management unit abuts a palustrine forest to the east, a privately owned, forested parcel to the west, and a higher quality forest within the Preserve to the north.

current and potential stressors

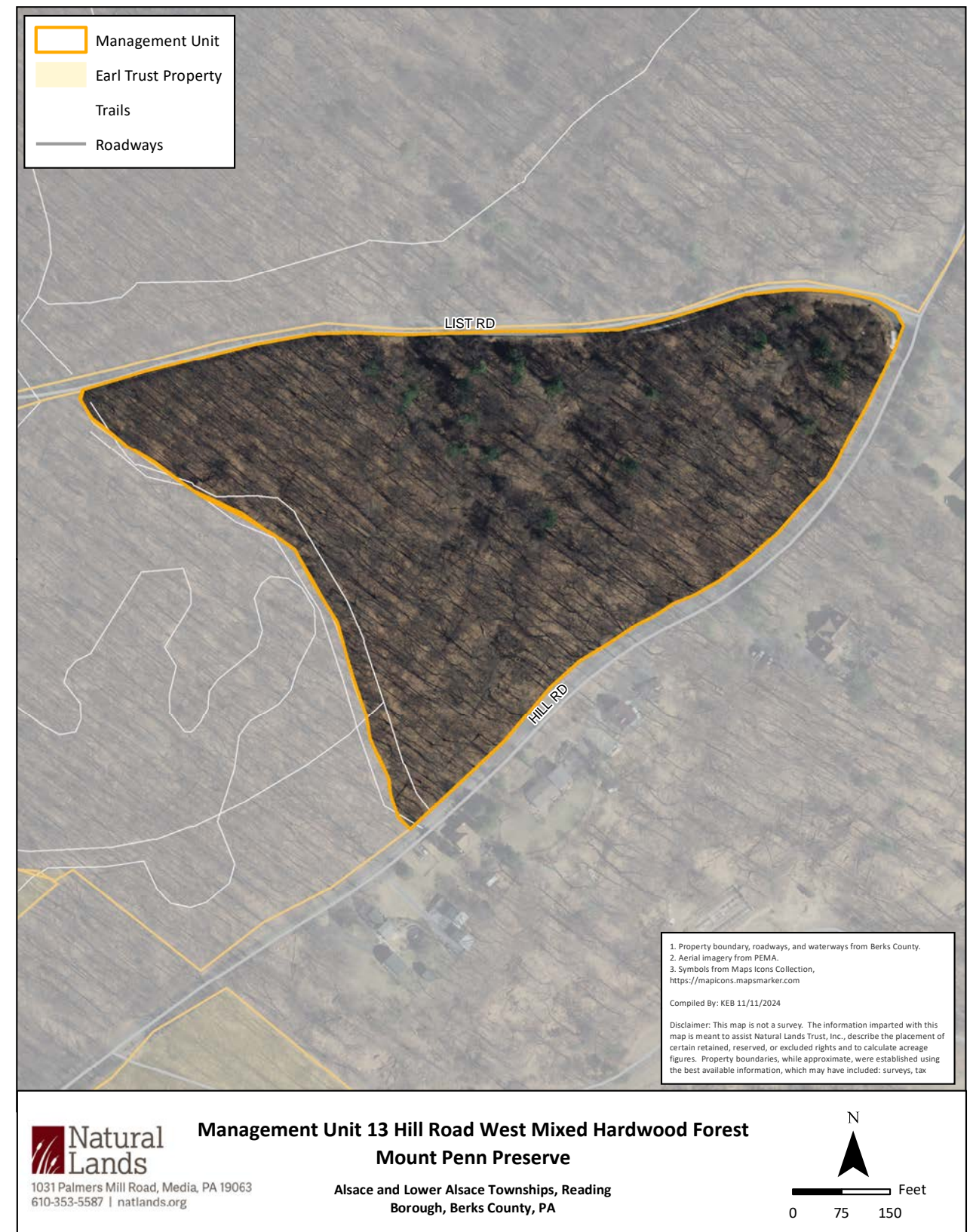
- Invasive plants
- Deer
- Proximity to powerline
- Ash die off

goal

As this area abuts a palustrine forest, a wetland, and a higher quality forest, the short-term goal should be to prevent the spread of invasive plants from this management unit into adjacent plant communities. Long-term, efforts should focus on invasive plant control and reestablishment of native plants to create a sustainable forest.

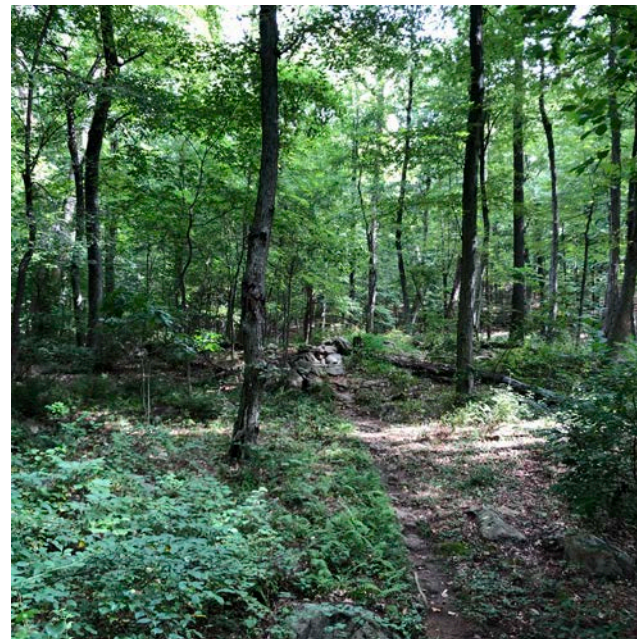
priority level

Medium – This area is already highly compromised by invasive plants, however its proximity to higher quality areas increase its importance for management.

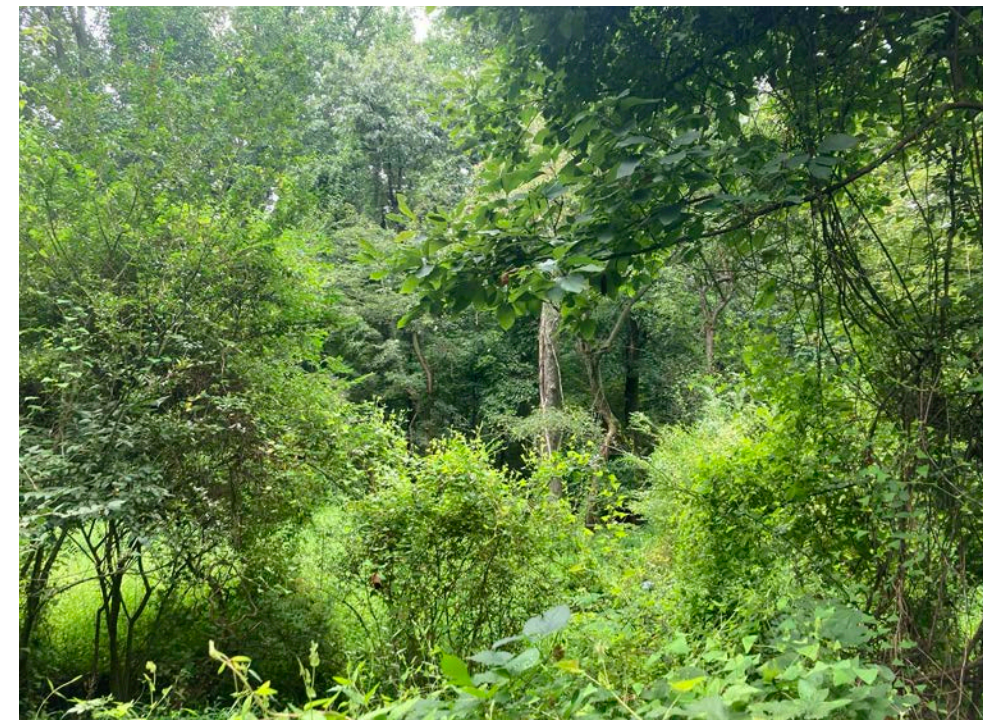


management strategies and activities

1. **Invasive plants** – Prevent spread of invasive plants into adjacent higher quality areas and address invasive plants in a top-down approach.
 - a. Prevent spread of invasive plants into adjacent palustrine forest and northern higher quality forest, particularly Japanese knotweed.
 - b. Control oriental bittersweet and Japanese honeysuckle.
 - c. Control Japanese knotweed.
 - d. Control winged euonymus, barberry, wineberry, privet, multiflora rose, and shrub honeysuckle.
 - e. Control mile-a-minute and garlic-mustard.
 - b. Control Japanese stiltgrass and periwinkle.
 - f. Prevent reestablishment or introduction of new invasive plants.
2. **Deer management** – see Preserve wide strategies.
3. **Restoration** – As the ask trees are dying, land managers should be prepared to control invasive plants that establish in any resulting forest gaps. Additionally, until deer reach a sustainable level that allows for native plant regeneration, land managers should be prepared to plant trees to fill canopy gaps and areas newly opened after invasive plant control. Tree selection should add a variety of species and prioritize native species that are likely less vulnerable to climate change.
7. **Recreation** – Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.



The interior of the forest also has primarily invasive plants in the shrub layer, however the invasive plants are less dense and shorter than those around the edges.



The edges of this forest have dense shrub layers comprised of invasive plants.



Invasive vines, like the oriental bittersweet in the center of this picture, stretch up into the canopy, compromising the health of the trees.

unit 14: hill road east mixed hardwood forest

property owner(s):

- Berks County

current condition

This management unit contains a forest with a mix of native plants in the canopy. It is one of the few areas within the Preserve that has conifer trees. The understory is also comprised of native plants. There is an abundance of invasive shrubs, vines, and herbaceous plants that dominate this plant community. The issue with this high level of invasive plants is demonstrated in the canopy gap at the northeastern corner of the management unit. Trees have died in this area, leaving large gaps that are heavily populated with invasive plants. There are no native seedlings or saplings to restore the canopy. Historically, most of the eastern half of this management unit was cleared prior to 1937. The entire management unit had returned to forest by 1958.

current and potential stressors

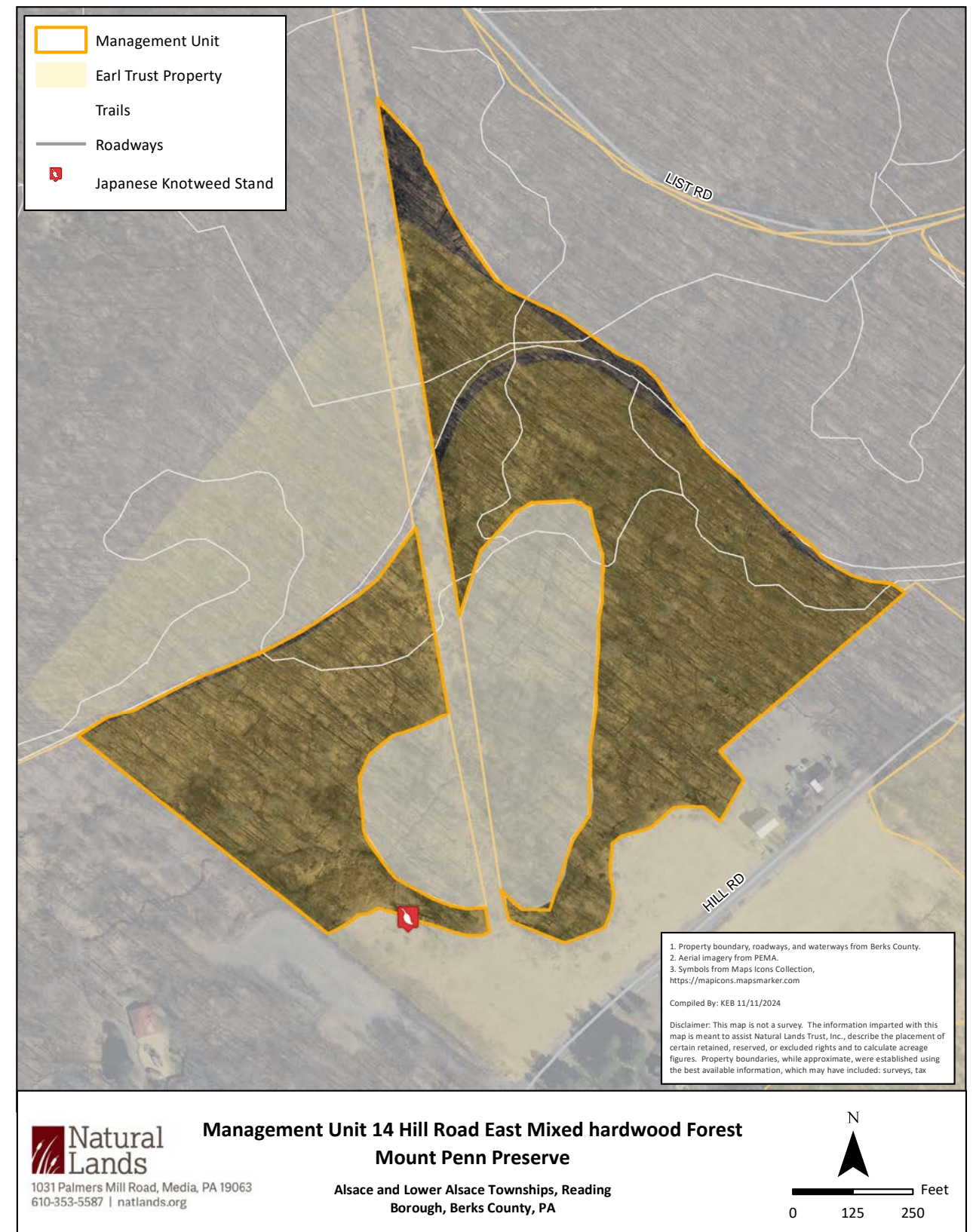
- Invasive plants
- Deer
- Canopy gaps

goal

In the short term, the goal should be to prevent further spread of the invasive plants into the adjacent forests that are of high quality. Long-term, this area will need significant restoration efforts to manage the invasive plants and establish a native plant community. This may first result in a plant community with scattered trees and low-growing native plants.

priority level

Low – This area is loosing its canopy and heavily degraded by invasive plants.



management strategies and activities

1. **Invasive plants** – This area can be addressed in a top-down strategy. The canopy gap area is primarily invasive plants with few remaining native plants. As such, it can be managed with a forestry mulcher.
 - a. Control oriental bittersweet.
 - b. Control tree-of-heaven.
 - c. Control shrubs – barberry, shrub honeysuckle, multiflora rose, wineberry, and privet.
 - d. Control garlic-mustard.
 - e. Control mile-a-minute.
 - f. Control Japanese stiltgrass.
2. **Deer management** – see Preserve wide strategies.
3. **Restoration** – This area will need to be restored after invasive plant control by planting native species. As much of this area will need to be fully restored, land managers should focus on adding a diversity of plants and favoring species likely to be resilient to climate change.



With the exception of the canopy gap area, this forest has full canopy and shrub layers with moderate density of plants in the understory and herbaceous layers. However, the majority of shrub and herbaceous plants are invasive.

unit 15: list to hill road oak forest

property owner(s):

- City of Reading

current condition

This area is a dry oak heath forest with oaks, beech, and tuliptree in the canopy. The understory is also comprised of native species. The shrub and herbaceous layers contain primarily native plants, but there are some invasive plants, including barberry and Japanese stiltgrass. The low invasive pressure is likely due in part to the fact that the area has been forested since at least 1937. In general, the understory, shrub, and herbaceous layers are very sparse. There are scattered oak seedlings throughout this unit. Multiple trails meander through this management unit, including the Gravity Trail. This management adjoins the dry oak health forest within Antietam Lake Park.

current and potential stressors

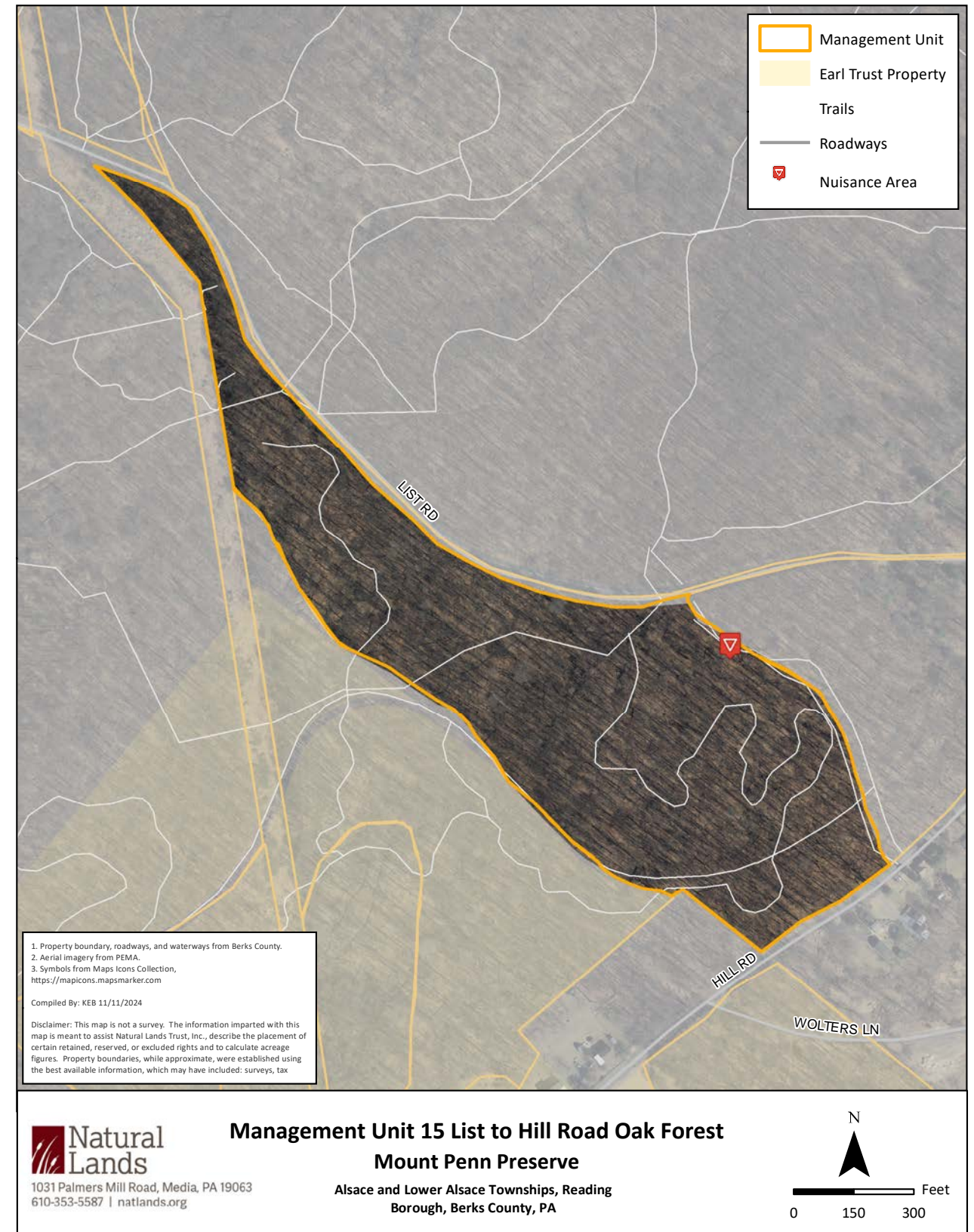
- Invasive plants
- Deer
- Climate change
- Beech leaf disease
- Oak wilt
- Degraded adjacent forest

goal

Improve forest conditions to have a dense, native understory, shrub, and herbaceous layers.

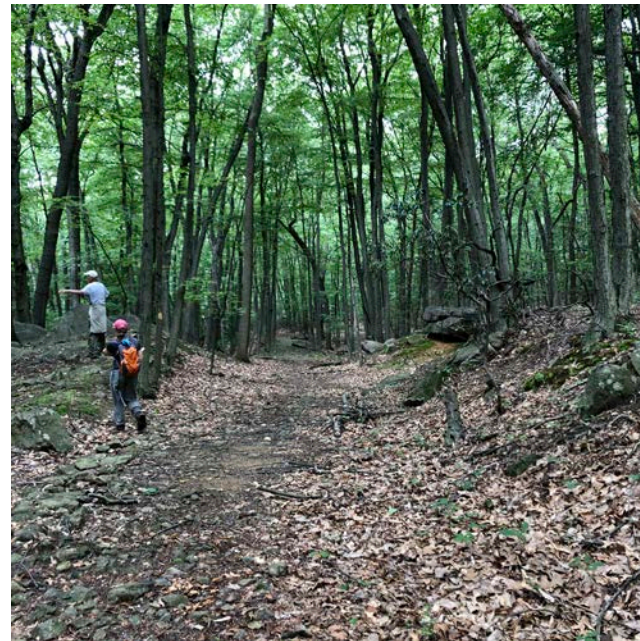
priority level

High – This area has a healthy, native canopy and low invasive plant pressure.



management strategies and activities

1. **Invasive plants** – take a top-down approach to control invasive plants.
 - a. Control wineberry and barberry.
 - b. Control Japanese stiltgrass.
2. **Deer management** – see Preserve wide strategies.
3. **Beech leaf disease** – If BLD leads to beech tree die off and canopy gaps without any advanced regeneration to replace the canopy trees, control invasive plants and plant native trees to fill the gaps.
4. **Potential for oak wilt impact** – Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
5. **Climate change** – A large proportion of the tree species are potentially vulnerable to climate change. To support a more sustainable forest, plant understory trees that are projected to be less vulnerable to climate change, such as shagbark hickory.
6. **Wildlife habitat** – The high proportion of larger oak trees can provide habitat for bats and mast for other wildlife. Bolstering the diversity of native trees in the canopy and adding to the structural density of the shrub layer can help improve habitat. Select a sub-area of this management unit to add native plants, protecting them from deer. Canopy gaps are prime areas to do this.
7. **Trails** – Minimize the impact of trails by carefully considering any future expansion of trails.



The Gravity Trail cuts a wide path through this management unit.



Oaks and mountain laurel are common throughout this management unit.



Dead trees, either standing or fallen, improve habitat quality by providing food and shelter for wildlife.

unit 16: old orchard

property owner(s):

- Berks County

current condition

This management unit includes a mixed hardwood forest and two clearings with herbaceous and invasive plants. This area was cleared for use as an orchard prior to 1937. The area transitioned out of active management to an unmanaged plant community sometime between 1970 and 1995. Currently, this area is the most heavily invaded portion of the Preserve. This is the only location within the Preserve where bamboo was found during the site visits. This invasive plant is incredibly invasive. Preventing further spread outside of this management unit should be a high priority for management. This management unit abuts private parcels and a meadow area owned by Berks County. The meadow area was previously used as a leaf collection area.

This entire management unit is part of the Earl Trust. Within these areas, the primary drivers of management are to protect the land for “the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources”. As such, stewarding the natural and historic resources are of the highest importance and any future recreation should be designed to avoid impacts to the natural resources.

current and potential stressors

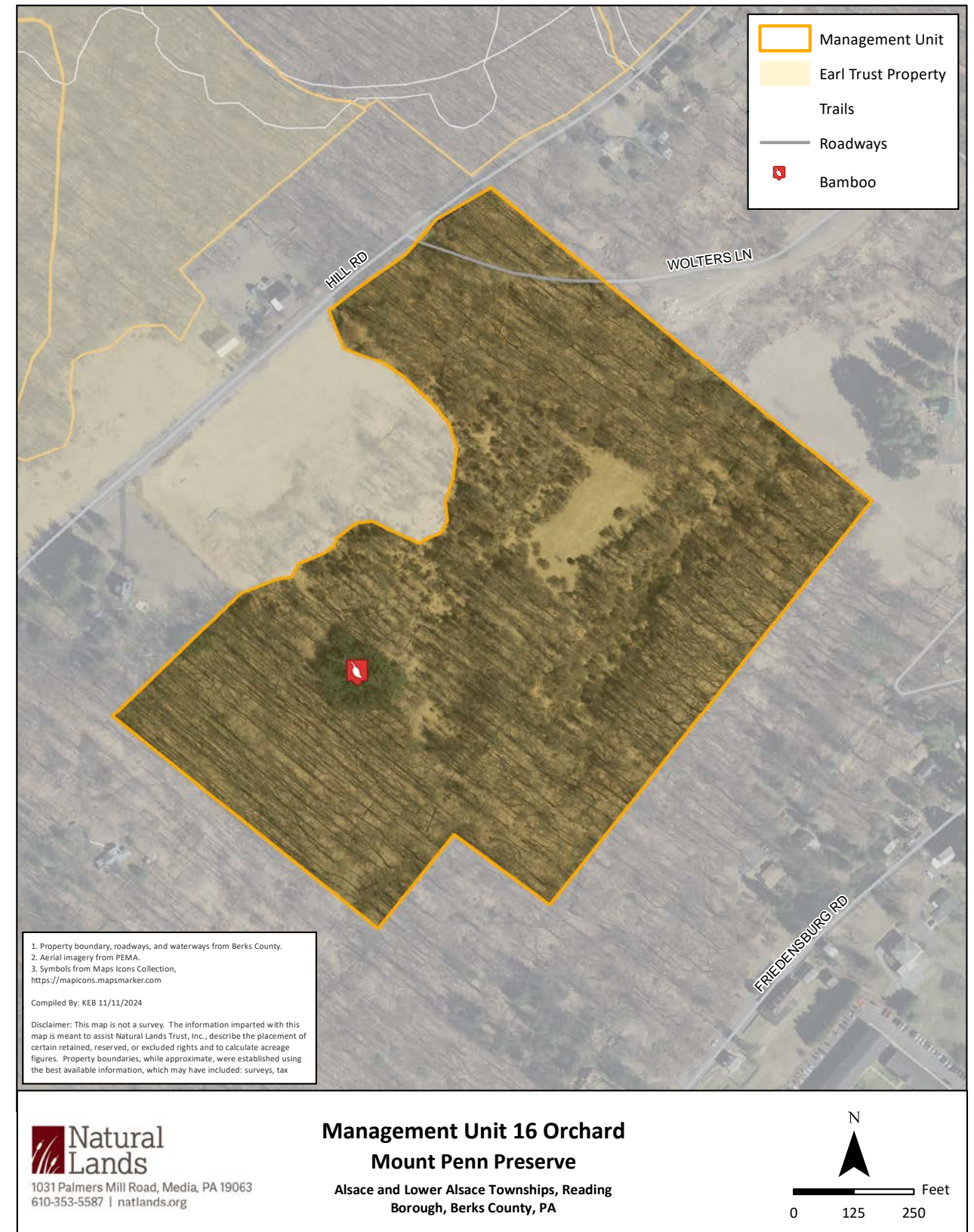
- Invasive plants
- Deer
- Canopy gaps

goal

Control the bamboo to prevent further spread and eventually eradicate it. Control the other invasive plants and restore a native forest to the area.

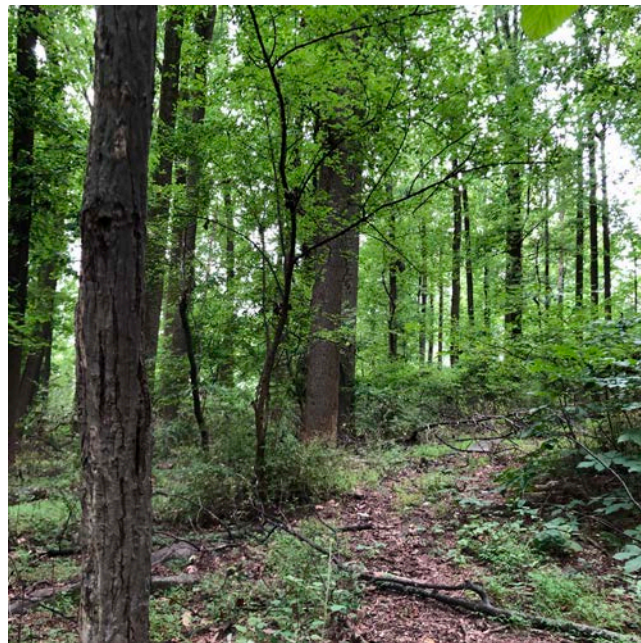
priority level

Low – This area is already heavily degraded. As such, there is less ecological value to conserve compared to other areas within the Preserve.



management strategies and activities

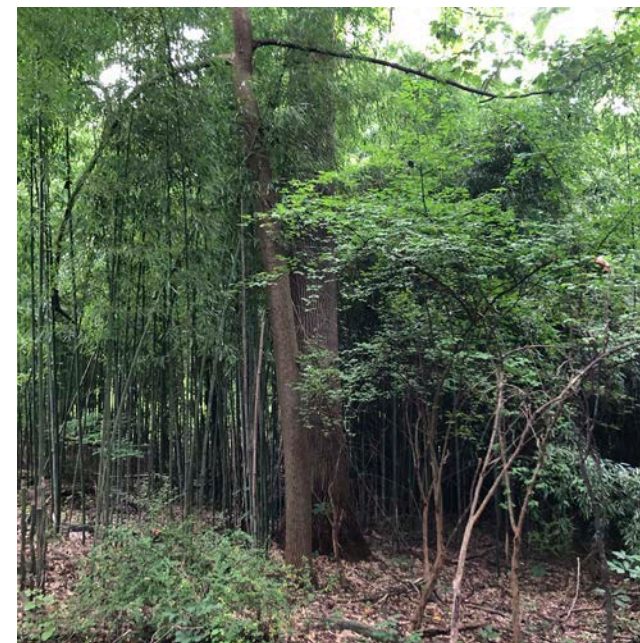
1. **Invasive plant control** – Focus first on controlling bamboo. From there, start in the lesser invaded areas closer to Hill Road and then moving the southeastern boundary of this management unit. In general, use a top-down approach.
 - a. Prevent further spread of bamboo and talk to neighbor to encourage them to control their stand of bamboo.
 - b. Control bamboo. This will take multiple years.
 - c. Control oriental bittersweet and English ivy.
 - d. Control Norway maple.
 - e. Control tree-of-heaven.
 - f. Control shrubs – wineberry, shrub honeysuckle, barberry, privet, and autumn olive.
 - g. Control garlic-mustard.
 - h. Control mile-a-minute.
 - i. Control Japanese stiltgrass.
 - j. The densest area of invasive plants around the clearings in the center of the management unit may be able to be addressed using a forestry mower due to the density of the invasive plants. However, this will also depend on the ability to get the equipment into the center of the management unit.
2. **Deer management** – see Preserve wide strategies.
3. **Restoration** – Restoration will be necessary after invasive plant control. Within areas the still have native trees, focus on planting trees and shrubs to improve forest conditions. Within the central clearing, the County can restore the area by planting saplings to create a young forest. A shrubland could be planted in the clearing instead, but this would require the most resources to maintain, including fencing and either periodic removal or trees or cutting ½ of the area every 3-10 years.



This is a dense forest with native plants and in the canopy and understory and invasive plants dominating the shrub and invasive layers.



Invasive vines are present throughout this unit.



There is a dense stand of bamboo within this forest, which is a significant issue as bamboo spreads aggressively and is especially difficult to control.

unit 17: egelman's upland

property owner(s):

- **City of Reading**

current condition

This management unit comprises the western portion of Egelman's Park, with a hillside sloping from the parking area upward to the west. The bottom portion of the slope contains a tuliptree-beech-maple forest which then transitions to an oak mixed hardwood forest near the top of the slope. In general, there is a moderate diversity of native plants in the canopy and understory layer. The tuliptree-beech-maple forest has dense understory and shrub layers. The oak forest has understory, shrub, and herbaceous layers are generally sparse until a dense patch of barberry towards the top of the hill. Historically, portions of the lower elevation area were cleared of forest. The area was fully forested again by 1958.

current and potential stressors

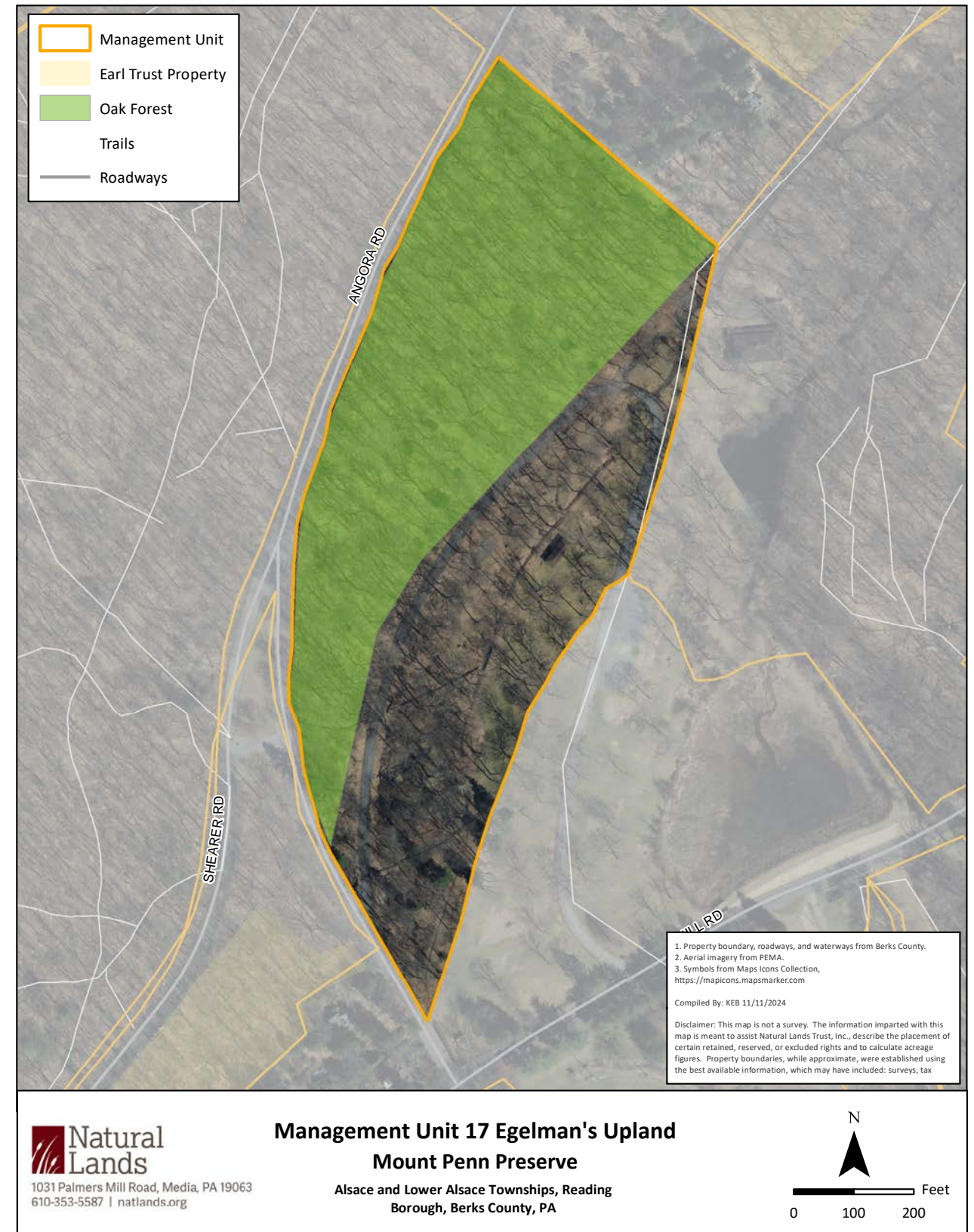
- Invasive plants
- Deer
- Proximity to recreation area
- Beech leaf disease
- Oak wilt
- Climate change
- Canopy gaps

goal

Support a sustainable, diverse forest that can management stormwater as it flows downhill toward Rose Valley Creek.

priority level

Medium – This area is of moderate ecological quality and is also important for protection of water quality for Rose Valley Creek.



management strategies and activities

2. **Invasive plants** – start with most aggressive species first and then move from less to more degraded areas.
 - a. Prevent further spread of periwinkle and barberry.
 - b. Starting in the less invaded areas, which in this case is downhill, control shrubs and then herbaceous invasive plants.
 - c. Control barberry.
 - d. Control periwinkle.
3. **Deer management** – see Preserve wide strategies.
4. **Climate change** – DCNR’s and NIACS’s projections for the tree species within this management are very uncertain. As such, land managers should monitor the health and regeneration of native trees within this unit. If tree decline is not, or if native regeneration does not reestablish even with deer and invasive plant control, land managers should plant climate resilient species to help sustain the canopy over time.
5. **Beech leaf disease** – If beech trees die from BLD and create canopy gaps, control invasive plants that grow in gaps. Protect any naturally regenerating native plants with fencings. If no natural regeneration, plant tree saplings to fill growing space and restore the canopy over time.
6. **Potential for oak wilt impact** - Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
7. **Canopy gaps** – Currently, invasive plants fill the existing canopy gaps. Invasive plants should be managed and then the gaps replanted with native tree species. Protect plantings from deer with fencing or tree tubes. If the deer population reaches a sustainable level, regeneration of native plants can fill canopy gaps. Invasive plants will still likely need to be controlled to support establishment of native plants.



A mixed hardwood forest is present along the mid and lower slope of the hill.



The forest switches to an oak forest near the top of the hill.

unit 18: egelman's east

property owner(s):

- **City of Reading**

current condition

This management unit is located east of the Gravity Trail within Egelman Park. The forest between the Gravity Trail and the stream has oaks, beech, hickory, and tuliptree in the canopy. The understory is dominated by sassafras and pawpaw. The shrub and herbaceous layers are heavily invaded. Rose Valley Creek flows north to south through this unit. There are also seeps and springs, as well as a manmade basin along the stream. There is a large canopy gap from ash die off that is dominated by invasive plants.

Across the stream, invasive plant prevalence decreases. This forest canopy also has a high proportion of tuliptree, but has different canopy species including black locust, white oak, Norway maple, and sugar maple. The understory is comprised of native plants. Most of the species present in the shrub layer are invasives, but there is spicebush, which is a native plant. The herbaceous layer has a mix of native and invasive species.

The northern portion of this property was mostly cleared prior to 1937. By 1958, the entire management unit was under forest cover.

current and potential stressors

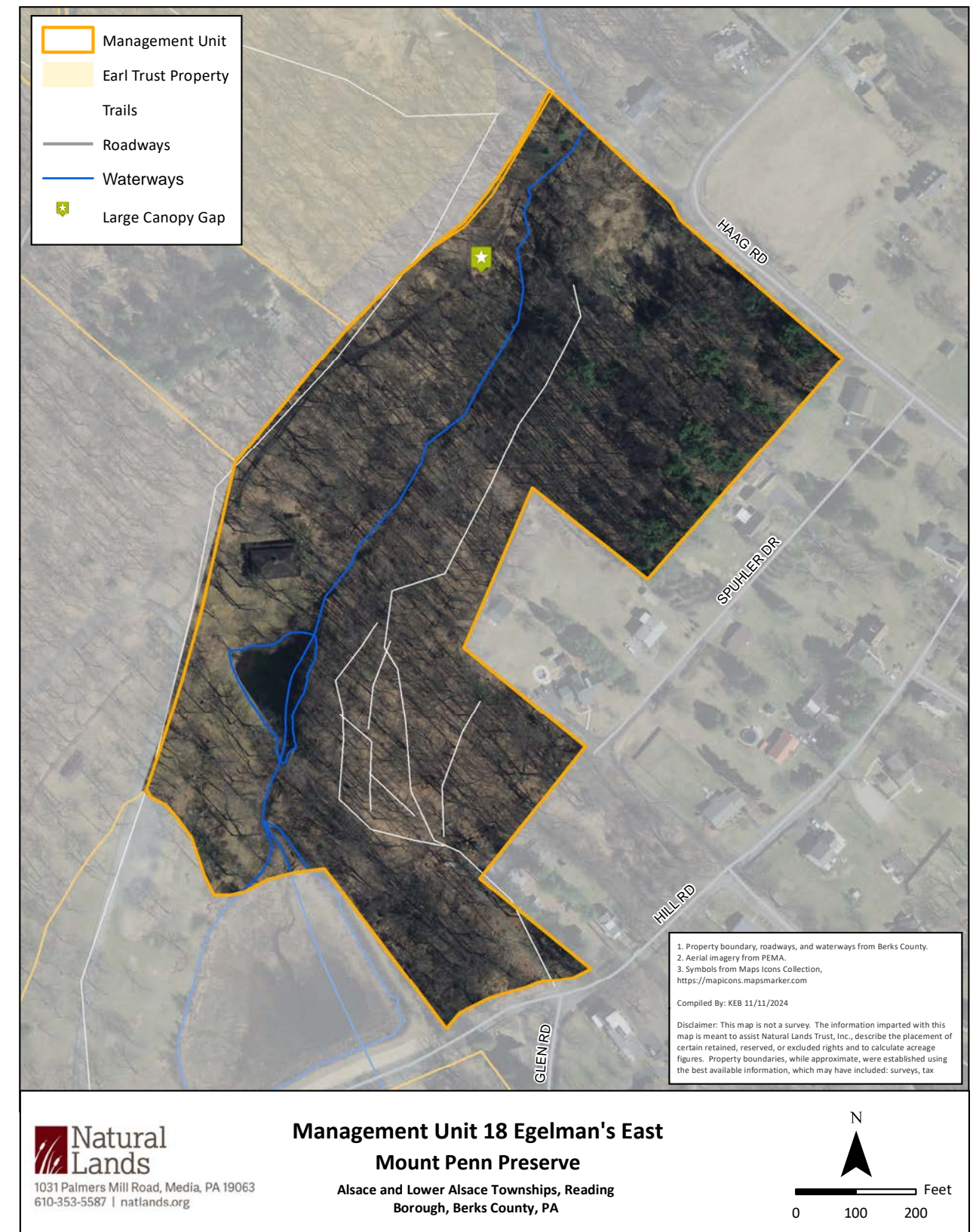
- Invasive plants
- Deer
- Canopy gaps from ash tree die off
- Climate change

goal

Create a sustainable, dense riparian buffer that is comprised of native plants to protect water quality and support wildlife. Create early successional habitat in the canopy gap.

priority level

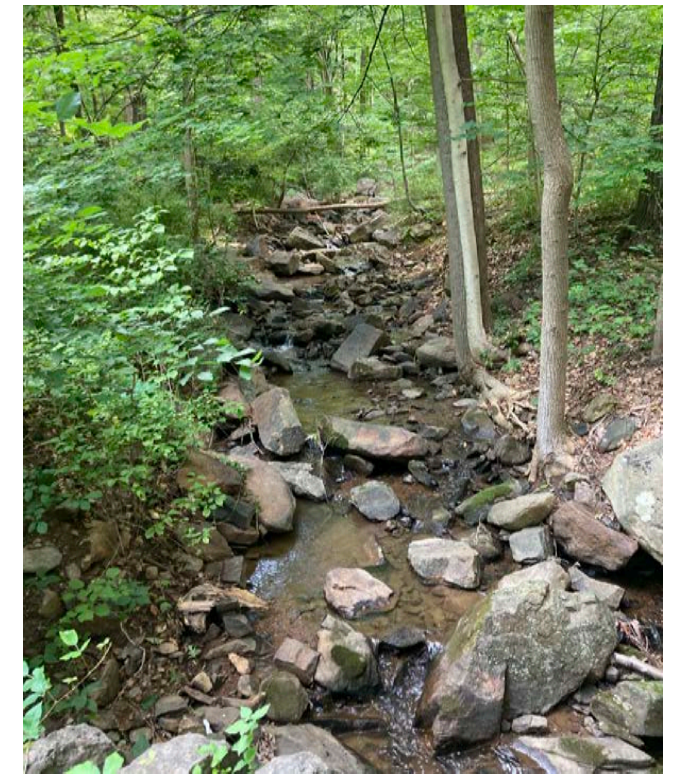
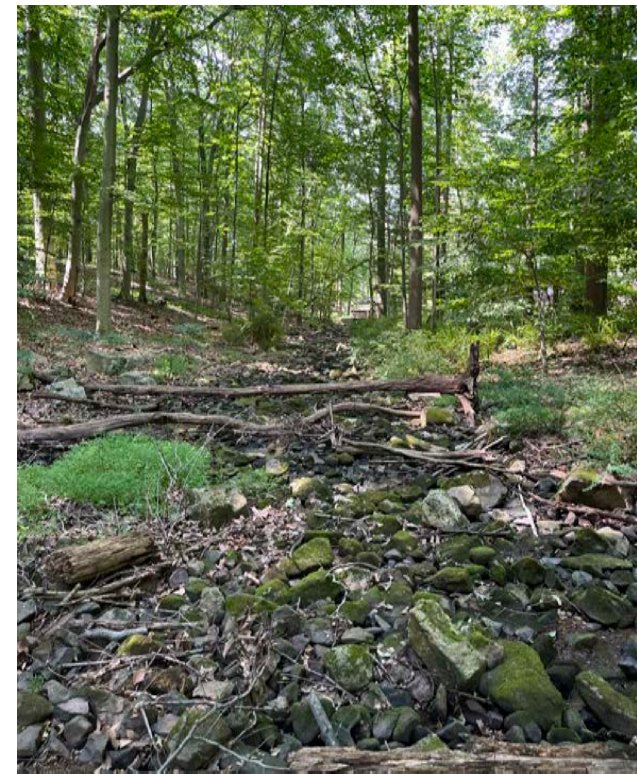
Medium-High – This unit is important as a riparian buffer for the stream.



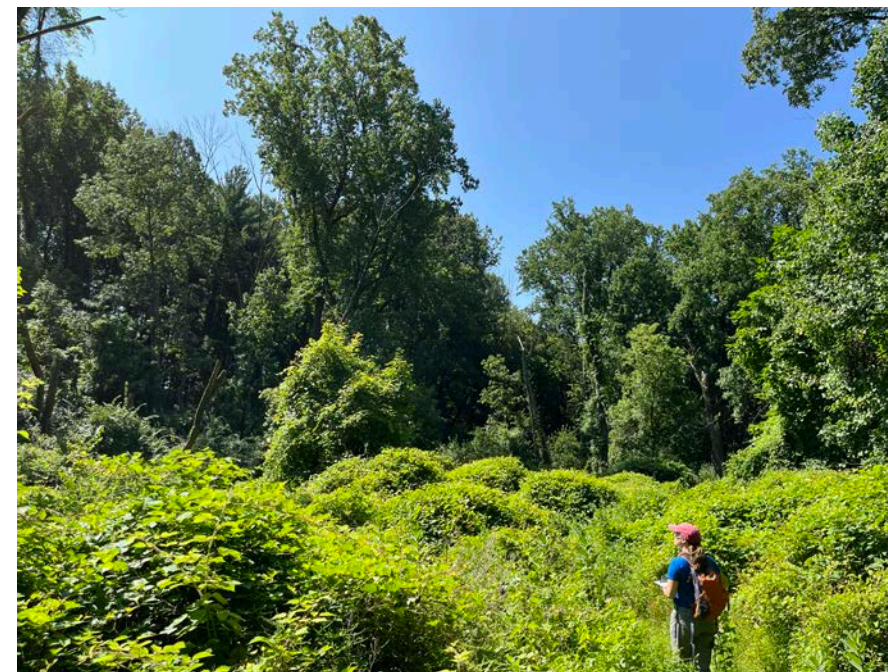
management strategies and activities

1. **Invasive plants** – Start in the less invaded area east of the stream. Then move to the area between the stream and Gravity Trail, leaving the canopy gap area until funds are available to fully address the invasive plants and replant the gap area (see 3. Canopy gap below).
 - a. Forest east of the stream
 - i. Control barberry, wineberry, and shrub honeysuckle.
 - ii. Control Japanese stiltgrass.
 - b. Forest between Gravity Trail and stream
 - i. Control oriental bittersweet and porcelain berry.
 - ii. Control Norway maple.
 - iii. Control shrubs – barberry, jetbead, multiflora rose, and shrub honeysuckle.
 - iv. Control Japanese stiltgrass, mugwort, and periwinkle.
2. **Deer management** – see Preserve wide strategies.
3. **Riparian buffer** – After invasive plant management, plant native trees and shrubs to improve the riparian buffer, focusing efforts first within 150 feet of the stream.
4. **Canopy gap**
 - a. Using herbicides and mechanical equipment such as a forestry mower as feasible with access, control invasive plants within the canopy gap. Repeated treatments will likely be needed due to the pervasiveness of the invasive plants.
 - b. After invasive plant control, plant native trees to restore the forest. Protect trees with tree tubing until able to withstand deer browsing and rubbing.
 - c. If resources allow, add scattered shrubs to add habitat diversity for birds. Select a diversity of trees, favoring species projected to be resilient to climate change. Protect shrubs with fencing until able to withstand deer impacts, typically 5+ years.
 - d. Continue to control invasive plants as needed to prevent reestablishment.
 - e. Allow to naturally progress from early successional habitat to young forest and so on.

5. **Climate change** - The majority of the tree species present may be vulnerable to climate change. As such, when doing planting to restore canopy gaps or other areas after invasive plant removal, favor species that are more likely to be resilient to climate change. Additionally, if existing trees begin to show signs of stress and/or if native species do not naturally regenerate even after deer and invasive plant control, add a diverse mix of native trees and shrubs.



A stream runs through this management unit. Trees create a riparian buffer, however the shrub layer is sparse and could be improved for better water quality protections.



The large canopy gap within this unit can be restored to control the invasive plants and restore a native plant community.

unit 19: haag road to egelman's forest

property owner(s):

- **City of Reading**

current condition

This forest has a native canopy that is dominated by tuliptrees and oaks. The rest of the canopy species and the understory tree species are all native. Generally, the understory and shrub layers are sparse. The exception to this are patches with dense populations of barberry and other invasive plants. The close proximity to Angora Road and Haag Road means that this area is more open to dumping. There are some dumped metal barrels within this area. There are streams, seeps, and springs within this management unit. There is also a vernal pool near a culvert under Haag Road. The Gravity Trail runs through this unit.

A portion of this management unit includes an Earl Trust property. Within these areas, the primary drivers of management are to protect the land for “the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources”. As such, stewarding the natural and historic resources are of the highest importance. Any trails through these areas should be assessed to determine their necessity and carefully maintained to prevent damage to natural resources. No further trail building or other recreational infrastructure should be allowed in these areas.

current and potential stressors

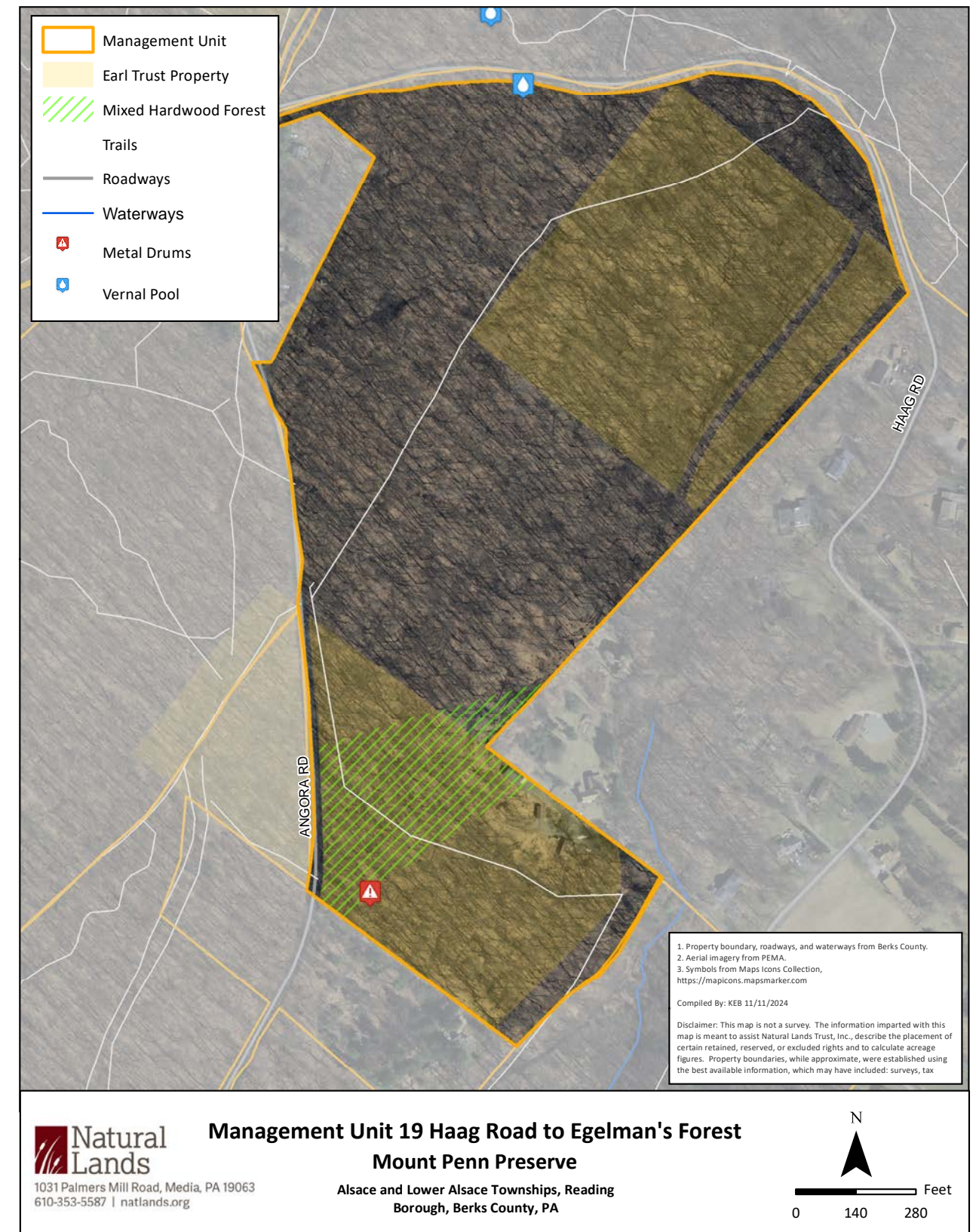
- Invasive plants
- Deer
- Oak wilt
- Dumping
- Climate change

goal

Control the invasive plants and remove dumped materials to create a healthy forest with abundant native plants in all forest structures.

priority level

Medium-High This area has sensitive water resources that should be protected through stewardship of the forest and avoiding disturbance within 300 feet of the water resources.



management strategies and activities

1. **Invasive plants**
 - a. Control Norway maple.
 - b. Control barberry and wineberry.
2. **Deer management** – see Preserve wide strategies.
3. **Dumping** – remove existing metal barrels and any other debris.
4. **Water quality protection**
 - a. Protect existing native plants.
 - b. Avoid disturbance within 300-feet of the water resources in order to protect the native vegetation and microtopography. This includes avoiding use of vehicles and not building trails within this buffer.
 - c. If native plants are not regenerating even with invasive plant control and deer management, increase the density of forest canopy, understory, and shrub layers.
5. **Potential for oak wilt impact** - Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
6. **Climate change** – Projections show that the majority of the tree species may not be affected by climate change under a low emissions scenario. However, nearly all of the tree species are likely to decrease in prevalence under a high emissions scenario. As such, land managers should monitor for tree health and regeneration. If trees start to decline and/or if regeneration is not noted even after invasive plant and deer management, land managers should consider planting trees that are projected to be less vulnerable to climate change.
7. **Recreation** - Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.



Much of the forest is comprised of native plants and has a sparse shrub and herbaceous layer.



There is a skunk cabbage wetland within this forest due to the presence of springs.

unit 20: rose valley creek

property owner(s):

- City of Reading

current condition

This management unit includes the riparian forest along Rose Valley Creek and the oak forest in the upland areas of Mineral Spring Park. The riparian forest is comprised of native species and is dominated by tuliptree. The ash trees within this plant community have already died due to emerald ash borer. The understory is a mix of native and invasive plants. The shrub and herbaceous layers are dominated by invasive plants and have few native species. Of particular concern is Japanese knotweed which spreads easily along waterways. Historical aerial photography shows that this area was a patchy forest in 1937. This patchiness persisted into the 1970s. The low native plant diversity and high proportion of invasive plants make this a lower quality plant community.

This oak forest has a high diversity of native plants in both the canopy and understory. Oak seedlings were noted in the southeastern portion of this unit during the site visit. However, the shrub and herbaceous layers are moderately to heavily invaded. Of particular concern in this plant community are wisteria and Japanese knotweed. The invasive plants are particularly dense near the ballfield and along the Gravity Trail corridor. Conditions improve toward the center of this management unit, away from disturbances associated with the ballfield, roads, and private development. There is also dead ash in this plant community. The majority of this plant community has been in forest since at least 1937.

The oak forest is part of the buffer between Rose Valley Creek and Glen Road, as such it is important for stormwater management. In some areas the oak forest is within 100 feet of the stream, a critical buffer area for water quality. Climate change will make this buffer area even more important for water quality protection as more severe storms increase the risk of flooding, introduction of contaminants through stormwater, and erosion.

The Gravity Trail runs along Rose Valley Creek, crossing it twice within this management unit. There is also additional infrastructure including two gazebos. There are sections of mown lawn along the stream. Additionally, parts of the stream have been channelized with stone walls and channel bed.

A portion of this management unit includes an Earl Trust property. Within these areas, the primary drivers of management are to protect the land for “the purpose of conserving, protecting, and maintaining the scenic and historic character and the agricultural, the woodland, and the watershed resources”. As such, stewarding the natural and historic resources are of the highest importance. Any trails through these areas should be assessed to determine their necessity and carefully maintained to prevent damage to natural resources. No further trail building or other recreational infrastructure should be allowed in these areas.

current and potential stressors

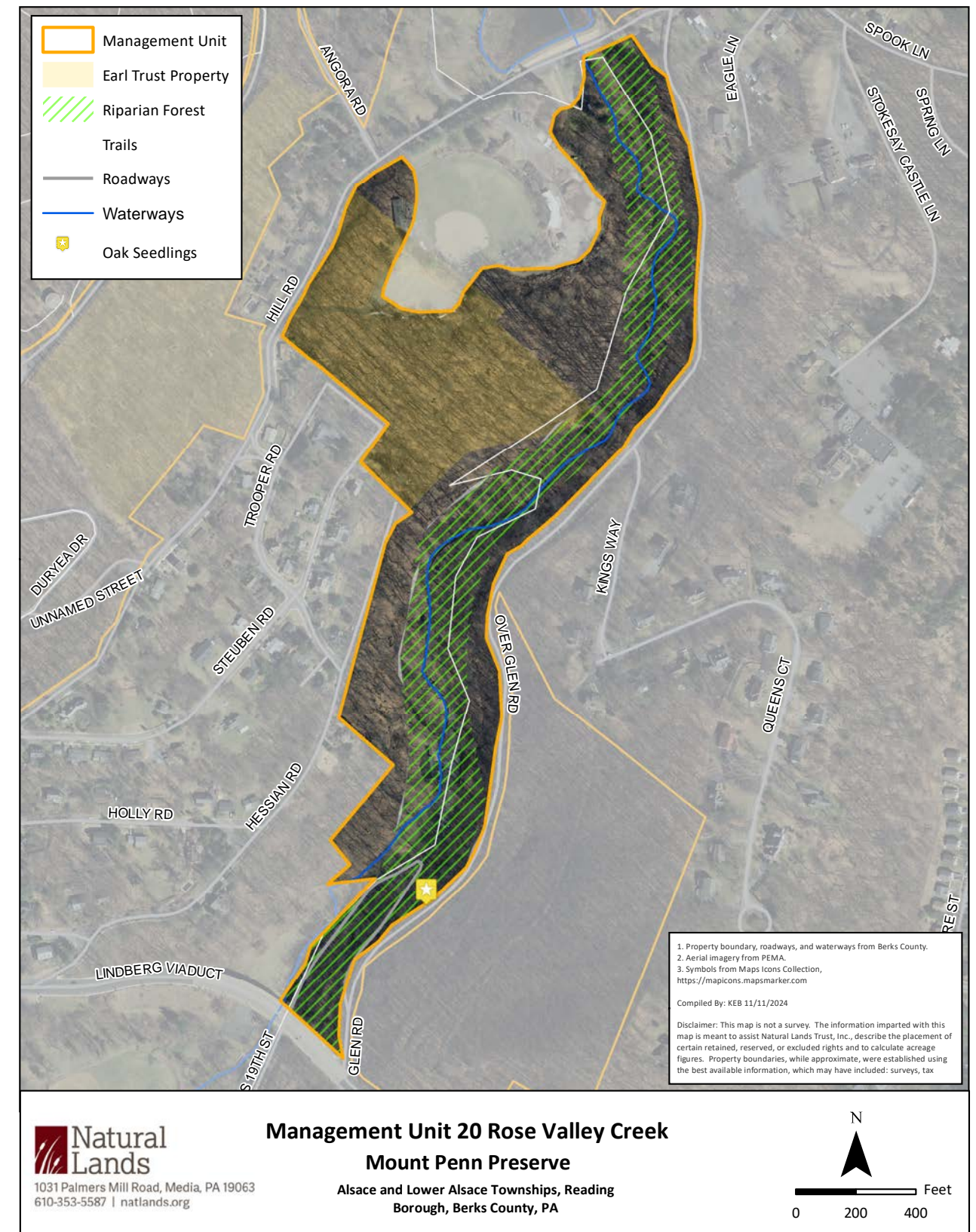
- Invasive plants, particularly Japanese knotweed and wisteria
- Deer
- Proximity to residential development
- Climate change
- Ash die off
- Oak wilt
- Recreation
- Erosion

goal

Create a resilient forest that can act as an effective riparian buffer for Rose Valley Creek with a high diversity and abundance of native plants.

priority level

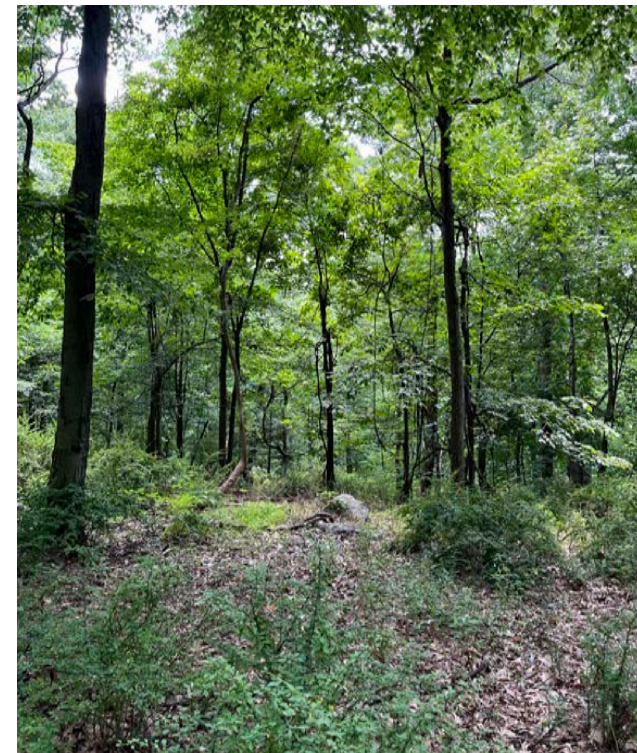
High – This management unit is important for protecting the water quality of Rose Valley Creek and downstream waters.



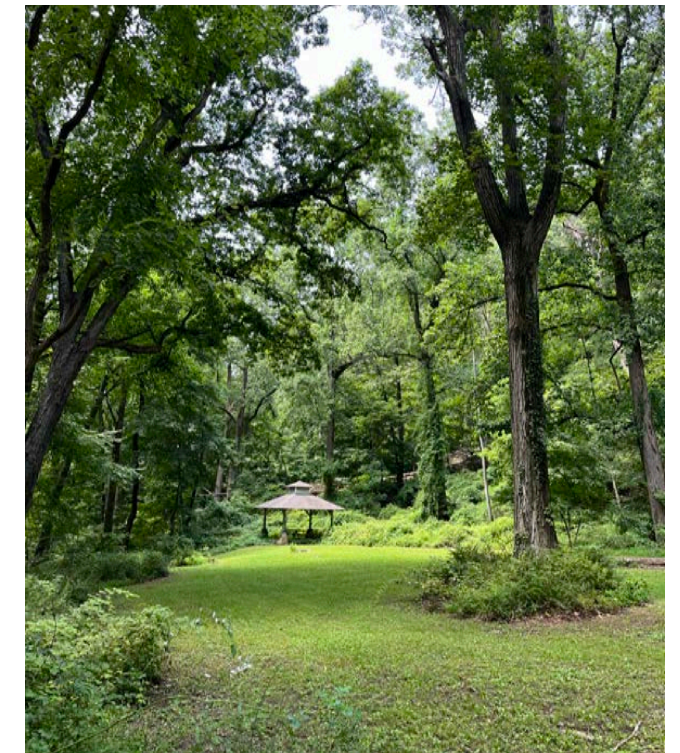
management strategies and activities

1. **Invasive plants**
 - a. Control Japanese knotweed.
 - b. Control wisteria.
 - c. Control vines – porcelain berry, oriental bittersweet, Japanese hops, and English ivy.
 - d. Control Norway maple and mimosa.
 - e. Control Japanese princess-tree.
 - f. Control shrubs -wineberry, shrub honeysuckle, barberry, and linden viburnum.
 - g. Control garlic mustard.
 - b. Control periwinkle and Japanese stiltgrass.
2. **Deer management** – see Preserve wide strategies.
3. **Potential for oak wilt impact** - Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
4. **Climate change**
 - a. The increased frequency and severity of storms caused by climate change will further increase the importance of a healthy riparian buffer. To help mitigate increased volume and velocity of stormwater, increase the density of native plants within 100 feet of the stream by planting shrubs and trees.
 - b. Under a lower emission scenario, the tree species within this unit may remain stable. However, under a higher emission scenario, a majority of tree species may be vulnerable to climate change. This is particularly true for the riparian forest. Any restoration plantings should increase the diversity of native species and favor native species that are more likely to be resilient to climate change.
5. **Maintain property boundaries**
 - a. See preserve-wide strategies for marking boundaries.
 - b. Monitor boundaries annually and note any boundary issues.
 - c. If issues arise, reach out to neighbors to explain boundaries and promote positive relationships.

6. **Restoration** – Restoration will likely be needed after invasive plant control and where ash trees die and leave canopy gaps.
 - a. After invasive plant control within the riparian forest, plant with native species. Utilize a variety of species to increase diversity and favor species that are likely to be resilient to climate change.
 - b. As the ash trees die, canopy gaps are likely to form as there is currently limited natural regeneration. As canopy gaps form, control invasive plants and plant native tree species.
7. **Riparian buffer improvement** – Increase the density of native plants in the understory and shrub layers to better manage stormwater prior to it reaching Rose Valley Creek and to prevent more erosion channels from forming. This is particularly important for areas within 100 feet of the stream. This can be done by planting native trees and shrubs. Additionally, naturally regenerating trees and shrubs can be protected from deer by fencing or tree tubes.
8. **Recreation**
 - a. The Gravity Trail and associated infrastructure are firmly established recreation and cultural resources. Invasive plant control around the historic resources should be carefully carried out to protect the resources. Land managers can consider native landscaping plantings around the historic resources to reduce lawn space where not utilized and to replace invasive plants.
 - b. Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.
9. **Erosion** – Erosion was noted within the forest near the ballfield. Planting additional vegetation near the start of the erosion channel, particularly trees and shrubs, can help slow and disperse stormwater. If erosion issues still persist, GSI can be used around the edge of the ballfield area to control stormwater.



The edge of the oak forest near the ballfield has a high prevalence of invasive plants, which then decreases towards the interior of the forest.



The Gravity Trail and structures like this gazebo are important features of this management unit.



Stormwater runoff from the nearby parking lot has created an erosion channel within the forest.

unit 21: pendora oak forest

property owner(s):

- **City of Reading**

current condition

This management unit is comprised of an oak mixed hardwood forest with moderate diversity in the canopy. The lower layers are sparse with few plants and limited diversity. There is also low invasive plant pressure. Historically, this area has been forested since at least 1937. No trails cross through this management unit. This area is adjacent to residential properties, which could cause problems with encroachment or invasive plant encroachment.

current and potential stressors

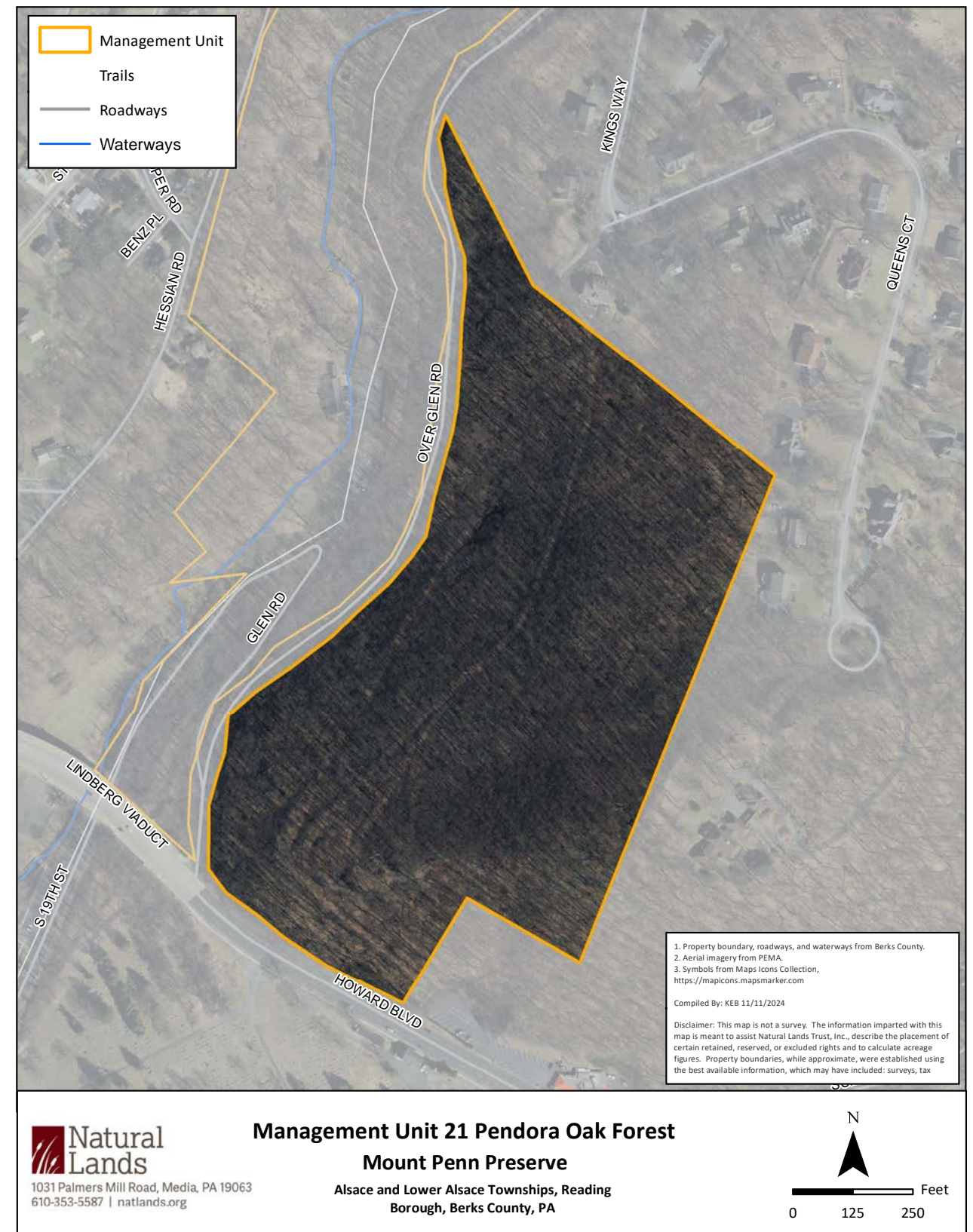
- Invasive plants
- Deer
- Oak wilt
- Climate change
- Adjacent private landowners

goal

Maintain diversity in the canopy and increase native plant abundance and diversity in the lower layers. Protect this area from further establishment of invasive plants.

priority level

High -This area has relatively high ecological quality compared to the rest of the Preserve. As such, this area should be a priority for stewardship.



management strategies and activities

1. **Invasive plants**
 - a. Control jetbead.
 - b. Control Japanese stiltgrass.
 - c. Prevent reestablishment of invasive plants after management and establishment of new invasive species.
2. **Deer management** – see Preserve wide strategies.
3. **Potential for oak wilt impact** - Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
4. **Climate change** – Most of the native tree species present are likely to be vulnerable to climate change under a high emissions future. Understory plantings of trees projected to be more resilient to climate change can help support long-term forest sustainability.
5. **Maintain property boundaries**
 - a. See preserve-wide strategies for marking boundaries.
 - b. Monitor boundaries annually and note any boundary issues.
 - c. If issues arise, reach out to neighbors to explain boundaries and promote positive relationships.



This management Unit has a forest with a healthy canopy and sparse understory made up mainly of mountain laurel.

unit 22: antietam road east

property owner(s):

- Berks Nature
- Berks County

current condition

This management unit is relatively narrow and runs along Antietam Road. It contains an oak-mixed hardwood forest at the lower elevations. This forest has a moderate diversity of native plants in the canopy and understory, a high proportion of invasive plants in the shrub layer, and a mix of invasive and native plants in the herbaceous layer. There are dense patches of privet, and a dense patch of vines in the center of the forest. There are also canopy gaps from dead ash trees. Historic remnants include stone walls.

The forest at the top of the ridge and land east of the ridge has a much more limited number of invasive plants in the canopy and understory. The area is heavily degraded and there is a high proportion of native plants in the shrub and herbaceous layers.

current and potential stressors

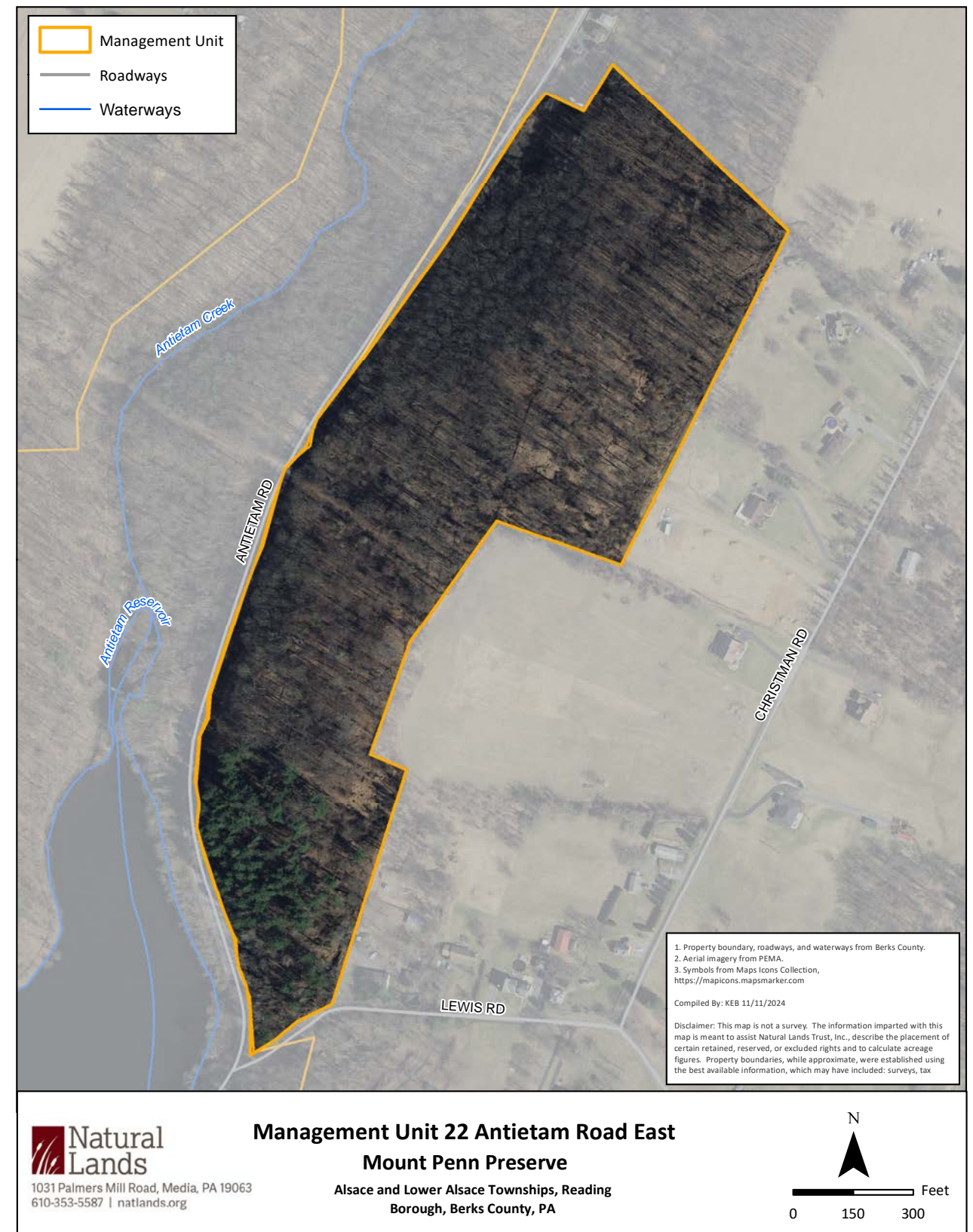
- Invasive plants
- Deer
- Canopy gaps
- Roadside proximity
- Private property proximity
- Climate change

goal

Address invasive plants and canopy gaps to create a sustainable forest.

priority level

Medium-Low This forest area is already impacted by invasive plants and canopy gaps. It is also disconnected from the bulk of the forests within the Preserve, making any of the impacts here more isolated.



management strategies and activities

1. **Invasive plants** – Take a top-down approach across this management unit.
 - a. Control Japanese honeysuckle and oriental bittersweet.
 - b. Control tree-of-heaven.
 - c. Control shrub honeysuckle, privet, wineberry, barberry, and multiflora rose.
 - d. Control garlic-mustard.
 - e. Control Japanese stiltgrass.
2. Deer management
3. **Canopy gaps** – Control invasive plants and plant gaps with native trees and/or shrubs. Protect plantings with tree tubes or fencing. If there are trees or shrubs naturally regenerating, protect those with fencing or tree tubes. As native plants begin to naturally regenerate and survive as deer are controlled, there will be less of a need for plantings. Retain downed trees for habitat and carbon storage.
4. **Roadside proximity** – As this area is along Antietam Road, there is a risk of lawn debris and trash dumping. The roadside should be monitored regularly for trash and debris and the area cleared as needed. Lawn debris are of particular concern as they can introduce invasive plants.
5. **Private property proximity** – Mark and monitor the boundaries to prevent encroachment. If encroachment occurs, reach out to neighbors to address issue.
6. **Climate change** – A large proportion of trees within this management unit are vulnerable to climate change under a high emissions future. As invasive plants are controlled and canopy gaps addressed, focus on selecting native tree species to plant that may be more resilient to climate change.



The forest at the lower elevation and on the slope has a healthy native canopy and sparse understory, while the forest on the ridge has a similar canopy composition, but more canopy gaps and invasive plants.

UNIT 23: Antietam Lake Park

Natural Lands created a natural resources stewardship plan for Antietam Lake Park in 2018. This plan is still being used and is generally still applicable to current conditions. The following recommendations are additions to the 2018 plan based on changes to the site noted during the 2024 site visits. Additionally, there are two topics below, the Master Plan and Restoration of Antietam Creek, that do not include any recommendations but are still important to note for the context of this plan.

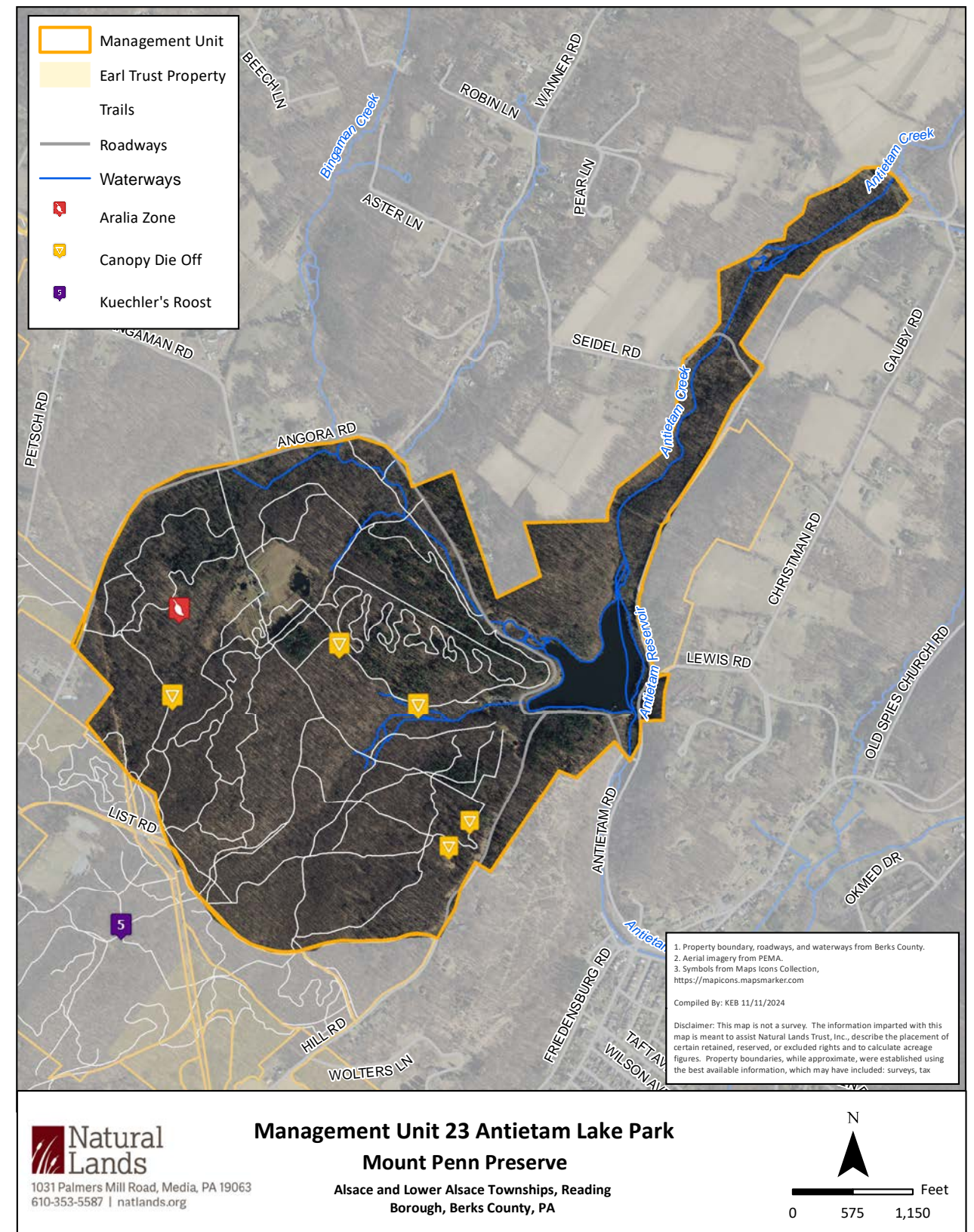
CANOPY LOSS

The most noticeable change within the Park is the loss of conifer and ash trees from the canopy of the mixed hardwood and conifer plantation areas. This loss, be it through age, suppression mortality, natural disturbances, or disease, is creating large gaps in the canopy. Additionally, there is no existing tree understory to replace the dying trees and quickly restore the canopy. There are some scattered young trees that are beginning to emerge above the invasive shrubs that have densely filled these areas. However, these trees are not currently sufficient in number to restore the canopy and they have to compete with invasive plants and deer.

Stewardship efforts in these areas should focus on restoration. This will involve controlling the invasive plants, protecting the existing young native trees from deer, and planting trees and shrubs to fully reestablish the area with native plants. As a start, the County can focus on identifying existing native trees, protecting them with tree tubes, and clearing the invasives back from the trees.

Strategies:

1. Identify young native trees. Clear invasive plants to create a buffer space around the trees and protect them with tree tubes.
2. As resources allow, control the invasive plants within the gaps.
3. After invasive plant control, plant trees and then shrubs to restore the area. Select a variety of native species, including plants that are projected to be more resilient to climate change and trees that can support bat habitat.



DISEASES

There are new diseases moving into the area since the 2018 plan. Of note are oak wilt and beech leaf disease. As with much of the rest of the Preserve, oak wilt is a significant threat as oak is widespread throughout the Park. Beech leaf disease is of more concern in the Park compared to the rest of the Preserve as there is a higher proportion of beech trees. Combined with the conifer tree and ash tree die-off, these diseases threaten the long-term sustainability of the forest.

In addition to monitoring for these diseases and implementing best management practices where feasible, County staff should have a plan in place to support forest restoration if impacted by these or other diseases. This would include protecting naturally regenerating trees – even before any signs of infection in canopy trees, controlling invasive plants, and being prepared to enact large-scale tree plantings if canopy trees die.

There were two other species that were also showing signs or stress or die off – mountain laurel and black birch, though it was unclear if this was caused by disease or a different stressor. Mountain laurel within Antietam Lake Park and along the frontside of the mountain, particularly in the northern half, appear to be dying off with leaf loss and dead branches. While there are diseases that affect mountain laurel, Natural Lands staff could not identify a disease that matches the symptoms seen in the field at this time. Drought could potentially be causing the mountain laurel to die, but that is also uncertain. Staff should continue to monitor the condition of mountain laurel and to see if there is any regeneration.

The second species is black birch. Within the Park, there are areas with black birch that appear to have large cankers and have broken trunks. This could be from canker rot, *Nectria* cankers, or from a different disease. It's also uncertain if the cankers are causing the trees to die, though there does appear to be correlation between the two. An arborist may be able to determine if any disease is present and the cause of mortality. Despite this uncertainty, there are some measures that can be taken even prior to consulting an arborist. Staff can monitor the condition of the birch trees to see if this condition spreads further. Staff should also avoid wounding black birch trees, as that can be a means for canker-causing fungi to infect the tree, and they should work with user groups to ensure that they are also not wounding the trees.

1. Potential for oak wilt impact - Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.
2. Beech leaf disease – If beech trees die from BLD and create canopy gaps, control invasive plants that grow in gaps. Protect any naturally regenerating native plants with fencings. If there is no natural regeneration, plant tree saplings to fill growing space and restore the canopy over time.
3. In potential disease-impact areas, control invasive plants and protect young trees from invasive plants and deer browsing.
4. Monitor the condition of the mountain laurel and check for regeneration.
5. Monitor the condition of black birch. Hire an arborist to assess tree health. Avoid wounding any black birch trees.

INVASIVE PLANTS

No new invasive plants have been noted since the 2018 plan. However, there has been a slight increase in Japanese stiltgrass and an increase in the prevalence of Japanese angelica tree. The stiltgrass can be managed by dedicated hand-pulling efforts, as is currently being done by volunteers, and/or herbicide applications. The extent of the Japanese angelica tree population has expanded in the portion of the Park just north of the Fruit Farm. Though its prevalence has increased, it also appears to be dying from a disease, which may help manage the population. Regardless of if the trees die from disease or management efforts, County staff should be prepared to replant this area with native trees or shrubs to restore habitat and prevent reestablishment of invasive plants.

Berks County has also been able to add a Natural Resource & Trails Supervisor position since the 2018 plan. This allows for more staff time specifically dedicated to managing the natural resources at the Park. Part of this work has involved experimenting with different invasive plant management techniques that can be more efficient and effective while not opening large areas within the tree or shrub layers that would suddenly allow in more light and encourage colonization by other invasive plants.

Key to this work is monitoring the results of the work and collecting this data in a way that can be assessed over time. This will support the efforts to improve management by having sound information on which to base management techniques. Additionally, Berks County can share what they learn with other Mount Penn and regional partners.

1. When conducting experiments with invasive plant control, create a monitoring plan to assess effectiveness of techniques and collect data.
2. Share what is learned about various techniques and plant species with Mount Penn and other regional partners.

RESTORATION DEMONSTRATION AREAS

While best management practices for ecological restoration often follow the approach of addressing the highest quality areas first to protect the intact ecological functions, there are times when it may make sense to address more degraded areas first, such as when there is funding to do a specific project or to create demonstration areas.

Berks County staff are interested in creating such demonstration areas to better showcase the work they are doing throughout the Park, as caring for areas that are already of higher ecological quality does not always result in changes that are readily discernable to those not involved in restoration work. Creating such demonstration areas can both engage and inform the public and encourage financial support from outside individuals or organizations.

To create such demonstration areas, Berks County should focus on spots that are readily accessible to the general public, such as along well-used trails and near trailheads. In addition to carrying out the actual restoration work, such as invasive plant control and native plantings, the County should also use interpretive signage at the project area, social media posts, and email blasts to explain the work they are doing, both the process and the intended outcomes. Such outreach can help mitigate concerns about what is happening and build support for natural resources stewardship.

1. Create demonstration areas for restoration in accessible locations to showcase stewardship work such as invasive plant removal and native plantings.
2. Utilize interpretive signage, social media posts, and email blasts to share information about the work being done and to engage the public and potential funders.

MASTER PLAN

Berks County recently completed a Master Plan for the Park which had a heavy focus on the Fruit Farm area. The recommendations for the Fruit Farm in the Master Plan focus on increasing native plant density and diversity, habitat restoration, and invasive plant control. These recommendations align with and compliment the recommendations from the 2018 Antietam Lake Park Forest Stewardship Plan and this Mount Penn Forest Stewardship and Trails Assessment.

RESTORATION OF ANTIETAM CREEK

Berks County is working with a consultant to restore Antietam Creek after impacts from severe storms. The plans for this work focus on restoring the stream channel to better accommodate larger amounts of precipitation. This is a benefit to the adjacent natural areas, trail, and parking lot, and is also a benefit to downstream areas as the restoration could reduce the volume of stormwater flowing downstream. This restoration work aligns with and compliments the recommendations from the 2018 Antietam Lake Park Forest Stewardship Plan and this Mount Penn Forest Stewardship and Trails Assessment.



Wide-spread canopy loss is becoming an issue at Antietam Lake Park and will require active stewardship to restore these areas.



Japanese angelica-tree has taken over an area north of the Fruit Farm, creating an opportunity to remove this invasive plant and create a young forest.

trail assessment and recommendations

trail system overview

The Mount Penn Preserve is a regional destination for hikers, nature lovers, runners, mountain bikers and others, for good reason. The Preserve contains over 30 miles of trails, ranging from highly designed, contoured downhill mountain bike routes like the Skyline Trail, to long, flat and gently rolling trails like the Bridle Path. The trail system brings visitors to well known attractions like the Pagoda, the William Penn Memorial Fire Tower and the parks of the City of Reading and Berks County, as well as hidden treasures like Kuechler's Roost.

Nearly all of the trails are earthen or stone surfaced, with a portion of the Gravity Trail surfaced with compacted gravel and fines. Skyline Drive, paved to two lanes wide plus adjacent bike lanes, is the only hard paved surface that can be used as a trail. The terrain varies with the surfaces. The earthen trails are generally smooth, but sometimes cross wet areas. The rocky trails are dry, but the footing is inconsistent, or even loose, better suited to mountain bikes. Few of the trails allow the visitor to get lost in thought, needing to frequently look down to monitor the surface and watch their footing.

The trail slopes also vary greatly. The site is a mountain after all, and the climbs are challenging, while the downhills are thrilling to mountain bikers, and tough on the knees of hikers. A few trails follow the contours along the faces of the mountain or use switchbacks and climbing turns to better manage the slopes. The Bridal Path is a nice, relatively flat, "easy" hike along the front side. The Wizard of Oz trail is popular amongst runners, as it passes through some of the more scenic areas of forest, including views of Bingaman Creek, and features challenging yet manageable slopes and curves. Twisted Sister lives up to its name,

featuring a succession of reverse curves, packing a longer trail into a tight space, while providing good rhythm and flow, resulting in an interesting and fun experience.

The trails at Mount Penn Preserve offer something for everyone. Whether you're a mountain biker seeking the thrill of a fast downhill, a good uphill climb workout or just a nice ride through the woods; a hiker or runner, looking for some outdoor exercise or wanting to get lost in nature or your own thoughts; or a dog walker, looking for an alternative to the city streets, Mount Penn Preserve offers options for everyone.

overall circulation

Most visitors seem to enter the site from the Angora Road parking lot, the BAMBA parking lot or the Oak Lane entrances (based on key person interviews and conversations at public meetings). However, there are many more entrances to the Preserve, including through other city parks and streets. The permeable site boundaries and many entrances contribute to a lack of a consistent or predictable circulation. The many entrances, combined with the overwhelming number of trails and segments makes every portion of the preserve accessible.

Considering the size of the site and the length of the trails within the site, it's likely that no visitor sees the entire site in a single day. Therefore, there is no site-wide circulation. It's more common for visitors to park at Bamba, Angora or the Oak Lane trailheads and complete a loop, or a few loops, in the vicinity of their parking location. In the case of the Skyline Trail (and likely other manicured mountain bike trails) some riders will simply repeat the same trail over and over again.

Some consideration was given to assigning the trails one way directional status. However, due to the vast number of segments, circuitous routes and confusing nature of the system, one way trails may cause more problems than they solve. However, a few trails could benefit from a formal, one-way designation. These include:

- **Skyline Trail** – should be designated downhill only, due to the speed obtained by riders, combined with the jumps and turns.
- **Boomsauce** – should be designated one-way only, due to the technical nature of the trail in part due to the blind, reverse curves. (Trailforks currently shows the trail as an uphill trail.)
- **Twisted Sister** – should be designated as one-way due to the many twisting, blind curves. However, this trail can be used in either direction due to its gentle slope and comfortable flow. The trail could be signed for direction based on days of the week or months of the year.

Other trails may also be deemed suitable for one-way designations, but we recommend the proposed Users Council provide input and inform these decisions in the future and in conjunction with creation of the proposed, unified signage system.

overall trail surface conditions

In general, the trails are in good condition. With over thirty miles of trail, of course there are some issues. However, very few trails are in such poor shape that they should be rerouted, redesigned or rebuilt. These are described later in the report. Additionally, there are so many trails that visitors have options. It's ok if a trail is particularly rough, as visitors who wish for an easier walk can find a more appropriate trail. This section focuses instead on issues that are dangerous, block access or will lead to additional damage or cost.

The maps section of the plan includes a map called Trail Surface Issues, which includes graphic symbols representing the issues listed below at locations where these issues exist, based on location data associated with geo-referenced photographs. Many isolated issues exist along the trails. Where a trail features a clump or series of issues, that trail may need to be redesigned, rerouted or rebuilt.

- **Obstacles to Access** – These typically include structures which make it more difficult for some or all users to access a trail. Examples at the Mount Penn Preserve include formal stone staircases, rock stairs, downed trees, and walls. In some cases, like the wall along Skyline



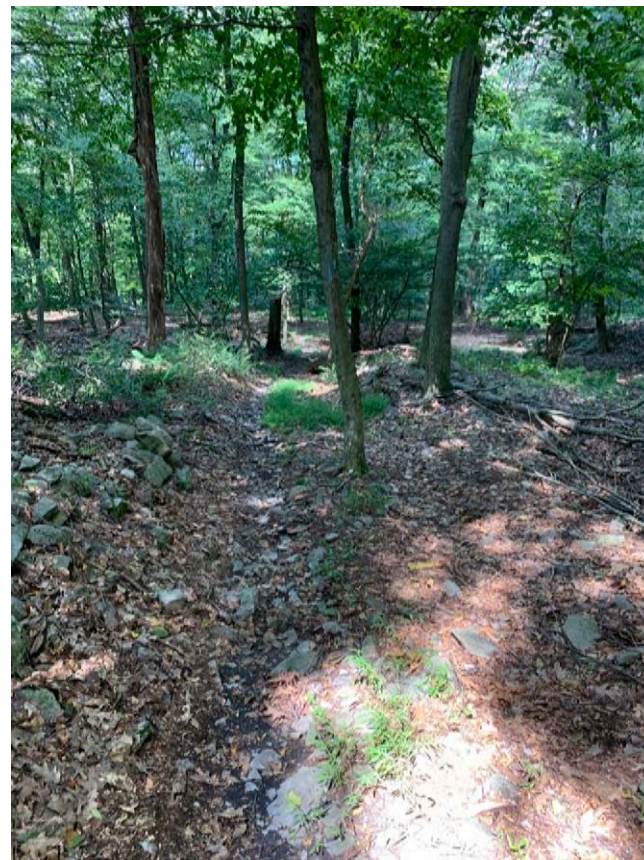
Examples of obstacles to access at the Mount Penn Preserve include formal stone staircases, rock stairs, downed trees, and walls.

Drive, the trail was created well after the wall was built. Solutions to trail stairs include providing bypass trails and ramps. A cut in the Skyline Drive wall would provide access to the existing trail and provide a connection to the Skyline Drive bike lanes. It could also reduce damage to the wall caused by bikers carrying their bikes over the wall.

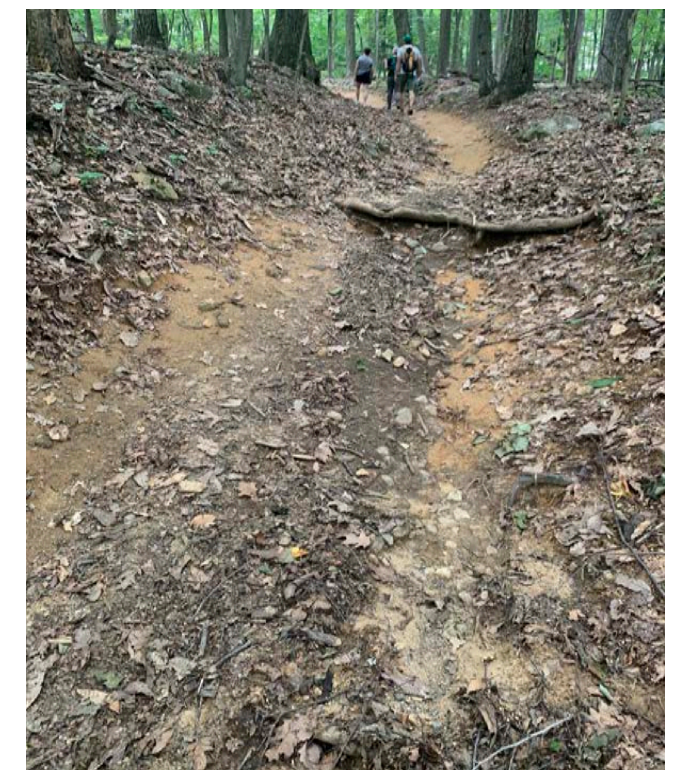
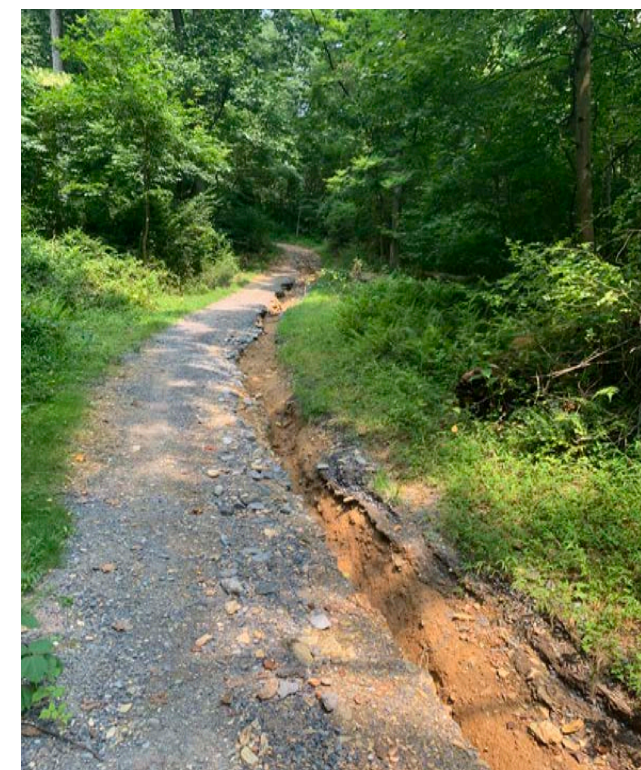
- **Braided Trails** – When a single lane trail gets wet, muddy or eroded, users will find a way around the issue. As they continually bypass the issue on the existing trail, they create a parallel trail. Sometimes the issue, especially water related issues, spreads to the parallel trail too, which can lead to users bypassing that trail too. As more and more parallel trails are created, they begin to resemble a braid. The solution to the appearance of braided trails is to identify and address the initial issue. When wet soil is the problem, a bog bridge may carry visitors above the wet spot. Otherwise, trails may need to be rerouted around the wet area.

- **Erosion** – All natural surface trails are subject to erosion. Some erosion is natural, as even wind can erode a soil surface. However, on heavily used trails like these, water and use combined with steep slopes or poor design lead to severe erosion which must be addressed. Erosion is caused more by the conditions of the trail itself, rather than the user group. Trails which are too steep or cross wet soils are the most easily eroded. A well designed and built trail can stand up to the impacts caused by pedestrians, bikers and even equestrians, with little maintenance. However, trails that are too steep or wet will erode even without heavy use.

As storms become more frequent and more severe, we see their effects on trails more clearly. During the summer of 2023, a severe storm washed out a portion of the Gravity Trail leading to the Antietam Lake parking area. More trails to the west were also completely destroyed. The Antietam Lake section of the Gravity Trail should be re-designed to incorporate gentler slopes and



Examples of braided trails at the Mount Penn Preserve.



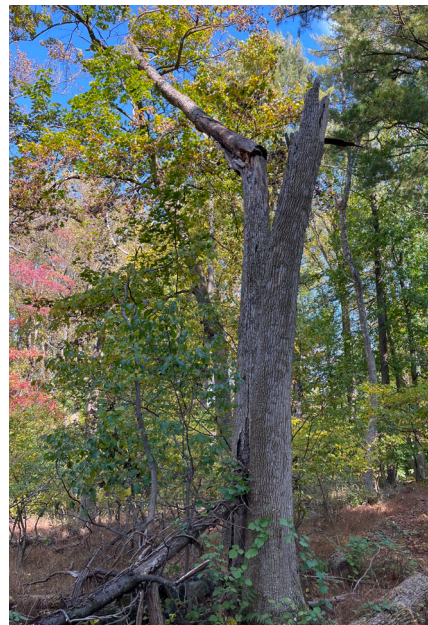
Examples of erosion at the Mount Penn Preserve.

stormwater management, to help avoid future damage. The nearby Fruit Farm Access Road trail has also been severely eroded and would benefit from rerouting.

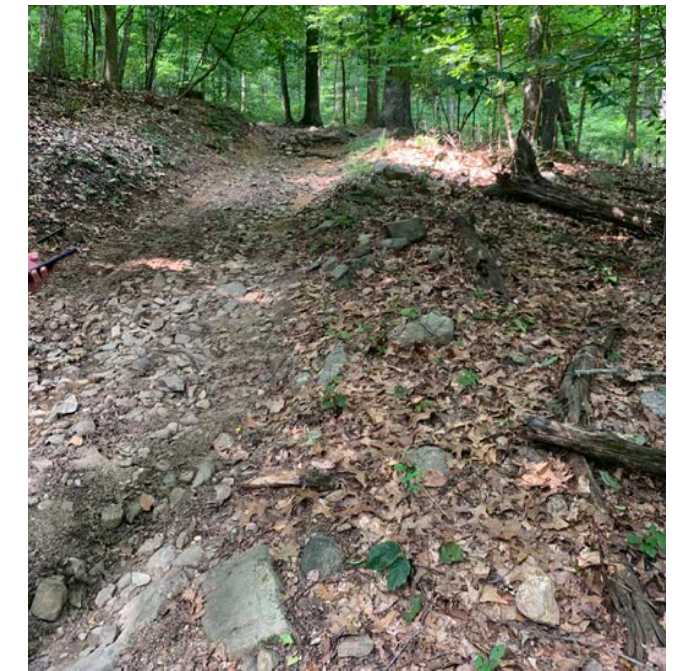
- Hazards** – Trail hazards can typically include anything that could cause harm to a trail user. However, at the Mount Penn Preserve, a certain level of danger is expected, as the mountain bikers who frequently use the site are seeking steep slopes and sharp turns. Here, hazards shown on the map are most frequently standing dead or severely leaning trees. These could drop large limbs or even topple onto a trail. Some of the trees have died of natural causes, such as old age, infestation from the Emerald Ash Borer, or being overtaken and out-competed by vines. Others are declining due to trail building activity nearby which may have disturbed or buried their root systems. The plan recommends hazard tree assessments be conducted annually. The map of issues can serve as a guide to finding some of the hazardous trees located closest to existing trails.

- Steep Slopes and Fall Line Trails** – Many of the other issues listed may be considered the result of steep slopes or fall line trails. When trails are too steep they frequently erode more quickly, as water travels more rapidly along the trail surface. Typical trail use also speeds erosion on steeper slopes, as the act of climbing or descending a hill causes the trail user to dig into the trail surface harder, whether on foot or wheels, further disturbing the surface.

A “fall line trail” is one which follows the steepest possible route, running perpendicular to the contours, straight up and down a slope. Fall line trails are rarely successful and frequently fail or require considerable ongoing maintenance. The segment of the Gravity Trail which leads to the Antietam Lake parking area is a fall line trail and was severely damaged by a storm recently. Stormwater flows down a hillside and fall line trails frequently provide a channel. Water collects on the trail and flows hard and fast straight down, eroding the trail along the way.



Standing dead or severely leaning trees could drop large limbs or even topple onto a trail.



Steep trails frequently erode more quickly, as water travels more rapidly along steep trail surfa.

- Wet Areas** – Trail surfaces typically become wet for a few reasons. A trail may be routed through a floodplain, wetland, spring or another area featuring hydric or other moisture laden soils. Sometimes a trail dips in elevation, carved into a site deep enough to penetrate ground water, or at least wetter soils beneath the surface. A third scenario, observed throughout the Mount Penn Preserve trail system, and found at most trail system sites, involves a trail that is graded (or not designed at all) in a way which captures water and holds it on the trail surface. With no way to escape, the water forms puddles or pools on the trail. As the soil remains moist as a result, it is more easily impacted and left with deep footprints or tire tracks, which can eventually become ruts. As these indents worsen, so does the issue itself, as water will collect in the ruts and footprints. Visitor frequently avoid these areas, creating social or braided trails, as described above. Most of these situations need to be fixed with minor regrading of the trail or its surroundings to manage the flow of water.

- Destructive Trail Building Methods** – The Mount Penn Preserve features a variety of trail design and construction methods. Some of the oldest trails are remnants of the past, following old rail lines, and logging, fire and charcoal roads. These trails typically lack modern design features, like proper grading and stormwater management features, as the original uses predate modern design techniques. These trails are more susceptible to erosion and other issues which may damage the trails and their surroundings.

Additionally, some modern trails have been built without careful planning. In many cases, soil moved to build trails has been piled up in ways that will kill the nearby trees. Too much soil piled on top of roots will suffocate the existing trees, leading to premature decline and death. Where new trails are sanctioned, it may be necessary to pile dirt to create berms, jumps and new trail features. However, in these scenarios, tree mortality should be factored into the design, with impacted trees planned to be removed or topped as part of the trail building. Where the trees' health hasn't been considered, many of them will become hazards.

- Nuisance Areas** – Many public parks, open spaces and natural areas are faced with addressing nuisance issues. For the purpose of this report, nuisances are activities which are prohibited within the park, but not considered emergencies, life threatening or even dangerous to others. We only encountered a few areas with evidence of nuisance activities. Most appeared to be related to people just hanging out in the woods, including rock bordered fire rings and alcohol bottles and cans. Some areas showed elevated nuisance uses, which appeared to be evidence of people living in the site. Once we encountered a tent pitched in the woods near the water tower on the southern end of the site. Another site was littered with dirty clothing. We did not observe any people at these sites, but also gave them a wide berth. Where nuisance uses appear limited to "hanging out" and littering, volunteers may clean up the mess and dismantle makeshift benches and firepits. Where it appears that people have been living on site, professionals, such as advocates for unhoused people and mental health advisors should be called in (alongside police or rangers if necessary).



Examples of wet areas at Mount Penn Preserve.



Example of destructive trail building methods.



Examples of nuisance areas.

priority trail recommendations

working together

Recommendation: Enhance cooperation at the use level.

The Mount Penn Preserve Partnership is a great example of governments working together. However, the Preserve would benefit greatly from more cooperation at the user level. Mountain bikers, walkers, runners, birders, dog walker, ecologists and others use Mount Penn in different ways, at different times and for different reasons. All of these user groups have a right to be there and bring valid concerns and needs. These groups need to work together to strengthen the community of users.

While the governments work together as the Mount Penn Preserve Partnership to address safety, financing, maintenance and other high level issues, another level of partnership group should be established to handle coordination and cooperation amongst users. This group should be representative of a diverse set of constituents, but kept small enough to be effective, potentially 8 to 12 people maximum. The group should include representatives of, but not be limited to, the following user groups (or similar):

- Berks Nature
- Berks Area Mountain Bike Association
- Berks Trail Works
- Pagoda Pacers
- Pretzel City Sports
- Hiking Community (such as Berks Community Hiking Club)
- Hunting Community
- Birding Community (such as Baird Ornithological Club)
- Neighboring Businesses
- Neighboring Residents

This group should be considered as a users council or similar task force. They should meet on a regular basis, perhaps quarterly. To begin with, they may just share information about themselves, how they use the mountain, and what their concerns may be. They may be able to help each other address those concerns, or work together to avoid creating problems for each other. They may coordinate events to avoid conflicts. Over time, they should start to build better relationships between the different groups. They may start working on projects together, like organizing tree plantings, clean up days or trail maintenance. They may support the Mount Penn Preserve Partnership by applying for grants or providing supporting materials.

Many, many people LOVE the Mount Penn Preserve. But they don't always work with each other, or talk with each other. Sometimes they are at odds with each other, but don't always communicate why. The governments have protected the mountain, they fund the mountain and keep it open to the public. But its up to the users to really establish the Mount Penn Preserve as a safe place for all visitors, whether they are biking, hiking, birding or walking their dogs. They have to work together to make it an enjoyable destination for all of the area residents. And they can only do it well if they work together.

stormwater management

Recommendation: Install improvements to manage stormwater better, before it enters and after it leaves the trails.

Water is the biggest threat to every local trail system. As our climate begins to feature more frequent and heavier rain, water becomes an even bigger challenge to manage. Many of the trails at the Mount Penn Preserve have been professionally designed and built or have been implemented by knowledgeable volunteers. Most of these trails have been installed to include side slopes, grade dips and other features to remove water from the trail surfaces as soon as possible. With a few exceptions, the trails handle water fairly well. However, the stormwater management can still be improved in two major ways.

First, water can be captured before it enters a trail or can be diverted and captured as soon as it enters a trail. In some cases, water collects on the uphill side of a trail, flows down the face of the hill and collects on the trail. It

then follows the trail downhill, accelerating with gravity, and eroding the trail. In these cases, where the sideslope isn't too steep, water can be captured in swales or rain gardens above the trail. Similarly, where trails flow nearly straight down a hill, water may enter the top of the trail and flow straight down. In these cases, a trail head rain garden may be used to capture water before it flows onto the trail.

Secondly, water must be managed after it is diverted off the trails. While it is no longer a threat to the trail it just left, water flowing off of a trail can still erode the forest floor, washing out hillsides and damaging the surrounding ecosystem. With so many trails on site, water flowing off of one trail is likely to eventually cross another. Natural flow patterns should be maintained, but where water is collected on trail and diverted into concentrated areas, that water should be captured and infiltrated into planted rain gardens. Additionally, many trails are accompanied by disturbed areas that were likely used as borrow pits during trail building. Many of these, along with other low points, ruts and other depressions are already collecting water and may offer opportunities for conversion into planted stormwater management areas.



Stormwater can be captured in swales or rain gardens. Photo: Dan Barringer

enhancing legibility

Recommendation:

Simplify the trail system by connecting and renaming existing trails as longer routes and larger loops, with an emphasis on the historic and major trails as the framework of the trail system.

The critique most often stated in public meetings, key person interviews and interactions with the project committee and others, is that the trail system is too confusing. There may be too many trails. There are definitely too many trail names. Many of the names of the newer trails are related to a person, the character of the trail or the shape of the trail. Some trail names provide wayfinding hints, like the Radio Tower Trail, but too many change names abruptly or are considered different trails. This causes trail users to constantly question their location, needing to refer to trailforks or other online sources. This makes the mountain very challenging and uninviting to new visitors.

The preserve does feature a handful of existing, long, single named trails, or a series of similarly named segments, which could become the backbone of the trail naming system. The Gravity Trail, Ferndale Trail, and Bridal Path are all long trails under a single name, or a hyphenated name

with a common name. These longer trails are already the backbone of the trail system. However, they should be named and mapped accordingly.

In some cases, this may mean simplifying the names by removing hyphenated named sections and combining them under a single name. For instance, a visitor can travel from the Angora Road parking lot and trail head to Drenkel Field using the following route:

“Gravity Trail – Antietam Lake Park” to “Corkscrew/S-Turns (Gravity Trail)” to “Lullabye to Wine Vault (Gravity/Ferndale Trail)” to “Bobble Head (Gravity/Ferndale)” to “Ferndale/Gravity Trail – Egelman Section” to “Ferndale Trail A-Line Section.”

This section could be simplified so that the entire stretch is called the Gravity-Ferndale Trail. Or, if the Gravity and Ferndale trails should be individual trails, the stretch could still be combined down from 6 distinctly named sections down to two. There are similar examples of loops and longer trails that can be combined. These trails, combined with the major roads can act as a wayfinding framework. By highlighting these major trails and routes, visitors should be able to figure out roughly where they are and make their way to a major feature, such as a parking lot, park or significant landmark, even without knowing exactly where they are on the mountain. We recommend the following, as a basis of the framework:

- A. **Bridal Path** – Use the existing Bridal Path and rename other existing adjacent segments, so that the “Bridal Path” extends from the northern tip of the frontside all the way to the Pagoda (Yellow).
- B. **Gravity Ferndale Trail** – Elevate the existing Gravity Ferndale Trail and extend it by renaming existing connected segments such that the expanded “Gravity Ferndale Trail” extends from the Antietam Lake Parking Area to the Pagoda (light blue).
- C. **Woodcutter Loop** – Combine the many different named segments to create a single loop which connects the Bamba Lot, Rotary Park, Angora Fruit Farm and other nearby trails (light green).
- D. **Northern Boundary Trail** – Combine the existing Wizard of Oz, TNT and Rock Drop trails, to create a single trail which will act as a Northern Boundary trail, connecting the Antietam Lake Parking Area, The Angorra Fruit Farm and the proposed Woodcutter Loop (orange).
- E. **Historic Gravity Trail** – Highlight the existing Historic Gravity Trail and identify it as a major route, as it connects the City of Reading, Pendora Park, Mineral Springs Park, Egelman’s Park Ballfield, and Egelman’s Park to the rest of the trail system.
- F. **Frontside Reading Trail** – Connect and unify the many differently named segments of trail that are closest to the City of Reading along the front (western) side of the mountain, to create a single name, continuous trail from the northern tip to the Pagoda, connecting to the existing street grid, with an emphasis on the Walnut Street entrance.
- G. **Spuhler Lane** – Extend the existing Spuhler Lane trail to include the segment currently known as “Lullaby.” This will create a single trail connecting Rotary Park to the Fire Tower.



Haag to Ferndale Trail.

additional trail recommendations

celebrate and elevate existing trails

Recommendation: Enhance, elevate and celebrate existing trails and routes that provide access to important points of interest and make strong connections.

The Mount Penn Preserve Master Plan prepared by Simone Collins recommended implementation of the following additional trails:

- City Park to the Pagoda
- Pagoda to the Fire Tower
- Mount Penn Preserve to Neversink Mountain
- Lower Alsace to Antietam Lake Park (along Antietam Road)
- Mount Penn Preserve to Lower Alsace Township (along Hill Road)
- More Regional Trails and Connections

When we asked the public about these recommendations, they showed strong support for a trail from City Park to the Pagoda and from MP3 to Neversink Mountain. However, we learned that these trails already existed in one form or another. Therefore, we've concluded that the public isn't aware of their existence.

Walnut Street is considered the trailhead for the route from the city to the Pagoda. The route requires a trail user to zig zag along segments of many different trails. This route could be simplified by renaming the most direct route and unifying it into a single trail to the Pagoda. Additionally, the trailhead at Walnut Street should be "dressed up," to better announce that it is a formal entrance to the preserve. Signage and other improvements should notify the public that they can park and walk or ride onto the trail system here.

Additionally, Trailforks shows a few on road routes across the city. One connects City Park at the eastern end to Reading Area Community College and the RACC trail to the west. Another on road route follows 19th Street, Fairview Street and 18th Street, connecting Pandora Park across town to Neversink Mountain. These on road routes can be improved to help beautify the community, highlight the trail connections and improve circulation. Improvements could include special street signs that identify the trail route, colorful street surface paint, bike lanes, additional tree planting and more. Additional traffic studies and detailed design would be a necessary next step.



Native mountain laurel in the shrub layer of Pagoda.

reducing damage

Recommendation: Protect and enhance sensitive areas by closing them to trail building and removing existing trails that damage the ecosystem.

Every trail we build has an effect on the surrounding ecosystem. Trails alter the flow of water, making some areas wetter and drying out others. They create barriers that some animals, including insects, will not or can not cross. Trails open up the canopy and change the way light enters the forest, changing the makeup of plant communities. If the trails themselves do not have an effect, the humans that follow them do, as we alter animal behavior when we're nearby. In many parts of the forest, a new trail will have little impact, but in sensitive areas, a trail may destroy the ecosystem.

On a site as large as Mount Penn Preserve, its nearly impossible to identify all of the potentially sensitive sites. Like most natural areas in southeastern Pennsylvania, much of the forest has been damaged by deer and invasive plant species. This makes the sensitive, pristine or even "very good" areas worth protecting. Land managers should ask the following questions to determine whether an area may be sensitive and assess whether they should follow through with a potential action such as trail building, vegetation removal, earthmoving or other activities.

- Is the area of disturbance wet? Right now? Seasonally? Annually?
- Have we seen animals like frogs, toads, salamanders or others that would indicate that the area is sometimes wet?
- Have we seen plants, such as skunk cabbage, that would indicate that the area is sometimes wet?
- Have we seen animals in the area that are included on DCNR's List of Threatened, Endangered, or Recovered Species, such as bats, bald eagles, or flying squirrels?
- Does the site of the proposed project contain a continuous, healthy plant community?
- After standing in one place quietly for a few minutes, do I hear birdsong? Does the area provide valuable habitat for many species of native birds?
- Is the slope of the land so steep that any modification could trigger severe erosion?
- Will the project damage existing trees, including burying their roots?

If the land manager answers "YES" to any of these questions, its likely they are potentially in a sensitive area and should strongly reconsider going forward with their project, unless it aims to restore, protect or enhance the surrounding ecosystem and habitats.



Skunk cabbage indicates the area is sometimes wet.

protect threatened species

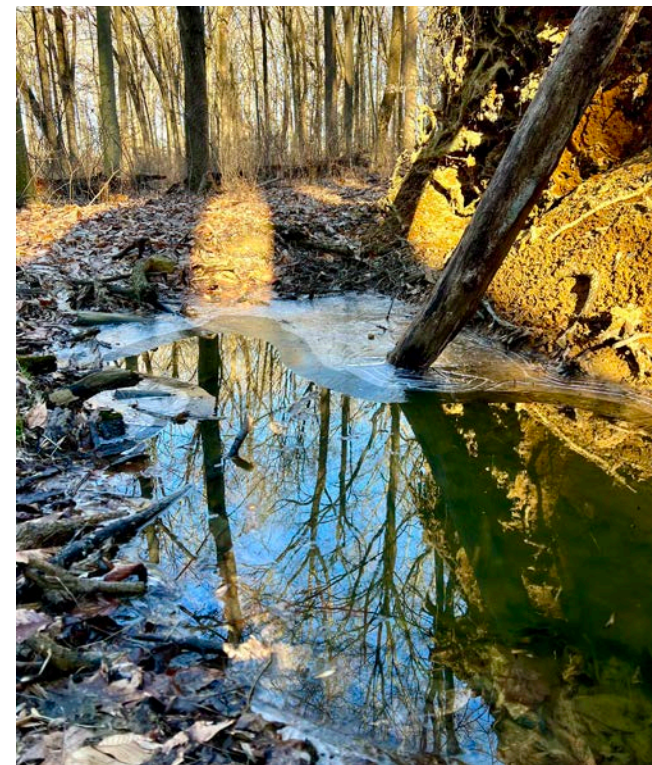
Recommendation:
Protect the two threatened species likely to inhabit the site, by protecting and enhancing their habitats.

The Pennsylvania Natural Diversity Index (PNDI) has identified the potential for two “Sensitive Species” of “Special Concern Status” to be present on the site. The PNDI report does not name the species in order to keep them protected. However, based on the information provided, it appears likely that the species include one wetland plant and one native bat species. The habitats that these two species inhabit are the most important to conserve.

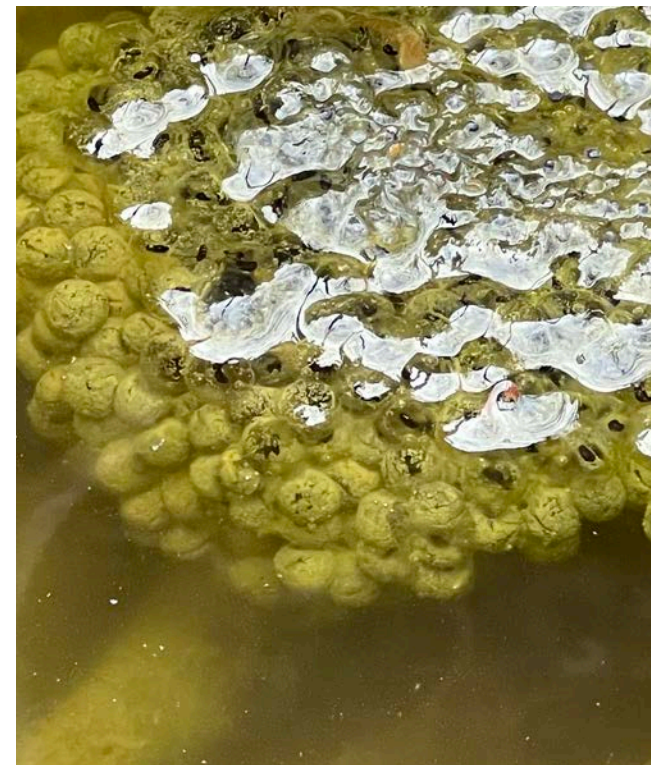
Wetlands are important habitat for plants, insects, mammals, reptile, amphibians and birds. Aside from the threatened species noted in the PNDI, other animals absolutely depend on wetlands or vernal pools (seasonal

wetlands) to complete their life cycles. Trails should be kept far from wetlands whenever possible, with a 300’ buffer as the gold standard. Where existing trails impact wetlands, they should be relocated. Land managers should consult the US Fish & Wildlife National Wetlands Inventory online mapping tool: <https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/>

To protect native bats, land managers should follow tree removal and road closure standards and timeframes as outlined in the Forestry Habitat Conservation Plan for Bats, prepared by DCNR and the Pennsylvania Game Commission. This document has been prepared for use on Pennsylvania agency owned lands but offers guidance relevant to Mount Penn Preserve. In addition to tree removal and cutting timeframe guidance, hickory trees, especially shagbark hickory (*Carya ovata*) should be specially protected as they are a favorite species for roosting bats. Additionally, snags, and standing dead wood should be left in place as they provide habitat and roosting sites.



Many animals are dependent on vernal pools (seasonal wetlands) to complete their life cycles.
 Photo: Ralph Hall



Frog eggs in a vernal pool.
 Photo: Ralph Hall

discourage dumping and illegal activity

Recommendation:
Close Skyline Drive, or more strategically restrict access to discourage dumping and other illicit

The City of Reading has recently approved construction of security gates at the intersections of Skyline Drive and List Road and at Duryea Drive and Shearer Road. The gates should help to deter illicit uses and gatherings, while leaving Skyline Drive open to cyclists, bikers, walkers and runners. By closing this section of Skyline Drive, the road will likely become safer and accommodate more recreational uses. The closure should also make the entire site safer, which benefits all users. However, closing Skyline Drive will make it even harder for mountain bikers to access parking at Drenkel Field, the Fire Tower and the Skyline Drive overlooks.

parking access

Recommendation:
Increase Access by Improving Existing Parking and Potentially Providing Additional Parking Areas

Parking is always a delicate subject at every site. Too much parking results in unnecessary impervious surfaces and maintenance and seemingly vacant areas that invite loitering. But not enough parking can lead to cars parked on roadsides, in the edges of the forests and other places they shouldn’t be. Fortunately, Mount Penn Preserve features many parking areas. However, many are not open on a regular basis, due to repeated vandalism, dumping, crime and other issues. We recommend the following:

- A. Consider expanding the existing BAMBA Lot to the south, into the forest to provide a second bay. While this would require the removal of trees and disturbance to the area, this section of forest does not appear to be especially healthy, as its been overrun with invasive

Japanese barberry. The BAMBA lot is frequently full on weekends. Expanding parking here would help to concentrate parking and traffic in one location and could act as overflow parking for Rotary Park on occasion.

- B. Consider providing additional parking at Egelman’s Park, closer to Hill Road. This location is ideal for parking as it is close to the Gravity Trail (a major trail), it could serve Egelman’s Park and Ballfield, and could accommodate mountain bikers using the Skyline Trail. As the Skyline Trail is a sculpted mountain bike trail featuring exciting jumps, berms and curves, many riders will fly down the trail, then shuttle back up. However, the constant shuttling requires multiple cars. When they are open, riders can park at the Fire Tower Lot or Drenkel’s Field at the top. However, at the bottom the existing Egelman’s lots are frequently closed, leaving riders to park on the sides of Shearer or Angora Roads. The open field between Angora Road and the Egelman’s Park driveway could accommodate a parking area. The existing hedge along Hill Road could be removed and replaced with more strategically planned landscaping to provide shade and some screening, while leaving the parking lot visible from the road. Visibility would make this parking lot less inviting to loitering and illicit uses. Egelman’s Park is a beautiful site and features a new pavilion which can be rented out for events. Parking near Hill Road would allow most visitors to park, then leave their cars and enjoy the walk to the pavilion. Further, parking near Hill Road could be accessible while the rest of the park is closed and gated. (This approach may be applicable to other parks as well, but may require additional planning and study.)
- C. Consider providing additional parking near the northernmost tip of the preserve, as there are few opportunities to park nearby. Skyline Drive, near the intersection with Bingaman Road, offers opportunities to provide simple, pull off parallel parking along the shoulder, or to create a more substantial off street parking lot.

shuttle service

Recommendation:
Increase access by providing shuttle service from key points surrounding the preserve to popular trailheads and points of interest within the preserve.

Mount Penn Preserve can be overwhelming to visitors, at over 4,000 acres and 30 miles of trails. Most visitors will only see glimpses of the site as its just too much area and distance for one day. For visitors who want to see more, shuttle service would allow them to visit many parts of the site in a day, or travel one-way from a drop off point back to a parking area.

Shuttle service would provide greater access to walkers, hikers, bikers and anyone else visiting the preserve. Shuttle buses could visit each of the major parking lots picking up visitors, then travel the major roads through the preserve to each of the major points of interest. Shuttles could also access Skyline Drive, even when the gates are shut to most traffic, providing more access with traffic control. Shuttles could run on weekends and for special events.

Shuttles would benefit day-trippers who want to see more of the site in a single trip. But they would also benefit hikers and bikers. Currently, bikers who want to repeatedly ride the downhill trails, like the Skyline Trail, team up to shuttle from the bottom back to the top. This requires at least two vehicles and requires riders to separate from their groups to ride back down. Shuttle service could reduce car traffic and help the bikers get back to the top.

Similarly, hikers face the same up and down dilemma at times. They may have a goal of hiking every segment, climbing from bottom to the top or crossing an entire face, end to end. One way travel may be enough for one day. They too could use a shuttle to bring them to the start of a route so they can hike back to their cars, or pick them up and drive them back to their starting point. Shuttles could also bring hikers to locations that they may not be able to reach on foot at all, especially after the gates on Skyline Drive are closed.

Shuttle service would improve access throughout the site. It would help to bring more people into the preserve, making it safer and better used. It would help control vehicular traffic and discourage visitors from parking on the sides of the roads. Shuttle service could come from an outside contractor, or potentially from the local public transit agencies. The visitors, and the Mt. Penn Preserve, would benefit in many ways.

new trail: universal access

Recommendation:
Provide universally accessible trails as new segments or by upgrading existing trail segments, throughout the preserve.

Universally accessible trails are frequently referred to as “ADA trails,” as they are intended to meet the requirements of the Americans with Disabilities Act, and subsequent legislation. They frequently invite visions of hard paved, dead flat and straight sidewalks. However, the moniker and the imagery are incorrect. It’s important not to assume any visitor’s ability level. Even visitors who have a disability may still seek a challenge. We should provide trails without barriers that can bring more people into nature without making them boring, flat and wide.

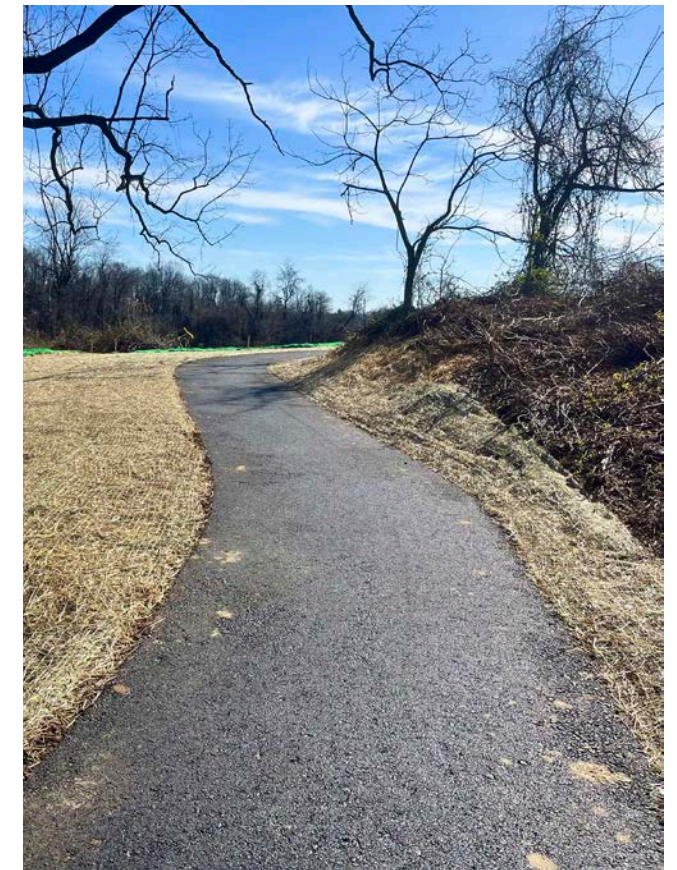
Some of the trails that already exist could potentially be converted to better meet the standards of the ADA, which states that a trail surface should be firm, stable and slip resistant. It should also be a minimum of 36” wide, with passing spaces of 60” widths at certain intervals. Additional requirements for removal of obstacles and clear overhead space and clear widths also apply. Slopes should be gentle, but not completely flat. Slope requirements allow certain %s over certain distances and allow for some flexibility.

The Mount Penn Preserve Partnership would need to invest in additional study and detailed design and engineering to create universally accessible trails. People who live with disabilities want the same access and experiences in nature as everyone. Universally accessible trails serve everyone and could make the Preserve more welcoming to visitors of all abilities.

Trails that already follow the contour lines and don’t include many steep slopes would be good candidates for universal accessibility upgrades. These include:

- The Bridal Path & Tour de Front Side (Loop)
- The Wizard of Oz
- Antietam Creek Trails

These trails also either connect or are close to existing access points, like city streets and major parking areas. None are ready made for universal accessibility, but they are good candidates for upgrades.



Example of an accessible trail.
 Photo: Jill Sabre

signage and branding

Recommendation: Unify, improve, and clarify the wayfinding and naming signage throughout the Mount Penn Preserve.

branding

Representatives of the Borough of Mount Penn, the Townships of Alsace and Lower Alsace, the City of Reading and the County of Berks are working together on the Mount Penn Preserve Partnership Council of Governments (MP3 COG). An effort should be made to develop a distinctive brand for Mount Penn Preserve that differs from local government branding.

A well-executed brand creates a consistent toolbox for stakeholders to use. This brand will be the official mark of the Mount Penn Preserve Partnership Council of Governments (MP3 COG), uniting the efforts of all stakeholders and creating a cohesive experience for visitors. Brands can be deployed in countless ways beyond the logo and tagline.

The four elements that work together to build a brand are the typeface, logo, tagline and color.

Typeface is a font or set of characters that share common design features. A primary and one or two secondary typefaces should be considered. These typefaces should be used consistently. Ascenders and descenders can be used to accent readability and for nesting other descriptors. A serif and sans serif typeface often complement one another.

A logo is a graphic mark used to quickly identify something. A logo can be figurative rather than literal. Communities with more figurative logos can often be imbued with more meaning. A simple word mark can also serve as a highly recognizable logo. The Coco-Cola logo is an easily recognizable work mark.

A tagline or slogan is a memorable set of words used to describe something. Unlike typefaces, taglines are the most "disposable" of branding tools and can be considered "campaigns" if they are deliberately designed not to have permanent usage. Communities can have different taglines for different efforts.

Color is a visual perception that enables one to differentiate identical objects. (This technical definition is courtesy Merriam-Webster). A community brand can have many different colors in its palette. It can be helpful to differentiate a main color palette and an accent color palette. If multiple colors are used in a primary brand, it should also be tested in a single color and in black and white for reproducibility since not all uses will be full color.

source:

Muldrow, Tripp. "An Introduction to Community Branding." American Planning Association PAS Memo, no. July/August (2013). Accessed July 29, 2023.



wayfinding

Wayfinding can reinforce a Mount Penn Preserve brand and help visitors to discover and explore the mountain. Wayfinding can enhance the sense of place for the many distinctive features of the mountain. Experiences for residents and visitors can be strengthened with cohesive wayfinding systems that provide appropriate information at key decision points within the preserve.

Planning a wayfinding system begins with understanding how an area is organized and what patterns already exist. Important elements of wayfinding on the Preserve will include gateways, parking lots, trails and landmarks. These features and landmarks allow people to create a sense of legibility of the space. This concepts of legibility and wayfinding are generally applied to urban areas; however, the Preserve is nearly 4,000 acres and there are many different types of features and landmarks within the preserve. We must consider the various combinations of destinations that a visitor might want to experience and ensure they are able to access those destinations. Kevin Lynch describes features and landmarks in the 1960 classic *The Image of the City*. Legibility of a city encompasses the mental images people hold in their minds and is the basis for how they will navigate through a space using those pathways, districts, boundaries, nodes, and landmarks (Lynch 1960).

People often refer to wayfinding as signage, but wayfinding systems are composed of a number of different elements that should be thought of as wayfinding tools. Because people absorb information using all five senses, wayfinding systems can be made up of a variety of solutions, including visual, tactile, or spoken. These solutions become the wayfinding tools. They can include signs, maps, lists of destinations, or direct assistance from other people.

The design of a wayfinding program is based on three key components: user groups, information requirements, and conditions. Each of these elements inform the who, what, where, and why of creating a program.

Understanding the needs of user groups will help inform the overall goals of the program. User groups may include residents or regional visitors; tourists, including those for whom English is a second language; and event facilitators. Each of these categories could be broken down further. Understanding who the users are will help determine what kind of information they need.

The design components of static signage include scale, color, and typography. The appropriate scale of the sign and size of the design elements are determined by the sign's location and the mode of transportation from which it will be viewed: vehicular, pedestrian, or cyclist. It is important to consider consistent design qualities, determine the hierarchy of information within different types of signs, and ensure the placement of signs at key decision points.

The Mount Penn Preserve needs a hierarchical signage system. The first tier should address the Mt. Penn Preserve as a single entity. The idea of the Mount Penn Preserve needs to be elevated. The Mount Penn Preserve could follow the example of nearby French Creek State Park, by placing identifying signs at every major entrance. Like Mount Penn, French Creek also surrounds some inholdings. The park boundary is permeable, and even inconsistent. However, French Creek features enough identifying signs to give visitors a good sense of when they are leaving or entering the park. Mount Penn could do the same by placing, "Welcome to Mt Penn Preserve" signs along major roads, intersections, and entrances, including, but not limited to the following:

- Glen Road at Mineral Springs Road
- 19th St at Pendorf Park
- Duryea Drive
- Walnut Street
- Hill Road near Egelman's Park
- Hill Road and List Road
- Angora Road and Wanner Road
- Skyline Drive, Oak Lane and Bingaman Road
- Oak Lane Trailheads

These first tier signs will help the public and visitors to think about the entire mountain as a single place. This is important for framing all other discussions. We can't think about a unified trail system or connected ecosystems if we don't first think of Mount Penn Preserve as a single place.

The next tier of signs could add detail by identifying the individual places, while keeping them under the umbrella of the greater Mount Penn Preserve. Every sign which identifies a place, whether it's a parking lot, a building, a water feature or a historic feature, should say "Mt. Penn Preserve," on it somewhere.

These signs can also identify the owner and the specific place. For example, Drenkel Field is a park owned by the City of Reading. Its currently identified with a sign that says, "Drenkel Field, Home of the Flying Dutchmen." This sign could be replaced with one that says, "Drenkel Field at Mount Penn Preserve, Home of the Flying Dutchmen, City of Reading Parks and Recreation." Similarly, the Angora Fruit Farm could receive updated signage with messaging like, "Angora Fruit Farm at Mount Penn Preserve, Berks County Parks & Recreation Department." Some words could be replaced with logos for brevity, but every place should be identified as part of the preserve.

The third tier may identify parking areas, buildings and trailheads that generally stand alone. These places sometimes take on local nicknames, which is fine for locals, but confusing for visitors. For example, everyone seems to know of the "BAMBA Lot." But the sign at the lot says, "Welcome to Mount Penn Preserve Trails." The sign is well made, fits the character of the site perfectly and looks great. It does feature small BAMBA and IMBA signs attached to it. However, when this sign is due to be replaced, it would make more sense for it to say, "Welcome to the BAMBA Trailhead at Mount Penn Preserve." Similar signs could be placed at the Andora Road parking area, the Mudcatcher Lot, Bingaman Nature Center and even the Pagoda. Additionally, wayfinding signs should be placed on the surrounding roads or intersections to help direct visitors to the second and third tier destinations.

source:

Osborn, Katie. "Wayfinding: The Design of Getting Lost and Found." American Planning Association PAS Memo, no. March / April (2018). Accessed July 29, 2023.

trail blazing

It appears that many attempts have been made by multiple entities to provide signage and markings on the trail system. These attempts should be applauded, as signs and blazing are badly needed at the preserve, at every level. However, the multiple attempts in different styles have added to the confusion. Some trails are marked with traditional, simple blazes painted on trees. Others have small signs pinned to the trees, while others still feature small labels on posts. Some old wooden, grooved and painted signs still remain as well. These many different methods add to the confusion. In addition to the trails, the "places" throughout the preserve also need consistent, unified signage.

Consistent trail signs and markers should be established on the trails. The old markers should all be removed and replaced with a consistent, unified signage system. Trail blazes are stripes of paint, (typically on trees) that are two inches wide and six inches tall and are placed right above eye level. Hikers should always be able to have the next marker within sight. Depending on the orientation of the rectangles, trail blazes are used to indicate which way the trail is going, such as the beginnings and ends of trails, changes in direction, and intersections.

Here are some common blazes and what they mean:

- **Trail Start** -- Three rectangles forming an upward-pointing arrow indicates the trail starts, going forward.
- **Trail End** -- On the other hand, three rectangles forming a downward-pointing arrow means that you have reached the end of the trail.
- **Straight** -- A singular rectangle is the most common blaze. This means to keep going forward. You're on the right path.
- **Right Turn** -- A blaze featuring two rectangles with the top one to the right means go right. Imagine that it is forming a right diagonal pointing you in the correct direction.
- **Left Turn** -- Conversely, a blaze with two rectangles with the top one to the left means go left. Again, you can imagine that it is pointing diagonally to the left.

- **Intersection** -- A marker with two triangles stacked next to one indicates a spur leading to a different trail. The single rectangle is on the side where the spur trail intersects the one you're currently on.
- **Caution** -- Two blazes stacked on top of each other can mean two different things. If the rectangles are of the same color, that means to proceed with caution. There may be a sharp turn or obstruction ahead. If the rectangles are two different colors, this means that you are currently traveling along two trails that overlap each other.
- **Rectangle** -- notes trail as a "through" trail, or long linear trail
- **Circle** -- notes trail as a loop
- **Double circle/figure eight or similar stylized symbol** -- notes trail as a "link" or connector

"You are here," messaging should be incorporated throughout the signage and map system. Every place a map is posted, it should be marked with "you are here." Even people who frequent the outdoors may not be well versed in reading maps. In addition to "you are here," additional signs or markers should work with the maps, to send visitors where they want to be. For instance, if a map tells a visitor, you are here...at Rotary Park, the same kiosk or map board may offer more directional information to tell trail users that the Pagoda is one direction and the Antietam Lake parking lot is in the other. The signs and maps should work together to tell visitors where they are and how to get to where they're going.



Triangular Blaze indicating a left turn.
Photo: Mwaner



Cairns are piles of rocks left alongside a path to mark a trail and guide other hikers.
Photo: Nicholas A. Tonelli

other types of trail signage

posts

The easiest trail marker to see, posts are erected signs that often show the trail name or the next destination with arrows. Posts may also indicate distance traveled so far, the distance to the destination, or the distance at an intersection.

affixed signs

Because paint may fade, some trails may use signs nailed into trees rather than paint to indicate trail direction. These markers may be made out of metal, wood, or plastic. They may or may not include the trail's name.

Other metal markers in Pennsylvania state parks or forests are boundary markers that show the edge of the park or forest. Unfortunately, these fixtures may fall off or get stolen, so painted blazes end up being more reliable.

cairns

Cairns are piles of rocks left alongside a path to mark a trail and guide other hikers. Cairns may be used in situations where blazes cannot be put on trees such as mountainous terrain about the tree line, or where trees are just sparse. Cairns should only be built by park rangers or trail maintenance crews. Unofficial cairns can lead hikers in the wrong direction, contribute to unnecessary erosion, and leave many insects and animals without a home.

boundary postings

As noted earlier in the Safety chapter, boundary postings are important for marking property edges and conveying to users and neighbors that this is a property that is actively managed and monitored. The design of the boundary postings should be consistent with the branding established for all signage across the Preserve.

source:

Ritchey, Allyson. "Safely Navigating Pennsylvania's Trails - How to Read Trail Blazes." DCNR. September 13, 2023. <https://www.dcnr.pa.gov/GoodNatured/pages/Article.aspx?post=247>.



Boundary posting sign for Natural Lands.
Photo: Tianna Godsey

universal trail sign design requirements

As populations become more diverse with a range of abilities, wayfinding is an excellent opportunity to apply universal design standards for an inclusive and approachable wayfinding experience.

The term “universal design” was coined by the architect Ronald Mace to describe the concept of designing all products and the built environment to be aesthetic and usable to the greatest extent possible by everyone, regardless of their age, ability, or status in life (NCSUCUD 2008). These broad-spectrum ideas are meant to produce environments that are inherently accessible to older people and people with disabilities, as well as people without disabilities. The table below explains how universal design principles may be applied within wayfinding systems.

The Cities of Helena and East Helena and Lewis and Clark County in Montana developed a uniform and consistent wayfinding system to help users navigate and

access the community’s many parks, connecting trails, daily services, cultural destinations, and healthy living sources. It was important to them that the system be inclusive of people of all ability. They focused on route development and sign design encompassing the needs of people with disabilities, lower income residents, seniors, and families with young children to empower people to use human-powered transportation choices. An example of their signage standards can be found below.

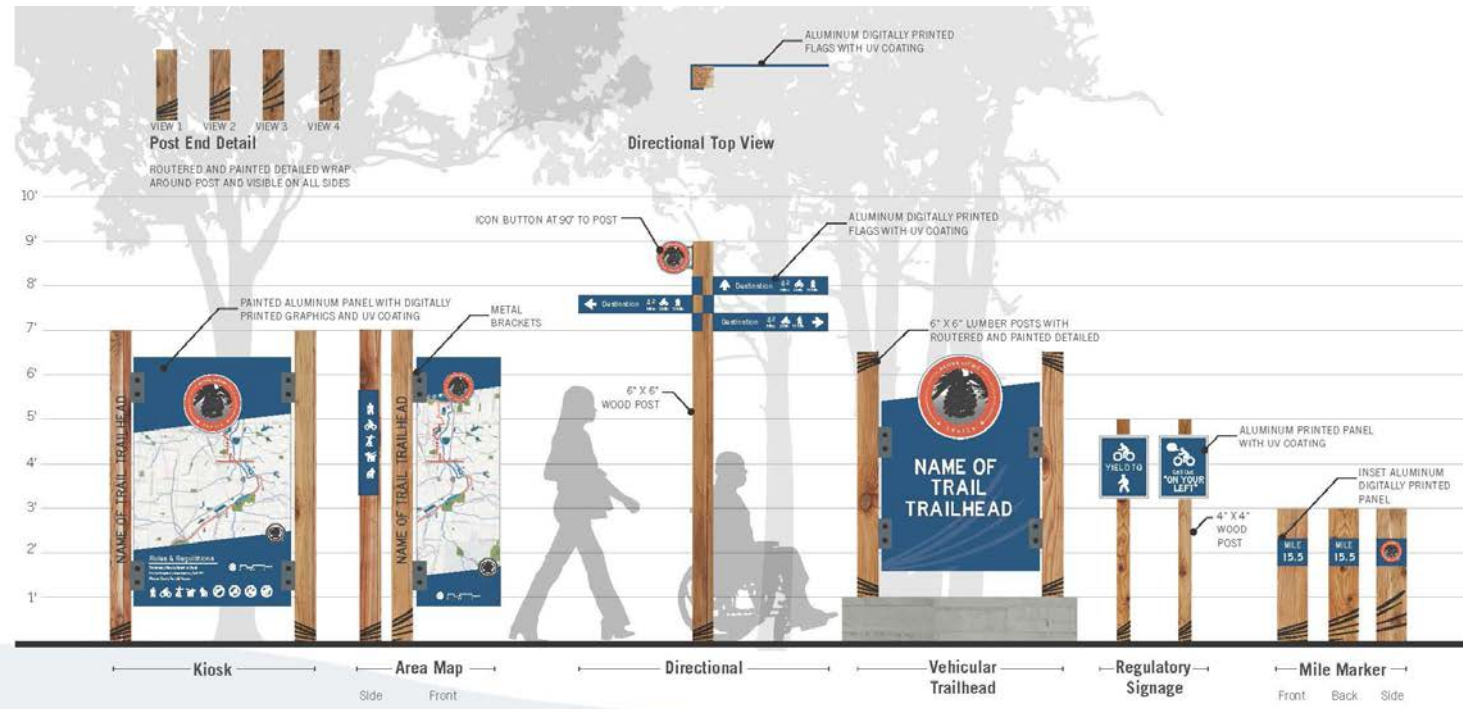
sources:

Osborn, Katie. "Wayfinding: The Design of Getting Lost and Found." American Planning Association PAS Memo, no. March / April (2018). Accessed July 29, 2023.

Alta Planning and Design, Lewis and Clark County Public Health. "Greater Helena Active Living Wayfinding System." (2017). Accessed August 2, 2024. https://www.lccountymt.gov/files/assets/county/v/1/health/documents/final17.03.20_greater_helena_area_active_living_wayfinding_system_revised.pdf.

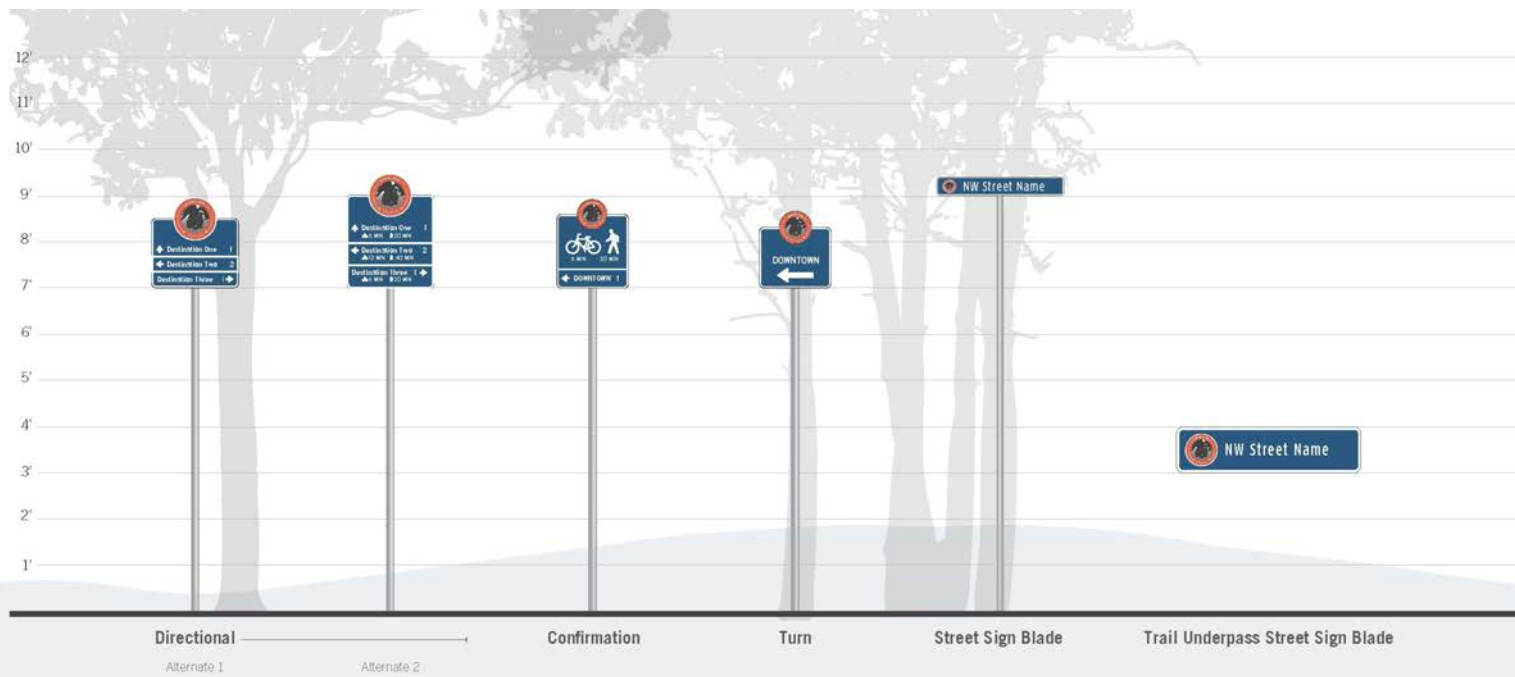
Landmark Design and Salt Lake City. "Salt Lake City Parks, Open Space and Trail Signage Guidelines." Accessed August 2, 2024 <https://www.slcdocs.com/parks/Salt%20Lake%20City%20PL%20Signage%20Guidelines.pdf>

universal trail sign design requirements		
Principle	Definition	Application
Equitable Use	The design is useful and marketable to people with diverse abilities.	The design is useful and marketable to people with diverse abilities. A greater variety of tools provided within a system will increase the availability of information to the broadest audience; signs, maps, digital, print or customer service. This approach also allows for flexibility for a user to consult multiple tools to confirm their assumptions about how to arrive at the destination.
Flexibility in Use	The design accommodates a wide range of individual preferences and abilities.	
Simple and Intuitive Use	Use of the design is easy to understand, regardless of the user’s experience, knowledge, language skills, or current concentration level.	The use of universal iconography (images and symbols) can be an asset in communicating destinations on the system. Iconography can help facilitate wayfinding in areas where populations speak a variety of languages. Additionally, using iconography can reduce the need for long lists and can promote grouping of information by category. A set of 50 public-domain symbol signs was developed in the 1970s by AIGA, the professional association for design, in partnership with the U.S. Department of Transportation, for free use by all (AIGA 2018).
Perceptible Information	The design communicates necessary information effectively to the user, regardless of ambient conditions or the user’s sensory abilities.	Large-scale graphics and the placement of signage will assist in the approachability of the sign or map. Good places for large-scale graphics include gateways, main entrances, or restrooms. The placement and scale of the sign or information will allow a variety of differently abled people to approach and consume the information.
Tolerance for Error	The design communicates necessary information effectively to the user, regardless of ambient conditions or the user’s sensory abilities.	When confronted with a level of confusion or when not able to interact with the sign or map, people will most likely turn to someone and ask for assistance. Deploying a customer service team at the gateway of a system—in a transportation hub, for instance, or in a central downtown district—can be a final step in helping people find the destination.
Low Physical Effort	The design can be used efficiently and comfortably and with a minimum of fatigue.	
Size and Space for Approach and Use	Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user’s body size, posture, or mobility.	The location of the wayfinding tool impacts the ease of use. The placement strategy of locating signs in low traffic-flow areas can assist those that need time to digest information or are using walking devices and better allows multiple people to use the same sign at the same time. Having adequate space without crowding can help people feel comfortable and less anxious about decision making when they may need more time with the map or list of information.



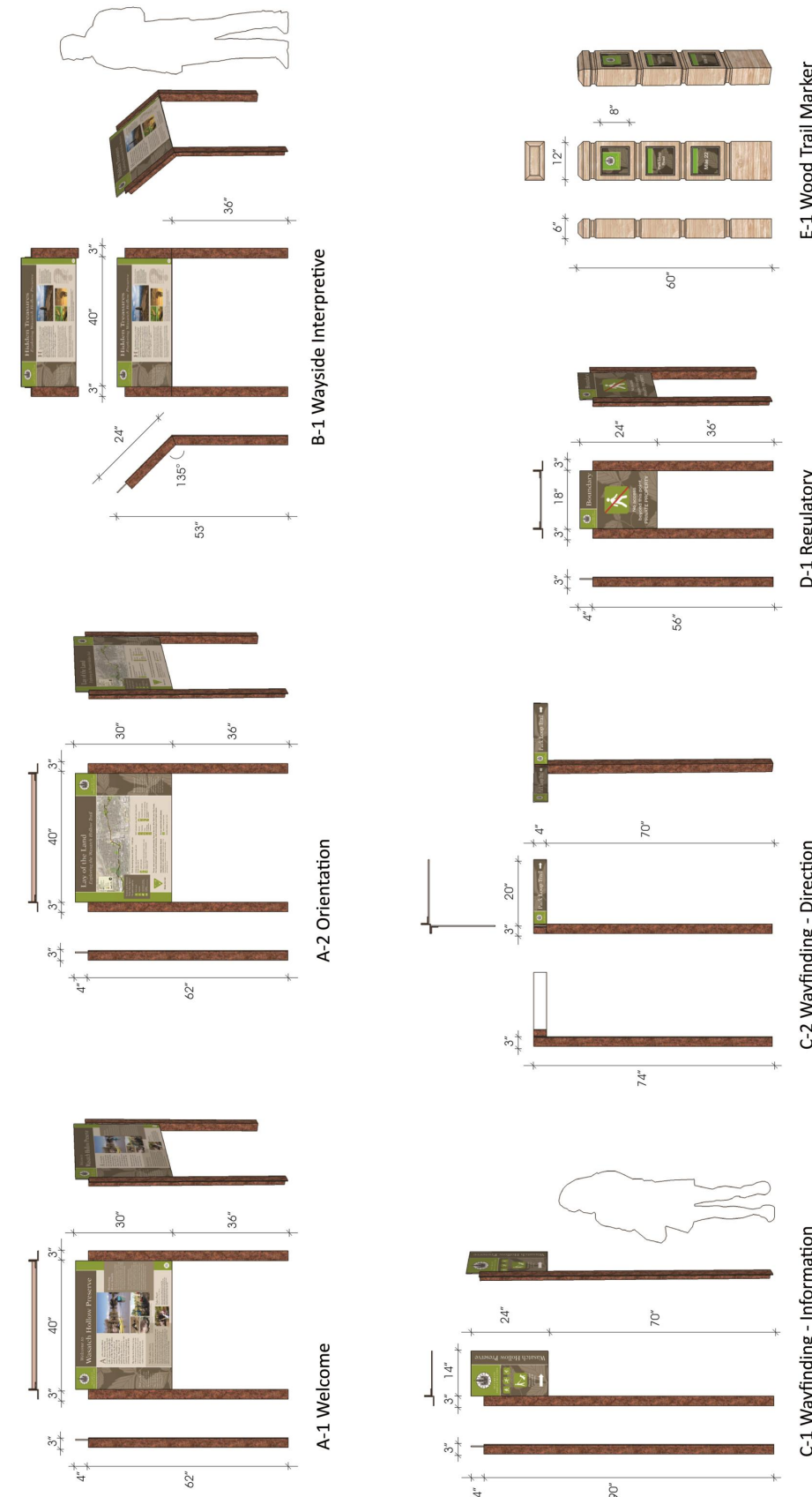
OFF-STREET WAYFINDING

Note: The panels are design to be customizable for each implementation project. The Kiosk and Vehicular Trailhead signs can be interchanged and width, height and art works can be adjusted to accommodation environmental conditions, while maintaining the intent of the design and following the Best Practices laid out in Chapter 4.



ON-STREET WAYFINDING

PANELS AND BASES



Examples use Open Space sign panels. Park versions are the same dimensions; only sign base material (powder coat 'graphite') and sign panel color/layout differ.

staffing and volunteers

ranger program *priority recommendation

Regular monitoring of the Preserve is critical to deterring unwanted use. Having a regular, positive presence can limit opportunities for unwanted uses and help legal users of the Preserve feel safer. Currently, Berks County hires rangers to patrol Antietam Lake Park and other parks within its county park system. There are no other patrols around the Preserve, though City staff and Berks Nature staff are on site at irregular intervals to carry out management actions. This level of monitoring has been insufficient to deter unwarranted activities.

Based on discussions with the study committee, there is potential to expand the ranger program to include City-hired rangers to oversee the City properties. This would be reliant on the City being able to hire rangers who would work in coordination with the County rangers. Coordination is important for managing issues that cross property boundaries and to ensure that there is a regular presence within the Preserve between coverage by the rangers.

All interested parties, namely the County and the City will need to have further discussions to establish an agreement on how the program would function, funding, etc. Discussions may also be needed with the various police forces in the area to help with enforcement in addressing illegal activities.

Beyond monitoring for unwarranted activities, Rangers can be an important first response team for visitor injuries. If Rangers have advanced training in first aid, such as wilderness first aid training, they can respond to emergencies on the Mountain until other emergency medical personnel are able to arrive or the injured person is able to be transported to further help. Due to their familiarity with the Preserve and trail system, this could be an important role for the Rangers as the proliferation of trails could be confusing when trying to either get to an injured person or transport them off the mountain for anyone who does not regularly travel the area.

Additionally, the Ranger program should be designed to support positive relations with the community. This may include initiatives such as having Spanish-speaking rangers and providing rangers with the training to connect people with social services as needed. Another option would be to have the rangers work with volunteer ambassadors who can also be a positive presence on the Preserve, interacting with visitors to make them feel welcome and encourage positive uses.

volunteers

Volunteers can be a great asset when managing conserved lands as many land stewardship tasks are well suited to volunteers. This can include cutting and pulling invasive plants, installing bird boxes, and providing routine trail maintenance. One of the most important roles volunteers can take on is to be a set of eyes and ears on the property. By having an active volunteer presence, unwarranted negative uses can be more quickly identified.

Mount Penn Preserve has dedicated volunteers from various groups that are conducting work on sections of the mountain. These groups include BAMBBA, Berks Trail Works, the Pagota Pacers, and Berks County's trained volunteer group.

A mountain wide established volunteer corps can provide a reliable base of volunteers to perform regular maintenance with limited supervision on an individual basis. They can mobilize as a group to perform large tasks during designated volunteer days. Additionally, a Volunteer Corps or Friends group can monitor a property for inappropriate uses, trail issues, or trash problems and report any concerns to a central coordinator. This can be done informally while volunteers are carrying out projects within the Preserve, or more formally through a volunteer ambassador program. Such an ambassador program could work in tandem with the ranger program.

With proper first aid training, volunteers could also provide minor first aid if needed. Any first aid administered should be in line with, and not exceed, the level of training held by the volunteer. Additionally or alternatively, volunteers could be trained in the location of first aid kits and in trail layout to help direct emergency medical response services to an injured person. These volunteers would be part of the volunteer corps or Friends group and would only be individuals who are comfortable with going through the training and providing first aid.

recommendations

Outreach to community members, especially neighbors, should be considered to generate a volunteer base. Natural Lands has developed methods to involve trained and invested volunteers. Similar volunteer opportunities can be implemented at the Preserve to further engage the community and build a Friends group.

A central Mount Penn Preserve Volunteer Corps or Friends group would help in many ways.

The "flow" of volunteer work would be generated by the MP3 board as a "request for volunteer work needed". The needs identified and agreed upon by all parties including the Borough of Mount Penn, the Townships of Alsace and Lower Alsace, the City of Reading and the County of Berks would be prioritized and the potential for unsanctioned work would be reduced.

One central coordinator would need to be aware of volunteer work before it occurs and would be on site to ensure standards are being met. If the volunteer work is not commissioned by the Board, does the volunteer group have permission to do the work and is the work taking place in an environmentally sensitive area? Multi-municipal coordination is particularly key for trail building as trails cross municipal borders.

Standards should be developed for volunteer tasks and volunteers should be classified into groups according to their skill level. For example, all volunteers can participate in clean ups, but trail building, invasive removal and erosion prevention projects require special skills.

The volunteer tasks that need completion should also be categorized by their difficulty level. For example, there may be volunteer interest from corporate groups and having a list of "easy" tasks would be helpful to have ready.

Volunteers should participate in hands-on training that not only gives participants practical skills to carry out tasks in the field, but also explains management practices and the importance of ongoing stewardship. This could be designed similar to Natural Lands' Force of Nature volunteer program. Force of Nature volunteers participate in an in-depth training program, which prepares them to assist with stewardship and visitor outreach as either a Trail Ambassador or Team Leader. Trail Ambassadors walk the trails, greeting visitors and helping with property care. Team Leaders lead volunteer groups or help with ongoing

volunteer projects in our offices and on our preserves. The Team Leaders can help lead projects with other Friends volunteers and manage event days with specific groups such as college volunteers. The training should not only cover how to carry out tasks, but also explain why they are important. This helps build the volunteers' knowledge base, provides motivation, and helps them be better ambassadors if they encounter curious visitors.

Annual trainings can be made available to the volunteer corps, so they have the ability to participate in more advanced work if they like. Children's youth and scout groups can contribute, and a training option should be accessible and appropriate for young people.

Training topics could include:

- invasive plant removal
- trail maintenance
- water monitoring
- event assistance and public relations
- bird and bat box monitoring and maintenance

In addition to a volunteer corps, MP3 can recruit volunteers for one-time projects, both individuals and groups like staff from a corporation or scouting groups. Another option is to engage the local schools and universities. Input from the first public meeting included suggestions to engage high school students in volunteer work or to have schools or classes adopt sections of the preserve to help steward through volunteer work. Such efforts would require staff coordination to oversee, but could provide opportunities to engage local students.

staff coordination

In addition to sharing volunteers across the Preserve, staff from the MP3 organizations can also work together to implement stewardship and trail tasks. While much of the work recommended in this plan is likely to be carried out individually by organization based on property boundaries, planning a few work days or projects each year that bring together staff from multiple organizations can help pool expertise and people to tackle specific projects. This can be particularly helpful for large-scale projects and work on trails that cross property boundaries. It can also be helpful to have additional staff on-hand for large-scale volunteer events. Projects can be coordinated amongst the individual partners or through the board, working to share the benefits and time commitments equitably amongst the partners.

employ corps programs

Another avenue for increasing dedicated support to steward the forest and maintain the trails is to engage with state and national corps groups. This can include partnering with programs such as PA DCNR's Outdoor Corps, AmeriCorps, and the Student Conservation Association. Of particular interest may be the ClimateCorps, which the City of Reading has already worked with in 2023. Through these programs, MP3 may be able to host corps members for individual projects or for longer placements. Often these programs require a cost-sharing agreement and require oversight by staff.



Volunteers can be a great asset when managing conserved lands.

Photos – top: Marie Schneider, bottom left: Debbie Beer, bottom right: Jerry Mangas

public outreach synopsis

Public outreach was facilitated through the advisory committee, public meetings and in depth, key person interviews.

advisory committee – three virtual meetings

The initial advisory meeting was well attended and included a review of roles and expectations, the scope of work, and a SWOT (strengths, weaknesses, opportunities, and threats) analysis.

The second committee meeting took place on October 11th, 2023. In between the initial and second advisory committee meeting, there were 10 site visits. Committee members joined many of these site visits, which were focused on certain trails or sections of forest. Natural Lands staff summarized the findings of the site visits at the second committee meeting. Committee members responded to these initial findings and their feedback was incorporated. The committee commented on initial plans for the public meeting.

The third and final committee meeting summarized the public input that was gathered at the initial public meeting. Initial plan recommendations were reviewed as well.

public meetings – two in person meetings

The initial public meeting was held on December 5th, 2023. A presentation was given on the purpose of the plan, the scope of work and the work to date. Then the room was broken up into four stations, where the public had the ability to provide comments. The stations included:

- Forest Priorities
- Trail Recommendations
- Volunteer Coordination
- Strengths, Weaknesses, Opportunities, Threats
- Open Comments

The second public meeting was held on May 16th, 2024. The meeting started with a presentation that reviewed the purpose of the plan, the scope of work, the work completed to date, the public feedback from the initial public meeting and the draft plan recommendations. Participants were given comment cards to evaluate the draft recommendations and there were comments stations where individuals had the opportunity to provide comments.

key person interviews (8)

Eight key person interviews were conducted to collect in depth feedback about certain aspects of the master plan. The committee suggested the following interviewees who were willing to share their time and experience.

- Matt Brophy: Pagoda Pacers, MP3 committee, resident
- Corrie Crupi: Lower Alsace
- Dane Clay: Berks Trail Works
- Christopher Dunkle: resident
- Logan Fox: Berks Trail Works
- Maria Jones: resident
- Fred Moreadith: BAMBA, project coordinator, Berks County staff
- Cathy Myers: Reading EAC, resident





The interviewees brought different perspectives, but we heard about some issues more frequently. The themes and issues we heard about often are:

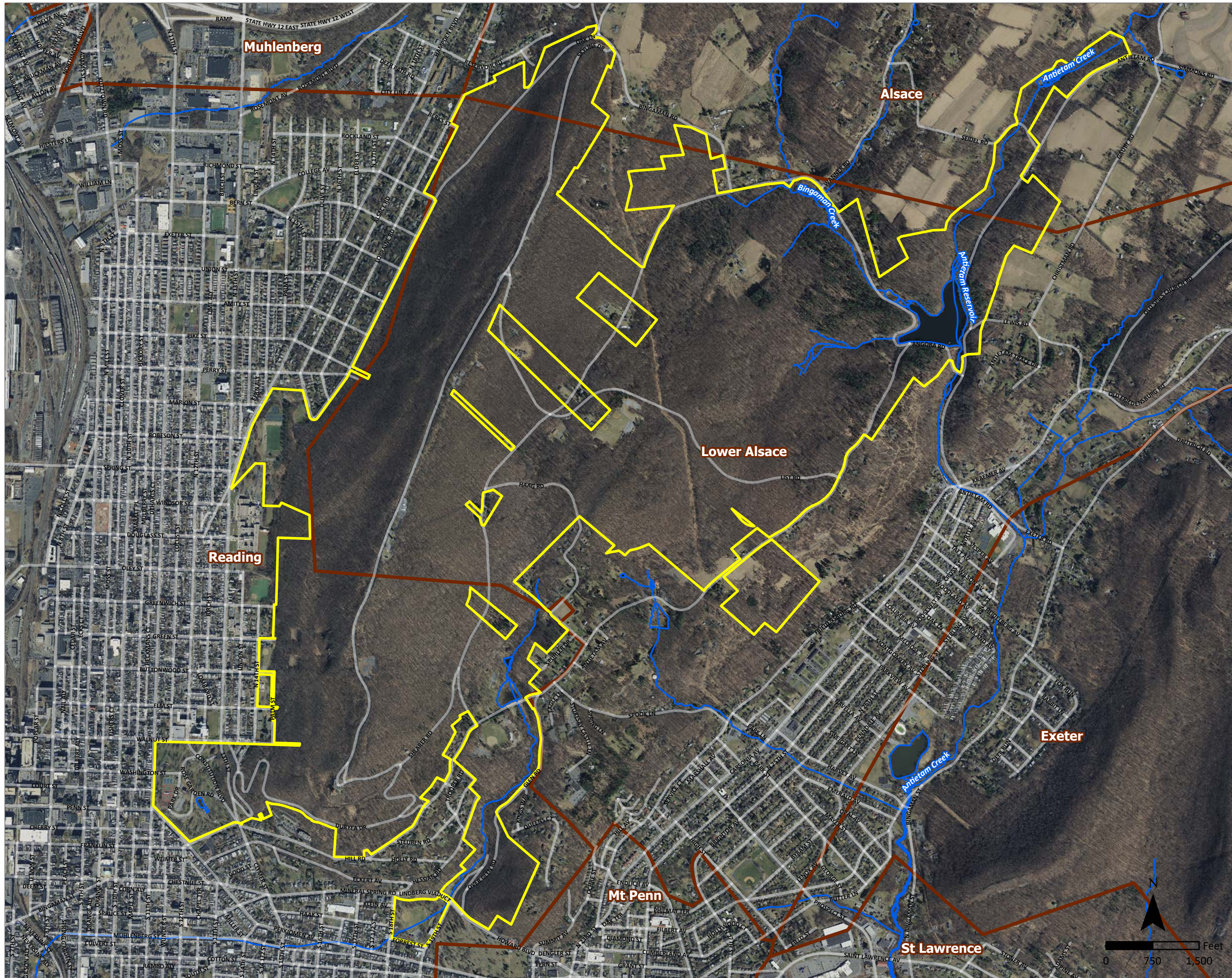
- safety top priority
- varying condition of trails
- lack of maps and signage an issue
- mountain bikers carry out a lot of maintenance
- concern about how trails impact natural resources
- invasive plants
- confusion over official vs social trails
- limited parking generally and lack of access in general from the city side
- rogue mountain biking

maps

- Map 1: 2021 Aerial Photography
- Map 2: Public and Protected Lands
- Map 3: Geology
- Map 4: Topography/Hydrology
- Map 5: Plant Cover
- Map 6: Management Units
- Map 7: Major Routes
- Map 8: Trail Surface Issues

Mount Penn Preserve
Alsace and Lower Alsace Townships, Reading
Borough, Berks County, PA

-  Mount Penn Preserve Boundary
-  Municipal Boundaries
-  Waterways
-  Roadways



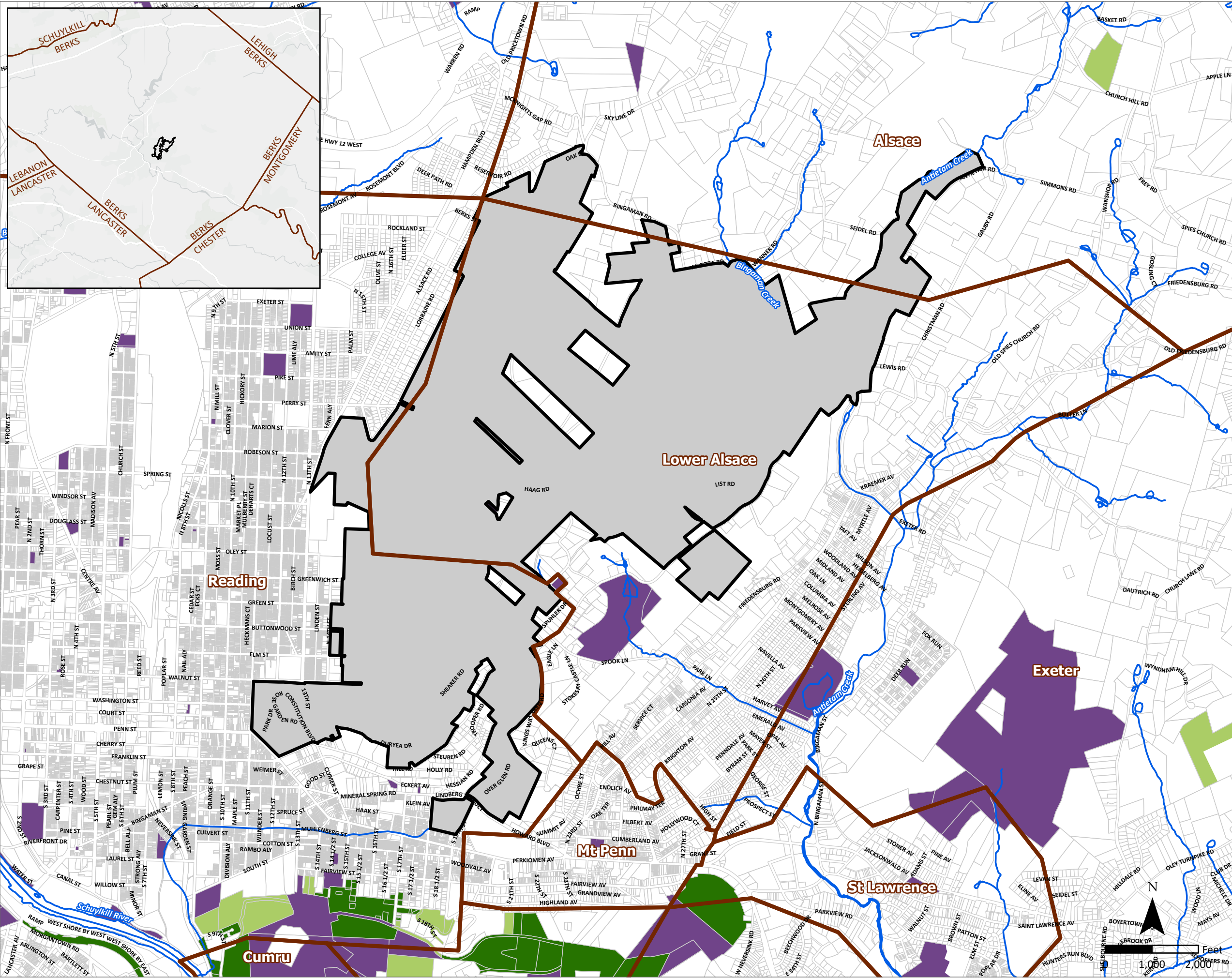
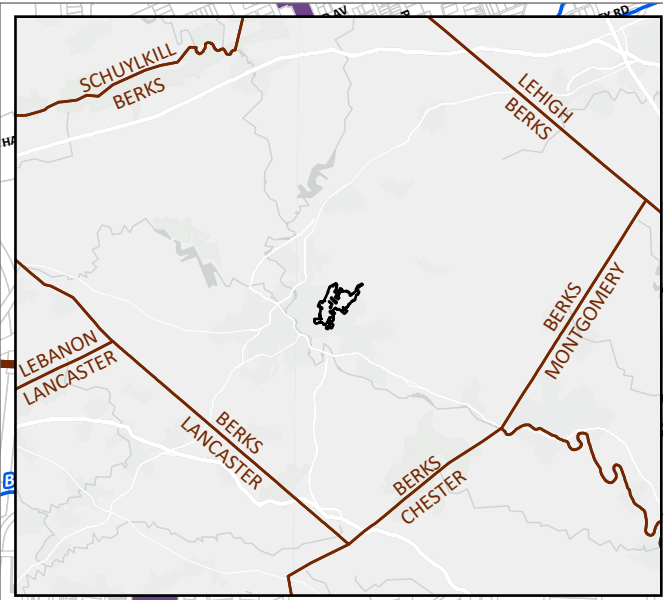
1031 Palmers Mill Road, Media, PA 19063
610-353-5587 | natlands.org

1. Property boundary, roadways, and waterways from Berks County.
2. Aerial imagery from PEMA.

Compiled By: MEB 10/23/2024








Disclaimer: This map is not a survey. The information imparted with this map is meant to assist Natural Lands Trust, Inc. (DBA Natural Lands), describe the placement of certain retained, reserved, or excluded rights and to calculate acreage figures. Property boundaries, while approximate, were established using the best available information, which may have included: surveys, tax maps, field mapping using G.P.S., and/or orthophotos. Natural Lands makes no representation as to the accuracy of said property lines (or any other lines), and no liability is assumed by reason of reliance hereon. Use of this map for other than its intended purpose requires the written consent of Natural Lands.





Public and Protected Lands MAP 2

Mount Penn Preserve
 Alsace and Lower Alsace Townships, Reading
 Borough, Berks County, PA

-  Mount Penn Preserve Boundary
-  Municipal Boundaries
-  Parcel Boundaries
-  Waterways
- Public and Protected Lands**
-  Conservation Owned
-  Local Owned
-  Conservation Easement



1. Public/Protected lands from WeConservePA and Berks County.
 2. Parcels, waterways, roadways, and municipal boundaries from Berks County.

Compiled By: MEB 10/23/2024












Disclaimer: This map is not a survey. The information imparted with this map is meant to assist Natural Lands Trust, Inc. (DBA Natural Lands), describe the placement of certain retained, reserved, or excluded rights and to calculate acreage figures. Property boundaries, while approximate, were established using the best available information, which may include: surveys, tax maps, field mapping using G.P.S., and/or orthophotos. Natural Lands makes no representation as to the accuracy of said property lines (or any other lines), and no liability is assumed by reason of reliance hereon. Use of this map for other than its intended purpose requires the written consent of Natural Lands.

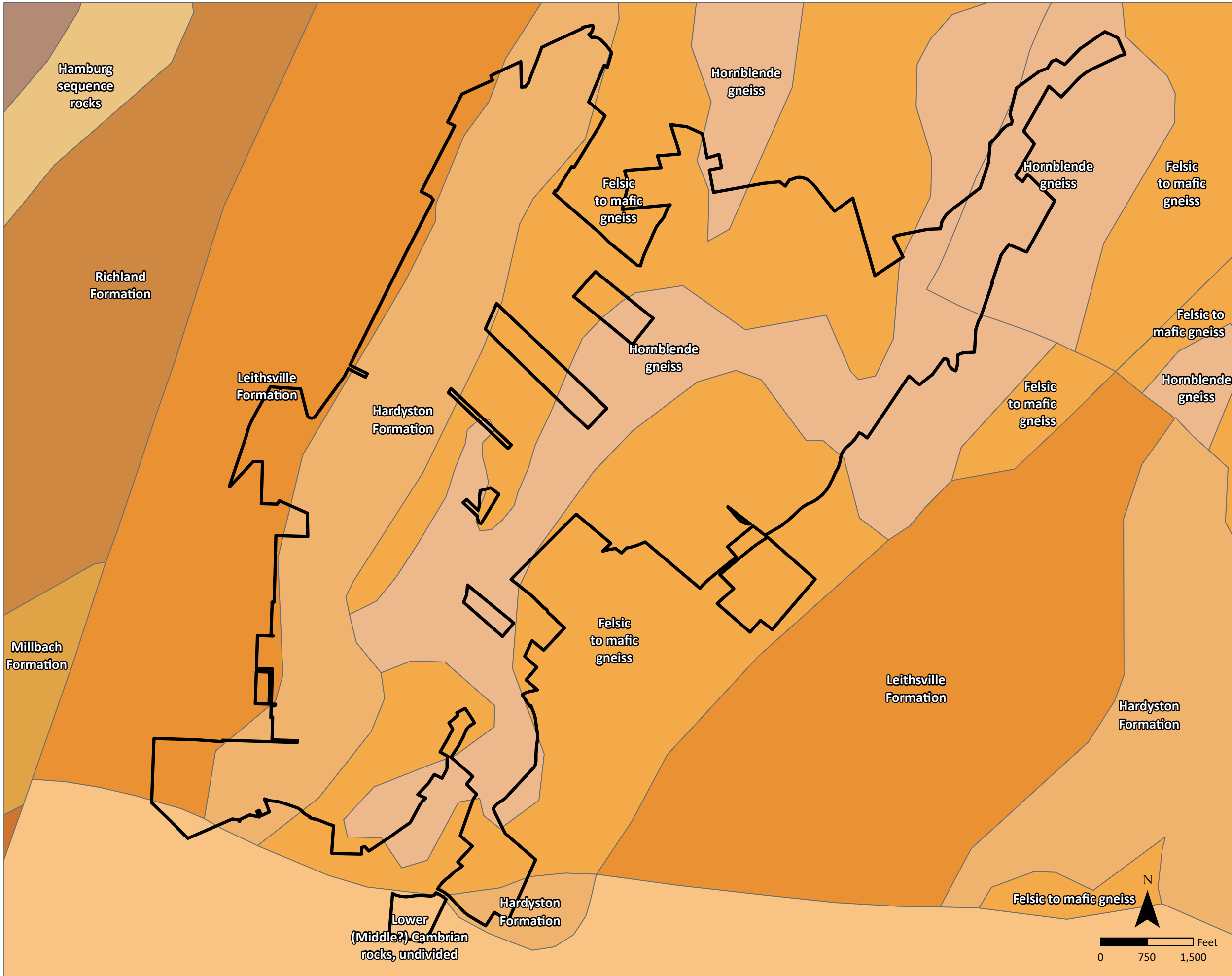
Geology

Mount Penn Preserve
Alsace and Lower Alsace Townships, Reading
Borough, Berks County, PA

 Mount Penn Preserve Boundary

Surface Geology

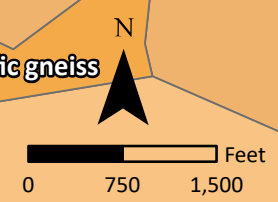
-  Allentown Formation
-  Buffalo Springs Formation
-  Felsic to mafic gneiss
-  Hamburg sequence rocks
-  Hardyston Formation
-  Hornblende gneiss
-  Hornblende gneiss
-  Leithsville Formation
-  Lower (Middle?) Cambrian rocks, undivided
-  Millbach Formation
-  Richland Formation




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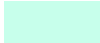





1. Parcels from Berks County.
 2. Geology from PA Geological Survey.
 Compiled By: MEB 10/23/2024

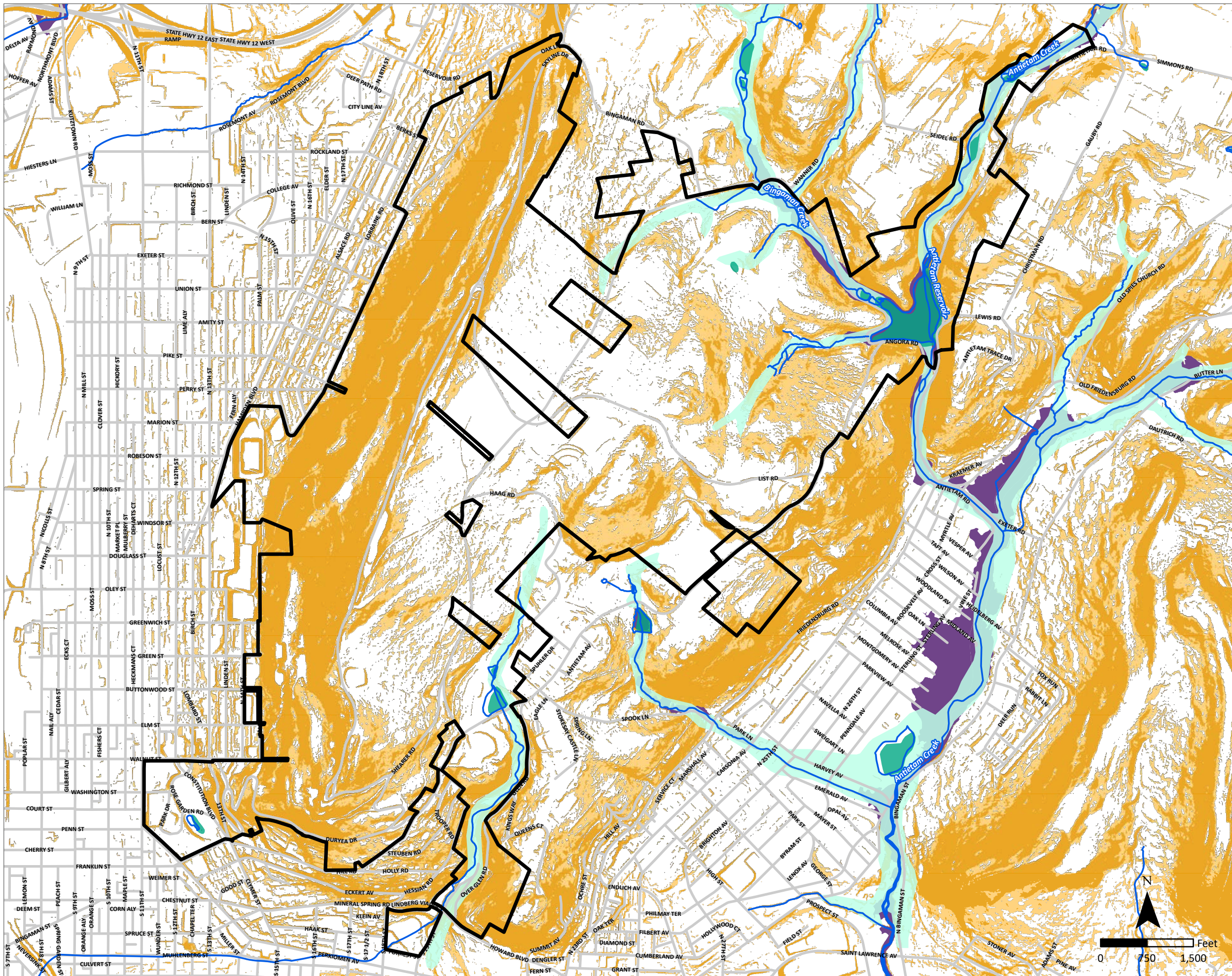
Disclaimer: This map is not a survey. The information imparted with this map is meant to assist Natural Lands Trust, Inc. (DBA Natural Lands), describe the placement of certain retained, reserved, or excluded rights and to calculate acreage figures. Property boundaries, while approximate, were established using the best available information, which may have included: surveys, tax maps, field mapping using G.P.S., and/or orthophotos. Natural Lands makes no representation as to the accuracy of said property lines (or any other lines), and no liability is assumed by reason of reliance hereon. Use of this map for other than its intended purpose requires the written consent of Natural Lands.



Topography/Hydrology

Mount Penn Preserve
Alsace and Lower Alsace Townships, Reading
Borough, Berks County, PA

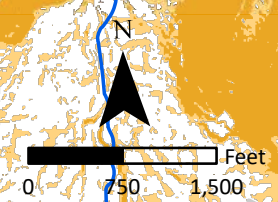
-  Mount Penn Preserve Boundary
 -  Roadways
 -  Waterways
 -  Hydric Soils
 -  Wetlands
 -  Floodplains (100-year)
- Slope
-  < 15%
 -  15% - 25%
 -  > 25%



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1. Slopes from LIDAR data, PA MAP Program, DCNR.
 2. Hydric soils from USDA-NRCS.
 3. Floodplains from FEMA.
 4. Wetlands from the National Wetlands Inventory.
 5. Waterways, roadways, and parcel boundaries from Berks County
- Compiled By: MEB 10/23/2024

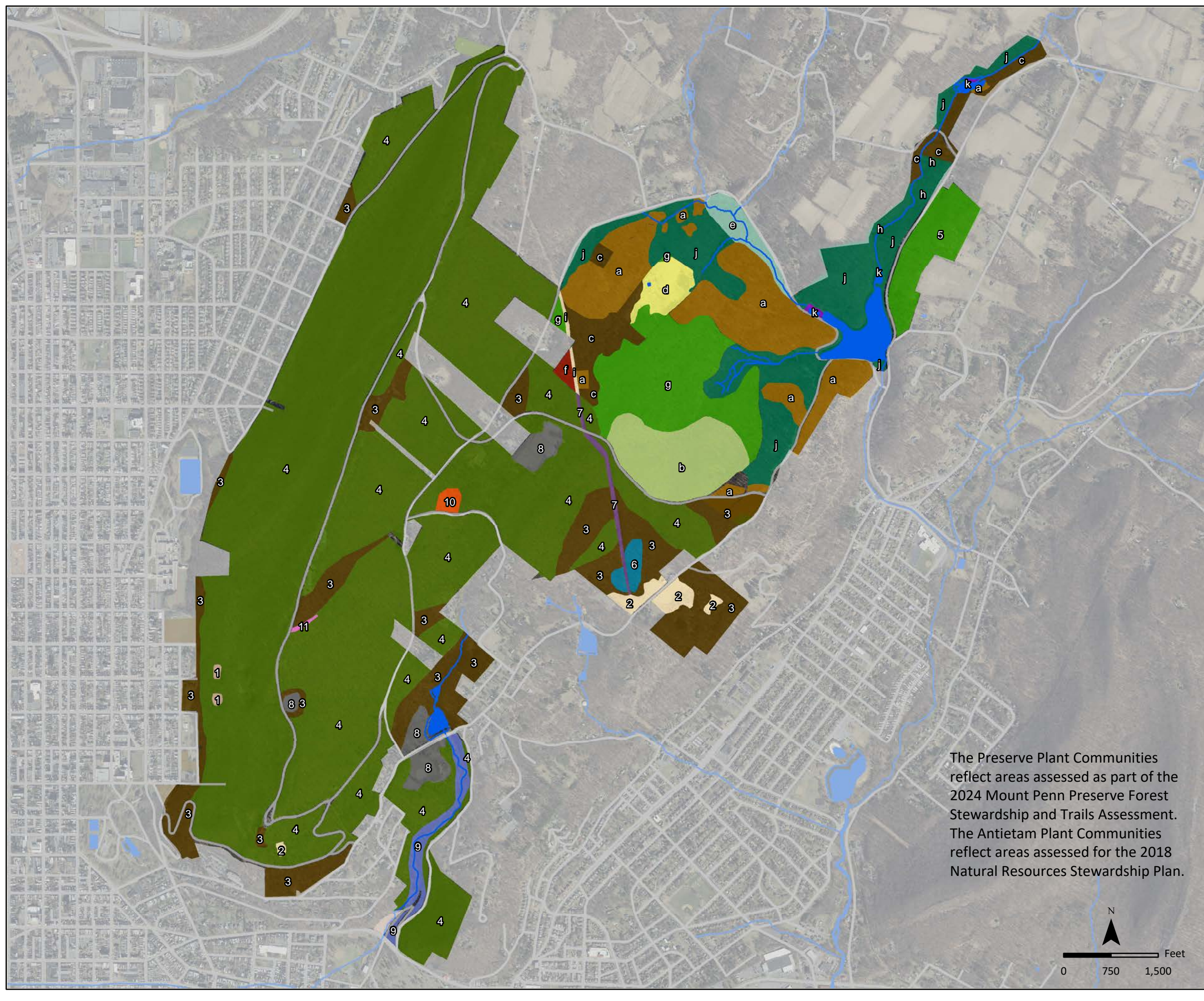
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Plant Cover

MOUNT PENN PRESERVE

Alsace and Lower Alsace Townships, the City of Reading, Berks County, PA

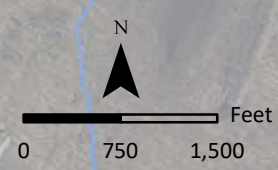


- | | |
|-----------------------------------|--|
| Waterways | Antietam Plant Communities |
| Roadways | a Conifer Plantation - Mixed Hardwood Forest |
| Preserve Plant Communities | b Dry Oak Heath Forest |
| 1 Lawn | c Mixed Hardwood Forest |
| 2 Meadow | d Orchard |
| 3 Mixed Hardwood Forest | e Red Maple Palustrine Forest |
| 4 Oak Forest | f Red Maple - Mixed Hardwood Terrestrial Forest |
| 5 Oak Mixed Hardwood Forest | g Red Oak - Mixed Hardwood Forest |
| 6 Palustrine Forest | h Skunk Cabbage Seep |
| 7 Powerline | i Terrestrial Meadow/Shrubland |
| 8 Recreation | j Tulip-Beech-Maple Forest |
| 9 Riparian Forest | k Wet Meadow/Marsh |
| 10 Skunk Cabbage Wetland | |
| 11 Stiltgrass Savanna | |

The Preserve Plant Communities reflect areas assessed as part of the 2024 Mount Penn Preserve Forest Stewardship and Trails Assessment. The Antietam Plant Communities reflect areas assessed for the 2018 Natural Resources Stewardship Plan.

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1. Aerial photography from PAMAP.
 Compiled By: KEB 11/22/2024




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Management Units

MOUNT PENN PRESERVE

Alsace and Lower Alsace Townships, the City of Reading, Berks County, PA

 Management Unit

- 1. Oak Lane
- 2. List Road to Skyline Drive Forest
- 3. List Road Oak Forest
- 4. Radio Tower
- 5. Radio Tower to Tower Road
- 6. Tower Road to Haag Road
- 7. Haag Road to Ferndale Trail
- 8. Stiltgrass Savanna
- 9. Ferndale Trail to Pagoda Oak Forest
- 10. Pagoda
- 11. Rotary Park
- 12. Palustrine Forest
- 13. Hill Road West Mixed Hardwood Forest
- 14. Hill Road East Mixed Hardwood Forest
- 15. List Road to Hill Road Oak Forest
- 16. Old Orchard
- 17. Egelman's Upland
- 18. Egelman's East
- 19. Haad Road to Egelman's Forest
- 20. Rose Valley Creek
- 21. Pandora Oak Forest
- 22. Antietam Road East
- 23. Antietam Lake Park

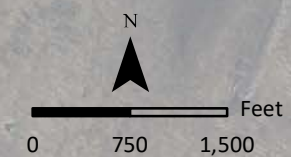


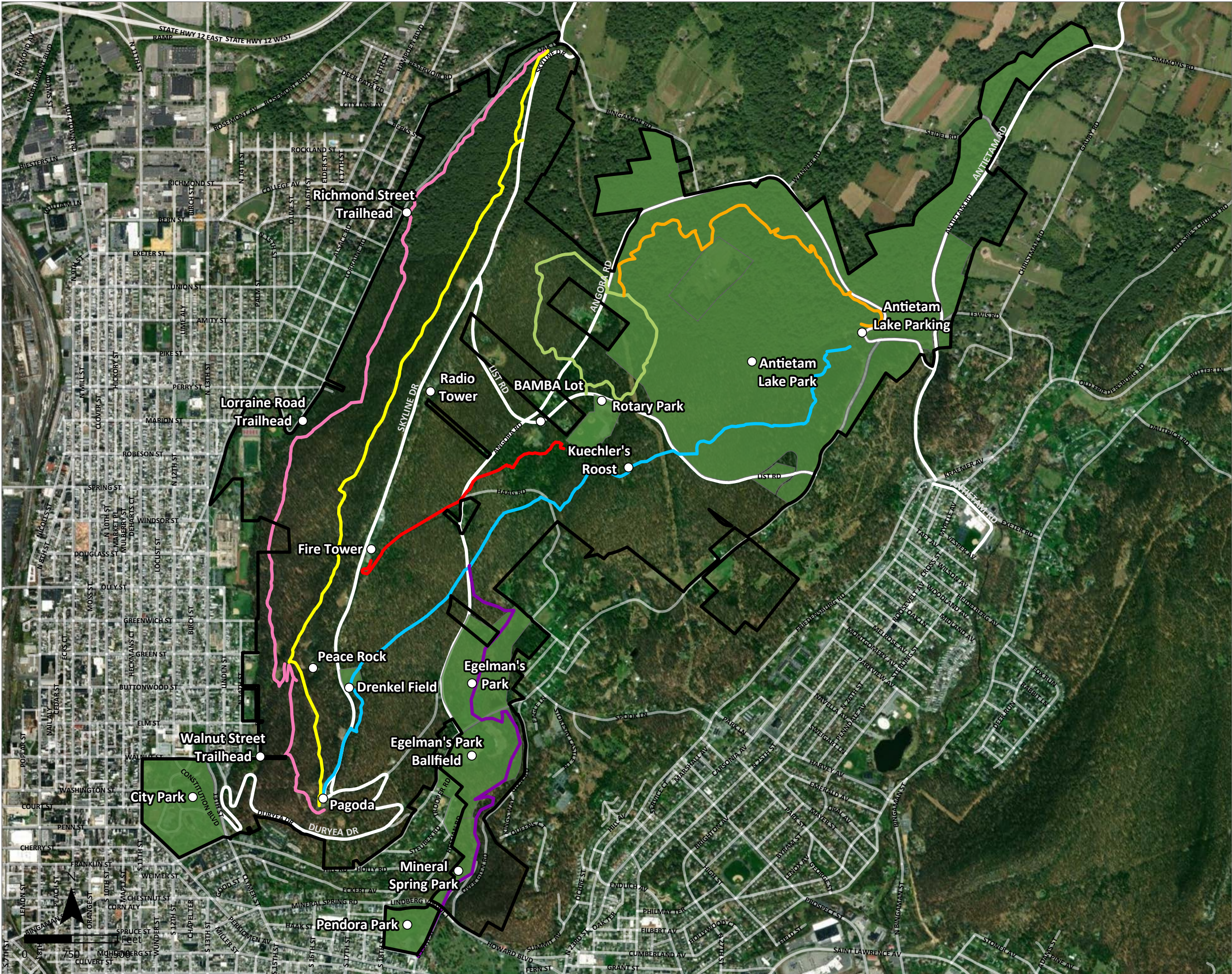
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1. Aerial photography from PAMAP.

Compiled By: KEB 11/22/2024










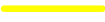
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Major Routes

Mount Penn Preserve
Alsace and Lower Alsace Townships, Reading
Borough, Berks County, PA

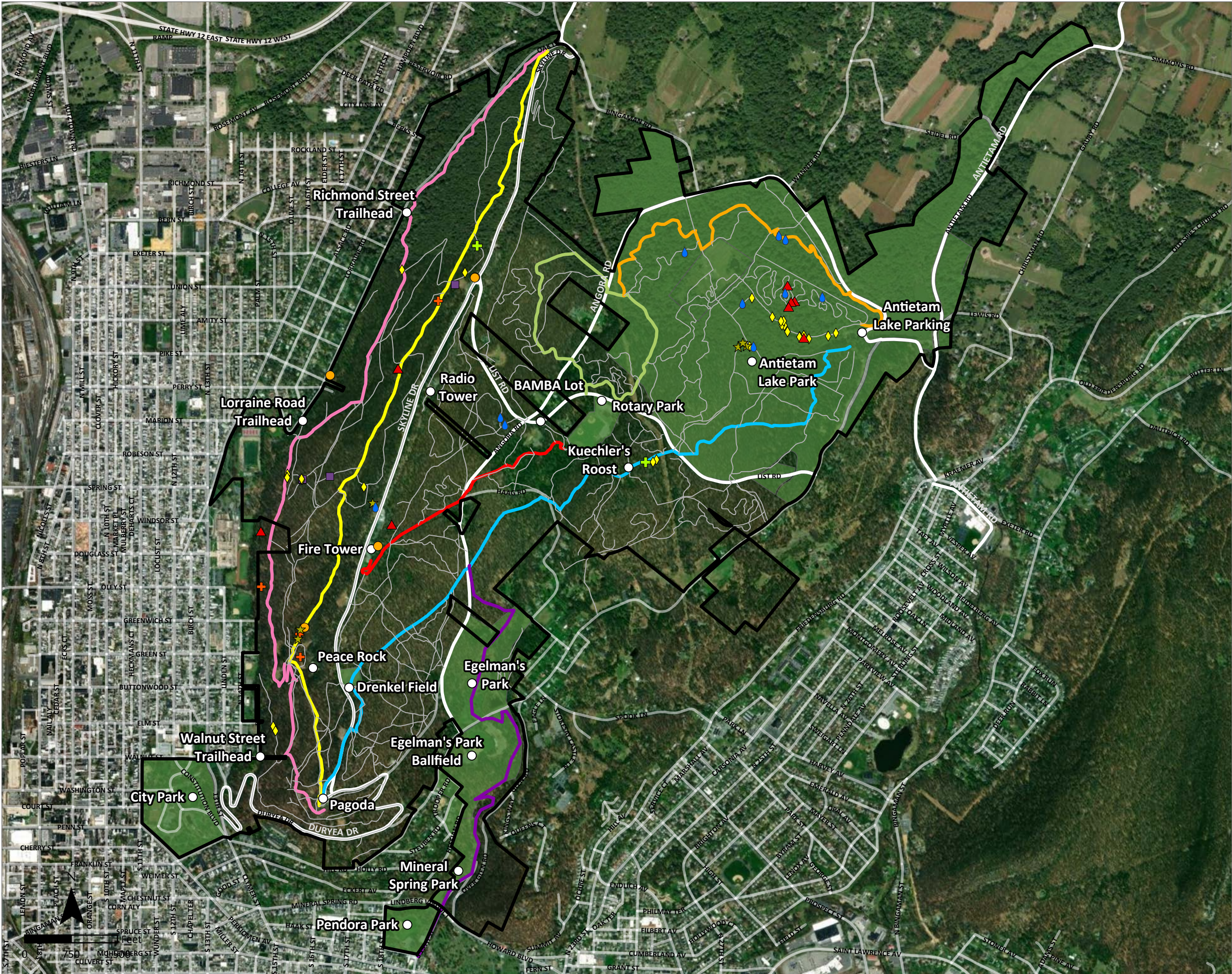
-  Mount Penn Preserve Boundary
-  Park
-  Landmark Locations
- Trails**
-  Gravity-Ferndale Trail
-  Woodcutter Loop
-  Northern Boundary Trail
-  Frontside Reading Trail
-  Historic Gravity Trail
-  Spuhler Lane
-  Bridal Path



1. Property boundary from Berks County.
 2. Light Gray Basemap from from Esri, Inc.
 3. Trails from Trailforks.
 4. Trail surface issues from Natural Lands staff.

Compiled By: MEB 12/18/2024

Disclaimer: This map is not a survey. The information imparted with this map is meant to assist Natural Lands Trust, Inc. (DBA Natural Lands), describe the placement of certain retained, reserved, or excluded rights and to calculate acreage figures. Property boundaries, while approximate, were established using the best available information, which may have included: surveys, tax maps, field mapping using G.P.S., and/or orthophotos. Natural Lands makes no representation as to the accuracy of said property lines (or any other lines), and no liability is assumed by reason of reliance hereon. Use of this map for other than its intended purpose requires the written consent of Natural Lands.



Trail Surface Issues

Mount Penn Preserve
Alsace and Lower Alsace Townships, Reading
Borough, Berks County, PA

- Mount Penn Preserve Boundary
- Park
- Landmark Locations
- Trails**
- Gravity-Ferndale Trail
- Woodcutter Loop
- Northern Boundary Trail
- Frontside Reading Trail
- Historic Gravity Trail
- Spuhler Lane
- Bridal Path
- connector trails

- Trail Surface Issues**
- Access Obstacle
- Braided Trail
- Erosion
- Hazard
- Steep Slope/Fall Line
- Wet Surface
- Destructive Build
- Hazard
- Nuisance

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appendices

- A: Priority Tables:
 - Forest Stewardship Preserve-wide Strategies
 - Forest Stewardship Recommendations by Management Unit
 - Trail Preserve-wide Strategies
- B: Cost Estimates
- C: Invasive Plant Control Techniques
- D: Plant List by Management Unit
- E: Climate Change Tree Vulnerability
- F: DCNR Climate Change Tree Species Projections
- G: PNDI
- H: Firewood Cutting and Bat Habitat Conservation Measures FAQ (June 2021)
- I: eBird Species List
- J: Case Studies
- K: USDAFS Rolling Dip Detail
- L: Emergency Info
- M: Sample Ordinance

forest stewardship preserve-wide strategies

PRIORITY	RECOMMENDATION ¹	WHO CAN IMPLEMENT? ²
deer management		
1	Continue the deer management program.	Staff and Contractor
1	Continue to expand deer management program where safety zones and ownership allow.	Staff and Contractor
2	Monitor the effectiveness of deer management. Consider culls, if allowed by the Game Commission, if the deer population remains too high.	Staff and Contractor
4	Share information with the community about the results of the program, such as changes in the health of the forest or number of deer and vehicle collisions.	Staff
1	Continue posting prominent signage about the deer hunting program leading up to and during hunting season.	Staff
trail impacts		
1	Carefully assess the need for new trails prior to approval and installation.	Staff
1	Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.	Staff
invasive plants		
1	Create an invasive plant management program.	Staff
1	Prioritize invasive plant control based on quality of management area, impact of invasive species, and resources available.	Staff
1	Reduce the spread of invasive plants by cleaning equipment between areas, minimizing soil disturbance, reducing fragmentation and edge areas, and educating visitors about cleaning personal gear and not planting invasive species in their properties.	Staff and Contractors
3	Replant areas where invasive plants have been removed until natural regeneration of native plants has been sufficiently restored.	Staff, Volunteer, or Contractors
1	Monitor the Preserve at least annually during the growing season to identify new invasive plants.	Staff or Volunteers
1	Monitor control efforts to determine effectiveness and prevent reestablishment.	Staff

monitor for and manage damaging pests		
2	Stay current on possible spread of pests and best management practices.	Staff
emerald ash borer		
1	Remove ash tree where they are hazards. Consult with an arborist prior to removal.	Staff or Contractor
3	Control invasive plants and replant canopy gaps that have formed as a result of ash tree die off.	Staff or Contractor
beech leaf disease		
1	Monitor the forest for any signs of beech leaf disease. Alert all partners if infected trees are identified.	Staff
3	Plant trees in the understory to replace beech trees if they die off.	Staff, Volunteer, or Contractors
2	For Antietam Lake Park: Identify select beech trees to treat, choosing trees that will protect the canopy and maintain the seed bank.	Staff
2	For Antietam Lake Park: Research possible treatment options for effectiveness, application methods, and cost.	Staff
1	For Antietam Lake Park: Identify beech trees that may become hazardous if they succumb to BLD and plan for their removal if BLD is identified within the Preserve or nearby.	Staff
oak wilt		
1	Monitor for the introduction of oak wilt into the region. Stay current with treatment options.	Staff
1	Avoid cutting or wounding trees from April through July. If wounds do occur, immediately use wound dressing paint or shellac to cover the wound.	Staff and Contractors
2	If trees become infected, identify the infected area and a buffer area. Create a 3-4 foot deep trench around this area. Remove infected trees over the winter prior to April.	Staff or Contractor
1	Avoid transporting oak wood. Limit use as firewood unless the downed wood has been onsite through the winter.	Staff
3	Improve the health of the forest by increasing the diversity and abundance of native plants.	Staff, Volunteer, or Contractors

PRIORITY	RECOMMENDATION ¹	WHO CAN IMPLEMENT? ²
account for climate change in management		
1	Account for additional time and budget needed for restoration after more frequent and intense storm events when developing work plans and budgets.	Staff
1	Establish extreme heat adaptation protocols such as adjusted work hours, cooling stations and other adaptations as needed(taken from City of Reading Climate Resiliency Plan)	Staff
3	Monitor for canopy loss from storms and control invasive plants in gaps. Replant with native species if they do not naturally regenerate. Protect seedlings from deer with fencing or tree tubes.	Staff, Volunteer, or Contractors
1	Maintain the current extent of the forest to support habitat and migration routes as well as retain carbon storage and sequestration capacity.	Staff
2	When doing plantings, include species projected to be resilient to climate change (see DCNR's Climate Adaptation and Mitigation Plan for species vulnerability; updated list from DCNR pending).	Staff
3	Allow for and support varying forest ages across the Preserve.	Staff
land protection and connectivity		
1	Maintain current forest extent, avoiding timber harvests.	Staff
4	Explore options for fee land acquisition or conservation easements with willing landowners around the Preserve and other central forest areas like Neversink Mountain, as well as connecting natural areas between large forest areas.	Staff and Partners
bird habitat		
2	Increase native plant diversity and abundance.	Staff
3	Have a range of forest ages and shrubland across the landscape.	Staff
5	Encourage or hold bird walks to collect more information on what species are present and to support positive use of the Preserve.	Staff or Volunteers

bat habitat		
1	Leave snags where they are not a hazard to provide roosting sites.	Staff
2	When doing plantings, include tree species that support bats and a less vulnerable to climate change.	Staff
4	Install additional bat boxes to create roosting areas. The boxes should be 10-15 feet off the ground, SE facing with sun exposure, and near water.	Staff or Volunteers
1	Avoid removal of shagbark hickory as possible as well as other flaky bark trees.	Staff
1	Avoid cutting potential nesting trees between November 15th and March 30th.	Staff
amphibians		
1	Create a 300-foot non-disturbance buffer around vernal pools and other wetlands.	Staff
2	Protect the forest within 1,000 feet of the vernal pool/wetland.	Staff
1	Avoid creating tire ruts deeper than 6" during the early spring.	Staff and Contractors
4	Monitor amphibian populations.	Staff or Volunteers
age diversity		
3	Use existing large canopy gaps to create young forests or shrublands.	Staff
2	In areas of new disturbance, control invasive plants to allow for natural succession of plant communities. Until deer are controlled, this may require fencing naturally regenerating plants if this occurs and/or planting trees or shrubs and protecting them from climate change.	Staff
2	Support progression to mature and old-growth forests by retaining mature trees, retaining dead and downed wood, and planting young canopy trees if they do not naturally regenerate after deer and invasive plant control.	Staff

¹ High priority recommendations are noted in bold.

² Volunteers should not be used to apply herbicide unless they have proper certification and personal protective equipment

forest stewardship preserve-wide strategies continued...

water quality

PRIORITY	RECOMMENDATION ¹	WHO CAN IMPLEMENT? ²
riparian buffers		
1	Ensure that all riparian buffers remain forested for at least 100 feet from waterways.	Staff
2	Increase the density of riparian buffers by planting native trees and shrubs.	Staff, Volunteer, or Contractors
seeps, springs, wetlands, and vernal pools		
1	Enact a 300-foot non-disturbance buffer around seeps, springs, wetlands, or vernal pools.	Staff
2	Protect vegetation within 1,000 feet upland of wetlands or vernal pools. Replant area after invasive plant control.	Staff
flooding and erosion		
2	Where feasible, add understory trees and shrubs to help slow and infiltrate stormwater. Prioritize steep slopes and areas that typically flood.	Staff, Volunteer, or Contractors
2	Where natural regeneration is occurring, protect young shrubs and trees with fencing or tree tubes.	Staff or Volunteers
firewood program		
5	If property owners want to allow for firewood collection by private individuals, enact regulations to protect the forest and prevent the spread of tree pests and diseases.	Staff
hazard trees		
1	Continue hazard tree monitoring programs.	Staff
1	Monitor for hazard trees by foot once a year and after severe storms. Contract an arborist as needed or train staff to carry out monitoring.	Staff or Contractor
1	Prune or remove hazard trees to eliminate risk. Hazard trees within the forest areas can simply be dropped and allow to decay in place.	Staff or Contractor

boundary encroachment and illegal use		
1	Install and maintain boundary postings every 50-100 feet along boundaries.	Staff
1	Monitor Park yearly for encroachment. Ensure that boundary signs are properly maintained and clearly mark property boundaries.	Staff
trash cleanup		
2	Remove trash, prioritizing debris accessible to visitors, especially children.	Staff or Volunteers
1	Monitor the Park for new dumping, particularly in areas that have already had volunteer cleanups.	Staff or Volunteers
2	Inform neighbors of Park regulations regarding dumping.	Staff
historic resources		
1	Protect historic resources while carrying out stewardship work. Conversely, protect natural resources when doing any maintenance work to historic features.	Staff
2	Monitor impacts from climate change on both historic resources and surrounding natural resources and assess how that might change management of the resources.	Staff
4	Create interpretive signage and/or hold guided walks to showcase historic resources.	Staff
plantings maintenance		
1	For any plantings, protect with fencing or tree tubes.	Staff or Volunteers
1	Maintain plantings until established and can withstand deer browsing or rubbing. Maintenance includes mowing between tree rows, controlling invasive plants, and repairing or replacing tree tubes or fencing as needed.	Staff or Volunteers (tree tube and fence maintenance)

¹ High priority recommendations are noted in bold.

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forest stewardship recommendations by management unit

unit 1: oak lane • priority: high

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
control invasive plants in center of forest			
1	Control barberry.	Fall	Staff or Contractor
2	Control Japanese stiltgrass.	Summer	Staff or Contractor
1	Monitor invasive plant treatments.	Growing Season	Staff
control invasive plants along skyline drive			
3	Control tree-of-heaven.	Fall	Staff or Contractor
3	Control shrubs along Skyline.	Fall	Staff or Contractor
control invasive plants in the mixed hardwood forest			
1	Reach out to neighbors to share the issues with dumping yard waste.	Spring	Staff
2	Control Japanese knotweed.	June- cut stems; August/ September apply herbicide	Staff or Contractor
2	Control wintercreeper, Japanese honeysuckle, English ivy and oriental bittersweet.	Anytime - cut vines; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
3	Control Norway maple.	Fall	Staff or Contractor
3	Control Japanese-princess tree and weeping cherry.	Fall	Staff or Contractor
3	Control shrubs-barberry, winged euonymus, linden viburnum, wineberry, privet, and jetbead.	Fall	Staff or Contractor; Volunteers for cutting
4	Control mugwort.	Spring	Staff or Contractor

4	Control pachysandra.		Staff or Contractor
4	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
4	Control Japanese stiltgrass.	Summer	Staff or Contractor
4	Control periwinkle.	Spring	Staff or Contractor
restoration			
3	Protect naturally regenerating seedlings with fencing.	Spring	Staff or Volunteers
sightline areas			
4	Restore to a shrubland or, in the future, forest.	Spring or Fall	Staff, Volunteers, or Contractor
quarry			
1	Increase oversight of this area.	Year-round	Staff
recreation			
1	Carefully assess the need for new trails prior to installation.	Year-round	Staff
1	Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.	Year-round	Staff
4	Work with neighbors and schools to engage volunteers.	Anytime	Staff
5	Utilize as an outdoor classroom.	Anytime	Staff
oak wilt			
1	Monitor for oak wilt.	Growing Season	Staff
1	Enact best management practices if detected.	As Needed	Staff or Contractor
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff

¹ High priority recommendations are noted in bold.

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unit 2: list road to skyline drive • priority: high

Owner: City of Reading, City of Reading Water Authority, and Berks County

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Prevent further spread of invasive plants from heavily invaded areas into less invaded areas.	Growing season	Staff or Contractor
1	Control winged euonymus and barberry in less invaded areas.	Fall	Staff or Contractor
control invasive plants in the northern degraded section.			
1	Control oriental bittersweet.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
2	Control Norway maple.	Fall	Staff or Contractor
2	Control shrub honeysuckle, privet, barberry, and winged euonymus.	Fall	Staff or Contractor; Volunteers for cutting
3	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
3	Control Japanese stiltgrass.	Summer	Staff or Contractor
control invasive plants in the degraded area between List Road and Angora Road.			
3	Control oriental bittersweet and porcelain berry.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
3	Control tree-of-heaven and Japanese princess-tree.	Fall	Staff or Contractor
3	Control barberry, shrub honeysuckle, wineberry, winged euonymus, autumn olive, multiflora rose, and privet.	Fall	Staff or Contractor; Volunteers for cutting
4	Control garlic-mustard.	Spring	Staff, Contractor, or Volunteers
4	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
4	Control Japanese stiltgrass.	Summer	Staff or Contractor

4	Control periwinkle.	Spring	Staff or Contractor
4	Once invasive plants are controlled, replant the area with native plants to reestablish habitat and reclaim growing space.	After invasive plant control	Staff, Contractor, or Volunteers
hay-scented fern			
4	Control hay-scented fern.	July to October	Staff or Contractor
4	Replant area with native plants.	Spring or Fall	Staff, Contractor, or Volunteers
beech leaf disease			
1	Monitor for beech leaf disease.	Growing season	Staff
1	Remove infected trees if they will be hazards.	As Needed	Staff or Contractor
3	Plant native trees to restore the canopy.	Spring or Fall	Staff, Contractor, or Volunteers
oak wilt			
1	Monitor for oak wilt.	Growing season	Staff
1	Enact best management practices if detected.	See plan text for details	Staff or Contractor
recreation			
1	Make sure all trails area carefully planned and necessary prior to creation to reduce impact to natural areas. Avoid excess trails through area that has younger trees.	Year-round	Staff
1	Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.	Year-round	Staff

¹ High priority recommendations are noted in bold.

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unit 3: list road oak forest • priority: high

Owner: City of Reading and City of Reading Water Authority

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Prevent further incursion of invasive plants from radio tower area. Monitor for new invasive plants moving into the management unit.	Year-round	Staff
1	Control invasive shrubs, working from List Road and moving up to the Radio Tower.	Fall	Staff or Volunteers
2	Control Japanese stiltgrass, again working from List Road and moving up to the Radio Tower.	Summer	Staff or Contractors
habitat improvement			
2	Maintain seed mast by retaining oaks.	Year-round	Staff
3	Increase plant species diversity across all structural layers. This can be done by planting understory trees, protecting natural regeneration from deer browsing where it occurs, and controlling the deer population. Add hickories and other seed-producing canopy trees.	Spring or Fall	Staff, Contractor, or Volunteers
1	Leave dead and downed wood in place where not a nuisance of hazard.	Year-round	Staff
3	For plantings, choose species that provide bat habitat and are resilient to climate change.	Anytime	Staff

unit 4: radio tower • priority: low

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Control Japanese knotweed.	June- cut stems; August/ September apply herbicide	Staff or Contractor
1	Control oriental bittersweet and Japanese honeysuckle.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
1	Control Japanese angelica tree.	Fall	Staff or Contractor
2	Control tree-of-heaven.	Fall	Staff or Contractor
2	Control shrubs - shrub honeysuckle, barberry, wineberry, and multiflora rose.	Fall	Staff or Contractor; Volunteers for cutting
3	Control garlic-mustard.	Spring	Staff, Contractor, or Volunteers
3	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
3	Control periwinkle.	Spring	Staff or Contractor
3	Replant with native plants.	Spring or Fall	Staff, Contractor, or Volunteers
1	Monitor for reestablishment of invasive plants.	Growing Season	Staff
landscaping			
4	Utilize native shrubs, herbaceous plants, and small trees to add landscaping around buildings after invasive plant control.	Spring or Fall	Staff, Contractor, or Volunteers
disturbance			
1	Monitor the area for trash and introduction or reestablishment of native plants.	Year-round	Staff

¹ High priority recommendations are noted in bold.

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unit 5: radio tower to tower road • priority: medium

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plant control			
1	Control oriental bittersweet and Japanese honeysuckle.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
2	Control barberry and mulitflora rose.	Fall	Staff or Contractor; Volunteers for cutting
3	Control garlic-mustard.	Spring	Staff, Contractor, or Volunteers
3	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
3	Control periwinkle.	Spring	Staff or Contractor
1	Prevent further establishment of invasive plants from the powerline.	Spring to Fall	Staff or Contractor
hay-scented fern			
3	Control hay-scented fern.	July to October	Staff or Contractor
4	Replant area with native plants.	Spring or Fall	Staff, Contractor, or Volunteers
oak wilt			
1	Monitor for oak wilt.	Growing season	Staff
1	Enact best management practices if detected.	See plan text for details	Staff or Contractor
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff
recreation			
1	Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.	Year-round	Staff

unit 6: tower road to haag road • priority: medium

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plant control			
1	Contrl oriental bittersweet and porcelain berry.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
2	Control Norway maple	Fall	Staff or Contractor
2	Control shrubs – burning bush, wineberry, and barberry.	Fall	Staff or Contractor; Volunteers for cutting
3	Control Japanese stiltgrass.	Summer	Staff or Contractor
1	Prevent reestablishment of invasives or introduction of new species.	Growing Season	Staff
restoration			
2	Add a diversity of understory trees and shrubs.	Spring or Fall	Staff
2	Protect all plantings with tree tubes or fencing. Regularly maintain these structures until plants are able to withstand deer browsing and rubbing.	After Planting	Staff, Contractor, or Volunteers
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff

¹ High priority recommendations are noted in bold.

² Volunteers should not be used to apply herbicide unless they have proper certification and personal protective equipment

unit 7: haag road to ferndale trail • priority: medium

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants – Management efforts should be carried out starting from Ferndale Trail and then moving northwest. Drenkel Field can be addressed last as it is already heavily invaded.			
1	Control wisteria around Drenkel Field.		Staff or Contractor; Volunteers for vine cutting
1	Control oriental bittersweet.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
2	Control invasive barberry, privet, and wineberry	Fall	Staff or Contractor; Volunteers for cutting
3	Control garlic mustard.	Spring	Staff, Contractor, or Volunteers
3	Control Japanese stiltgrass, prevent further spread along trails.	Summer	Staff or Contractor
1	Control spread of invasive plants around Drenkel Field into adjacent forest areas until ready to manage. The one exception to this is wisteria, which should be a high priority for management.	Spring to Fall	Staff
control invasive plants around drenkel field.			
1	Control oriental bittersweet and porcelain berry.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
2	Control Norway Maple and Japanese princess-tree.	Fall	Staff or Contractor
3	Control shrub honeysuckle, barberry, multiflora rose, and wineberry.	Fall	Staff or Contractor; Volunteers for cutting
4	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
4	Control Japanese stiltgrass.	Summer	Staff or Contractor
4	Control periwinkle.	Spring	Staff or Contractor
2	Prevent reestablish of invasive plants or incursion by new invasive plant species.	Growing Season	Staff or Contractor

canopy gaps			
3	Control invasive plants.	See above or control all at once.	Staff or Contractor
3	As needed, plant trees and protect from deer.	Spring or Fall	Staff, Contractor, or Volunteers
oak wilt			
1	Monitor for oak wilt.	Growing season	Staff
1	Enact best management practices if detected.	See plan text for details	Staff or Contractor
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff

¹ High priority recommendations are noted in bold.

² Volunteers should not be used to apply herbicide unless they have proper certification and personal protective equipment

unit 8: stiltgrass savanna • priority: low

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plant control			
1	Control tree-of-heaven.	Fall	Staff or Contractor
1	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
1	Control Japanese stiltgrass.	Summer	Staff or Contractor
1	Control any newly establishing invasive plants as the native plants become established.	Growing Season	Staff or Contractor
restoration			
2	Replant area with native species, either trees to create a forest or shrubs to create a shrubland.	Spring or Fall	Staff, Contractor, or Volunteers
2	Allow for natural succession to progress after planting.	Year-round	Staff

unit 9: ferndale trail to pagoda oak forest • priority: medium – high

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plant control			
1	Prevent encroachment of invasive plants from Drenkel Field area, particularly wisteria.	Growing season	Staff or Contractor
2	Control Norway maple.	Fall	Staff or Contractor
2	Control barberry and wineberry.	Fall	Staff or Contractor; Volunteers for cutting
3	Control Japanese stiltgrass.	Summer	Staff or Contractor
recreation			
1	In general, carefully assess the need for new trails before moving ahead with new trail building to protect the forest trees and avoid further spread of invasive plants.	Year-round	Staff
1	Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.	Year-round	Staff
canopy gaps			
3	Control invasive plants.	See above or control all at once.	Staff or Contractor
3	As needed, plant trees and protect from deer.	Spring or Fall	Staff or Volunteers
oak wilt			
1	Monitor for oak wilt.	Growing season	Staff
1	Enact best management practices if detected.	See plan text for details	Staff or Contractor
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff

¹ High priority recommendations are noted in bold.

² Volunteers should not be used to apply herbicide unless they have proper certification and personal protective equipment

unit 10: pagoda • priority: medium

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants – Start with controlling invasive plants at higher elevations, then moving downhill through the central portion of this management unit and then moving out to the edges.			
1	Control wisteria.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor
1	Control oriental bittersweet, English ivy, and Japanese honeysuckle.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
2	Control Norway maple.	Fall	Staff or Contractor
2	Control tree-of-heaven.	Fall	Staff or Contracto
2	Control shrubs - barberry, jetbead, shrub honeysuckle, wineberry, privet, and multiflora rose.	Fall	Staff or Contractor; Volunteers for cutting
3	Control mugwort.		Staff or Contractor
3	Control garlic-mustard.	Spring	Staff, Contractor, or Volunteers
3	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
3	Control Japanese stiltgrass.	Summer	Staff or Contractor
3	Replant with native trees and shrubs.	Spring or Fall	Staff, Contractor, or Volunteers
1	Monitor after treatment to assess effectiveness of treatment.	Growing Season	Staff
1	Monitor for new populations of invasive plants.	Growing Season	Staff

forest gap			
3	Control invasive plants.	See above or control all at once.	Staff or Contractor
3	Protect naturally regenerating native tree species with fencing or tree tubes.	Monitor for seedlings - Growing Season; Leave protection in place year-round	Staff or Volunteers
3	Plant tree saplings after invasive plants have been treated.	Spring or Fall	Staff, Contractor, or Volunteers
4	Add understory plantings after original saplings are established and tree tubes removed.	Spring or Fall	Staff, Contractor, or Volunteers
3	Monitor the area for return of invasive plants or die off of planted trees.	Growing Season	Staff
oak wilt			
1	Monitor for oak wilt.	Growing season	Staff
1	Enact best management practices if detected.	See plan text for details	Staff or Contractor
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff
recreation			
1	Minimize impact to natural resources of any new trails.	Year-round	Staff
1	Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.	Year-round	Staff
interpretive signage			
1	For projects with significant disturbance, install signs explaining project.	As Needed	Staff

¹ High priority recommendations are noted in bold.

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unit 11: rotary park • priority: medium – high

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants – higher and medium quality forest areas			
1	Control oriental bittersweet, Japanese honeysuckle.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
2	Control grape – while not an invasive plant, this plant can become overly aggressive and should be cut back when they threaten trees.	Anytime - cut stems	Staff or Volunteers
1	Control Norway maple.	Fall	Staff or Contractor
2	Control Japanese barberry, autumn-olive, winged euonymus, multiflora rose, wineberry, and shrub honeysuckle.	Fall	Staff or Contractor; Volunteers for cutting
3	Control garlic mustard.	Spring	Staff, Contractor, or Volunteers
3	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
3	Control Japanese stiltgrass.	Summer	Staff or Contractor
invasive plants – pole stand			
1	Control oriental bittersweet.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
3	Control tree-of-heaven.	Fall	Staff or Contractor
3	Control shrub honeysuckle and wineberry.	Fall	Staff or Contractor; Volunteers for cutting
4	Control garlic-mustard.	Spring	Staff, Contractor, or Volunteers
4	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
4	Control Japanese stiltgrass.	Summer	Staff or Contractor

invasive plants – the cellar			
1	Prevent further spread of invasive plants from the central patch of invasive plants.	Growing Season	Staff or Contractor
2	Control oriental bittersweet.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
3	Control Norway maple.	Fall	Staff or Contractor
3	Control Japanese barberry, shrub honeysuckle, jetbead, wineberry.	Fall	Staff or Contractor; Volunteers for cutting
4	Control garlic-mustard.	Spring	Staff, Contractor, or Volunteers
4	Control periwinkle.	Spring	Staff or Contractor
recreation			
1	Make sure all trails area carefully planned and necessary prior to creation to reduce impact to natural areas. Avoid areas with native seedlings and saplings to allow for forest regeneration.	Year-round	Staff
1	Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.	Year-round	Staff
3	Install interpretive signage near BAMBAs lot explaining how trails impact the forest and using Leave No Trace language to encourage positive use of trails and discourage social trails.	Anytime	Staff
oak wilt			
1	Monitor for oak wilt.	Growing season	Staff
1	Enact best management practices if detected.	See plan text for details	Staff or Contractor
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff
the cellar restoration			
4	Plant trees and shrubs, including a diversity of native plants.	Spring or Fall	Staff or Volunteers

¹ High priority recommendations are noted in bold.

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unit 12: palustrine forest • priority: high

Owner: Berks County

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Control Japanese knotweed.	June- cut stems; August/ September apply herbicide	Staff or Contractor
2	Control porcelain berry and oriental bittersweet.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
2	Control Japanese hops.	Hand pull-Spring through Summer; herbicides - July-August	Staff or Contractor; Volunteers for vine cutting
3	Control Norway maple.	Fall	Staff or Contractor
3	Control multiflora rose and barberry.	Fall	Staff or Contractor; Volunteers for cutting
4	Control mugwort.	Spring	Staff or Contractor
4	Control Japanese stiltgrass.	Summer	Staff or Contractor
2	Prevent reestablishment of invasive plants after management and establishment of new invasive species.	Growing Season	Staff
climate change			
1	Create 300 foot non-disturbance buffer around the wet areas of unit.	Year-round	Staff
recreation			
1	Avoid creating trails within this unit to protect water resources and abide by Earl Trust restrictions.	Year-round	Staff
beech leaf disease			
1	Monitor for beech leaf disease.	Growing Season	Staff
3	Plant trees to replace beech trees if they die.	Spring or Fall	Staff or Volunteers
restoration			
4	If trees die off from climate change, beech leaf disease, or other reasons and natural regeneration of native plants has not established a cohort of trees to replace the canopy trees, plant trees.	Spring or Fall	Staff or Volunteers

unit 13: hill road west mixed hardwood forest • priority: medium

Owner: Berks County

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Prevent spread of invasive plants into adjacent palustrine forest and northern higher quality forest, particularly Japanese knotweed.	Growing Season	Staff
1	Control Japanese knotweed.	June- cut stems; August/ September apply herbicide	Staff or Contractor
1	Control oriental bittersweet and Japanese honeysuckle.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
2	Control winged euonymus, barberry, wineberry, privet, multiflora rose, and shrub honeysuckle.	Fall	Staff or Contractor; Volunteers for cutting
3	Control garlic-mustard.	Spring	Staff or Contractor; Volunteers to pull garlic-mustard
3	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor; Volunteers to pull garlic-mustard
3	Control Japanese stiltgrass.	Summer	Staff or Contractor
3	Control periwinkle.	Spring	Staff or Contractor
1	Prevent reestablishment or introduction of new invasive plants.	Growing Season	Staff
restoration			
2	Control invasive plants in canopy gaps.	Growing Season	Staff or Contractor
2	Plant native trees.	Fall or Spring	Staff or Contractor
recreation			
1	Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.	Year-round	Staff

¹ High priority recommendations are noted in bold.

² Volunteers should not be used to apply herbicide unless they have proper certification and personal protective equipment

unit 14: hill road east mixed hardwood forest • priority: low

Owner: Berks County

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Control oriental bittersweet.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
2	Control tree-of-heaven.	Fall	Staff or Contractor
2	Control shrubs – barberry, shrub honeysuckle, multiflora rose, wineberry, and privet.	Fall	Staff or Contractor; Volunteers for cutting
3	Control garlic-mustard.	Spring	Staff, Contractor, or Volunteers
3	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
3	Control Japanese stiltgrass.	Summer	Staff or Contractor
restoration			
2	Plant native trees to restore the area after invasive plant control.	Spring or Fall	Staff, Contractor, or Volunteers
3	Plant trees to replace beech trees if they die.	Spring or Fall	Staff or Volunteers

unit 15: list to hill road oak forest • priority: high

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Control wineberry and barberry.	Fall	Staff or Contractor; Volunteers for cutting
2	Control Japanese stiltgrass.	Summer	Staff or Contractor
beech leaf disease			
1	Monitor for beech leaf disease.	Growing Season	Staff
3	If BLD leads to beech tree die off and canopy gaps without any advanced regeneration to replace the canopy trees, control invasive plants and plant native trees to fill the gaps.	Invasives - see above; Planting - Spring or Fall	Staff; Volunteers for planting
oak wilt			
1	Monitor for oak wilt.	Growing season	Staff
1	Enact best management practices if detected.	See plan text for details	Staff or Contractor
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff
wildlife habitat			
4	Select a sub-area of this management unit to add native plants, protecting them from deer. Canopy gaps are prime areas to do this.	Spring or Fall	Staff
recreation			
1	Minimize the impact of trails by carefully considering any future expansion of trails.	Year-round	Staff

¹ High priority recommendations are noted in bold.

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unit 16: old orchard • priority: low

Owner: Berks County

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plant control – Start in the lesser invaded areas closer to Hill Road and then moving the southeastern boundary of this management unit.			
1	Prevent further spread of bamboo and talk to neighbor to encourage them to control their stand of bamboo.	Growing Season	Staff
1	Control bamboo. This will take multiple years.	Fall	Staff or Contractor
2	Control oriental bittersweet and English ivy.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
3	Control Norway maple.	Fall	Staff or Contractor
3	Control tree-of-heaven.	Fall	Staff or Contractor
3	Control shrubs – wineberry, shrub honeysuckle, barberry, privet, and autumn olive.	Fall	Staff or Contractor; Volunteers for cutting
4	Control garlic-mustard.	Spring	Staff, Contractor, or Volunteers
4	Control mile-a-minute.	Spring - pull with gloves; Summer and Fall - mow repeatedly or herbicide	Staff or Contractor
4	Control Japanese stiltgrass.	Summer	Staff or Contractor
restoration			
3	Within areas that still have native trees, focus on planting trees and shrubs to improve forest conditions.	Spring or Fall	Staff or Volunteers
4	Within the clearing, plant trees to create a young forest or shrubs for a shrubland.	Spring or Fall	Staff, Contractor, or Volunteers

unit 17: egelman's upland • priority: medium

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Prevent further spread of periwinkle and barberry.	Growing Season	Staff or Contractor
2	Control barberry.	Fall	Staff or Contractor; Volunteers for cutting
2	Control periwinkle.	Spring	Staff or Contractor
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff
beech leaf disease			
1	Monitor for beech leaf disease.	Growing Season	Staff
2	If BLD leads to beech tree die off and canopy gaps without any advanced regeneration to replace the canopy trees, control invasive plants and plant native trees to fill the gaps.	Spring or Fall	Staff
oak wilt			
1	Monitor for oak wilt.	Growing season	Staff
1	Enact best management practices if detected.	See plan text for details	Staff or Contractor
canopy gaps			
3	Control invasive plants.	See above or control all at once.	Staff
3	Plant with native trees.	Spring or Fall	Staff

¹ High priority recommendations are noted in bold.

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unit 18: egelman's east • priority: medium – high

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants – Start in the less invaded area east of the stream. Then move to the area between the stream and Gravity Trail, leaving the canopy gap area until funds are available to fully address the invasive plants and replant the gap area.			
Forest east of the stream.			
1	Control barberry, wineberry, and shrub honeysuckle.	Fall	Staff or Contractor; Volunteers for cutting
3	Control Japanese stiltgrass.	Summer	Staff or Contractor
invasive plants – Forest between Gravity Trail and stream.			
1	Control oriental bittersweet and porcelain berry.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
1	Control Norway maple.	Fall	Staff or Contractor
2	Control shrubs – barberry, jetbead, multiflora rose, and shrub honeysuckle.	Fall	Staff or Contractor; Volunteers for cutting
3	Control mugwort.	Spring	Staff or Contractor
3	Control Japanese stiltgrass.	Summer	Staff or Contractor
3	Control periwinkle.	Spring	Staff or Contractor
riparian buffer			
3	After invasive plant management, plant native trees and shrubs to improve the riparian buffer, focusing efforts first within 150 feet of the stream.	Spring or Fall	Staff or Volunteers

canopy gap			
3	Control invasive plants within the canopy gap. Repeated treatments will likely be needed due to the pervasiveness of the invasive plants.	See above or all at once.	Staff or Contractors
3	After invasive plant control, plant native trees to restore the forest. Protect trees with tree tubing until able to withstand deer browsing and rubbing.	Spring or Fall	Staff, Contractor, or Volunteers
4	If resources allow, add scattered shrubs to add habitat diversity for birds. Select a diversity of trees, favoring species projected to be resilient to climate change. Protect shrubs with fencing until able to withstand deer impacts, typically 5+ years.	Spring or Fall	Staff or Volunteers
3	Continue to control invasive plants as needed to prevent reestablishment.	Growing season	Staff
5	Allow to naturally progress from early successional habitat to young forest and so on.	Year-round	Staff
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff

¹ High priority recommendations are noted in bold.

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unit 19: haag road to egelman's forest • priority: medium – high

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Control Norway maple.	Fall	Staff or Contractor
1	Control barberry and wineberry.	Fall	Staff or Contractor; Volunteers for cutting
dumping			
1	Remove existing metal barrels and any other debris.	Anytime	Staff or Volunteers
water quality protection			
1	Protect existing native plants.	Year-round	Staff
1	Avoid disturbance within 300-feet of the water resources.	Year-round	Staff
3	If native plants are not regenerating even with invasive plant control and deer management, increase the density of forest canopy, understory, and shrub layers.	Spring or Fall	Staff or Volunteers
oak wilt			
1	Monitor for oak wilt.	Growing season	Staff
1	Enact best management practices if detected.	See plan text for details	Staff or Contractor
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff
recreation			
1	Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.	Year-round	Staff

¹ High priority recommendations are noted in bold.

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unit 20: rose valley creek • priority: high

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Control Japanese knotweed.	June- cut stems; August/ September apply herbicide	Staff or Contractor
1	Control wisteria.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor
1	Control vines – porcelain berry, oriental bittersweet, and English ivy.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
1	Control vines – Japanese hops.	Hand pull-Spring through Summer; herbicides - July-August	Staff or Contractor; Volunteers for vine cutting
2	Control Norway maple and mimosa.	Fall	Staff or Contractor
3	Control Japanese princess-tree.	Fall	Staff or Contractor
2	Control shrubs -wineberry, shrub honeysuckle, barberry, and linden viburnum.	Fall	Staff or Contractor; Volunteers for cutting
3	Control garlic mustard.	Spring	Staff, Contractor, or Volunteers
3	Control Japanese stiltgrass.	Summer	Staff or Contractor
3	Control periwinkle.	Spring	Staff or Contractor
oak wilt			
1	Monitor for oak wilt.	Growing season	Staff
1	Enact best management practices if detected.	See plan text for details	Staff or Contractor
riparian buffer improvement			
2	Increase the density of native plants within 100 feet of the stream by planting shrubs and trees.	Spring or Fall	Staff, Contractor, or Volunteers
2	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff

unit 20: rose valley creek (continued) • priority: high

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
restoration			
3	After invasive plant control within the riparian forest, plant with native species. Utilize a variety of species to increase diversity and favor species that are likely to be resilient to climate change.	Spring or Fall	Staff, Contractor, or Volunteers
3	As the ash trees die and canopy gaps form, control invasive plants and plant native tree species.	Invasives - see above; Planting - Spring or Fall	Staff, Contractor, or Volunteers
recreation			
4	Consider native landscaping plantings around the historic resources to reduce lawn space where not utilized and to replace invasive plants.	Spring or Fall	Staff
1	Within the Earl Trust properties, assess need for existing trails. Maintain trail to prevent impacts to natural areas. Avoid further trail building in these areas.	Year-round	Staff
erosion			
2	Planting additional vegetation near the start of the erosion channel, particularly trees and shrubs	Spring or Fall	Staff or Volunteers
2	If erosion issues still persist, GSI can be used around the edge of the ballfield area to control stormwater.	Anytime	Staff or Contractor

unit 21: pendora oak forest • priority: high

Owner: City of Reading

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Control jetbead.	Fall	Staff or Contractor; Volunteers for cutting
2	Control Japanese stiltgrass.	Summer	Staff or Contractor
1	Prevent reestablishment of invasive plants after management and establishment of new invasive species.	Growing Season	Staff or Contractor
oak wilt			
1	Monitor for oak wilt.	Growing season	Staff
1	Enact best management practices if detected.	See plan text for details	Staff or Contractor
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff

¹ High priority recommendations are noted in bold.

² Volunteers should not be used to apply herbicide unless they have proper certification and personal protective equipment

unit 22: antietam road east • priority: medium – low

Owner: Berks Nature and Berks County

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
invasive plants			
1	Control Japanese honeysuckle and oriental bittersweet.	Anytime - cut stems; Fall - herbicide stumps	Staff or Contractor; Volunteers for vine cutting
2	Control tree-of-heaven.	Fall	Staff or Contractor
2	Control shrub honeysuckle, privet, wineberry, barberry, and multiflora rose.	Fall	Staff or Contractor; Volunteers for cutting
3	Control garlic-mustard.	Spring	Staff, Contractor, or Volunteers
3	Control Japanese stiltgrass.	Summer	Staff or Contractor
canopy gaps			
3	Control invasive plants.	See above or all at once.	Staff or Contractor
3	Plant trees and/or shrubs as needed.	Fall or Spring	Staff, Contractor, or Volunteers
climate change			
3	Increase plant diversity, favor climate resilient species for plantings.	Spring or Fall	Staff

¹ High priority recommendations are noted in bold.

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unit 23: antietam lake park • priority: high

Owner: Berks County

PRIORITY	RECOMMENDATION ¹	TIMING	WHO CAN IMPLEMENT? ²
canopy loss			
2	Identify young native trees. Clear invasive plants to create a buffer space around the trees and protect them with tree tubes.	Anytime	Staff
3	As resources allow, control the invasive plants within the gaps.	See individual species techniques or control all at once	Staff or Contractor
4	Plant trees and shrubs to restore the area.	Spring or Fall	Staff, Contractor, or Volunteers
diseases			
1	Oak Wilt - Monitor the oak trees, particularly red oak, for brown, dead leaves which can be a symptom of oak wilt. If oak wilt is identified, see Preserve-wide strategies.	Growing Season	Staff
1	Beech leaf disease – If beech trees die from BLD and create canopy gaps, control invasive plants that grow in gaps. Protect any naturally regenerating native plants with fencings. If there is no natural regeneration, plant tree saplings to fill growing space and restore the canopy over time.	Growing Season	Staff
2	In potential disease-impact areas, control invasive plants and protect young trees from invasive plants and deer browsing.	Growing Season	Staff
2	Monitor the condition of the mountain laurel and check for regeneration.	Growing Season	Staff
2	Monitor the condition of black birch. Hire an arborist to assess tree health. Avoid wounding any black birch trees.	Year-round	Staff
invasive plants			
2	When conducting experiments with invasive plant control, create a monitoring plan to assess effectiveness of techniques and collect data.	Year-round	Staff
3	Share what is learned about various techniques and plant species with Mount Penn and other regional partners.	Year-round	Staff
demonstration areas			
3	Create demonstration areas for restoration in accessible locations to showcase stewardship work such as invasive plant removal and native plantings.	Dependent on work being done	Staff or Contractor
3	Utilize interpretive signage, social media posts, and email blasts to share information about the work being done and to engage the public and potential funders.	Start at the onsite of project or even earlier	Staff

trails preserve-wide strategies

PRIORITY	RECOMMENDATION ¹	WHO CAN IMPLEMENT? ²
1	WORK TOGETHER - Form a Users Council to meet regularly, discuss issues, schedule joint events and find opportunities to improve conditions and the visitor experience by working together.	MP3 Board to establish, partners to continue the work
1	INCORPORATE STORMWATER MANAGEMENT - Using the trail issues map, areas of erosion can typically be addressed by implementing stormwater management measures. As new trails are implemented, or existing trails are redesigned, stormwater management should be incorporated into new designs.	MP3 and individual members, volunteers and public works crews for construction, landscape architects and engineers for design
1	CELEBRATE AND ELEVATE EXISTING TRAILS - Use more public outreach, communications and announcements to publicize existing trails and routes. Install special signage to identify routes and connections through the City of Reading and on other public streets which act as trails.	Signage Consultant, MP3
1	ENHANCE LEGIBILITY - Focus on the main and historically important trails to form a recognizable framework for the trail system. This will help make the whole network more legible, easier to navigate and better known.	Signage Consultant, MP3
2	REDUCING DAMAGE - Utilize the guidelines included in this report to determine whether existing trails are in sensitive areas and rerouting or closing them accordingly. Similarly, if new trails are considered, use the guidance to determine where they may be installed.	Volunteers, Public Works, Engineers, Landscape Architects
2	PROTECT THREATENED SPECIES - Wetland plants and bats that are considered threatened appear to inhabit the site. Any proposed disturbance should incorporate protection measures in accordance with the information included in the appendix.	Public Works, Volunteers
3	DISCOURAGE DUMPING AND ILLEGAL ACTIVITY - The City of Reading is already taking action by installing gates to strategically close Skyline Drive and manage access.	Public Works, City of Reading
3	PARKING ACCESS - Consider expanding parking by expanding the BAMBA lot, redesigning and opening City of Reading park lots, and providing additional parking at the northern end of the site.	City of Reading, County of Berks, Design Consultants
2	PROVIDE SHUTTLE SERVICE - Bring more people into the site and help visitors reach more of the mountain by providing shuttles on the weekends and holidays.	City of Reading, County of Berks, Mt. Penn Borough
3	PROVIDE A UNIVERSALLY ACCESSIBLE TRAIL - A trail that accommodates all users could be inviting to those potential visitors who are intimidated by the steep and rocky terrain. A trail that meets ADA standards could open the mountain up to a whole new user group.	City of Reading, County of Berks, Design Consultants
1	SIGNAGE AND BRANDING - A unified signage system would make it easier to navigate the site, understand the trail system and better publicize the Mount Penn Preserve in general.	City of Reading, County of Berks, Mt. Penn Borough, Signage Consultant

¹ High priority recommendations are noted in bold.

² Volunteers should not be used to apply herbicide unless they have proper certification and personal protective equipment

cost estimates – trails

TYPE	DESCRIPTION ^{1,2}	QTY	UNIT	COST/UNIT (In-House or Vol)	COST (In House or Vol)	COST/UNIT (Contractor)	COST (Contractor)	RESPONSIBLE PARTY
WORKING TOGETHER								
One Time Action	Form the Users Council - Formally create, define and organize the Council	0	0					MP3 Board
Ongoing Program	Support the Users Council - staff person to create agendas, rent/reserve spaces, provide printing, A/V, etc - Similar to any municipal commission or board. (5 hr/mo)	60	HR	\$60.00	\$3,600.00	\$0.00	\$0.00	MP3 Board Representative Staff Member
	Subtotals:			\$60.00	\$3,600.00			
INCORPORATE STORMWATER MANAGEMENT								
Typical Trail Improvement Project	Stormwater Management Implementation- Retrofit w/ Typ. 100 sf BMP							N
	Design	1	LS	\$0.00	\$0.00	\$500.00	\$500.00	Contractor of Volunteers
	Earthmoving/Grading	100	CF	\$0.00	\$0.00	\$10.00	\$1,000.00	Contractor of Volunteers
	Plantings	100	1 Gal Per.	\$15.00	\$1,500.00	\$45.00	\$4,500.00	Contractor of Volunteers
	Subtotal:				\$1,500.00	\$555.00	\$6,000.00	
CELEBRATE AND ELEVATE EXISTING TRAILS & ENHANCING LEGIBILITY								
	Design a Unified Signage System for Use across MP3 Site	1	LS	NA	NA	\$50,000.00	\$50,000.00	Signage Design Consultant
	Fabrication	50	LS	NA	NA	\$2,000.00	\$100,000.00	Signage Fabricator
	Installation	200	HR	\$75.00	\$15,000.00			Public Works or Similar Staff
Signage	Subtotals:				\$15,000.00	\$52,000.00	\$150,000.00	

¹Notes:

¹ These estimates should be considered as ROUGH ORDER OF MAGNITUDE. These estimates are based on costs associated with similar, recent projects and our staff's professional experience. Before embarking on budgeting for any of these projects, the MP3 Board, City of Reading, County of Berks or other applicable party should consider engaging a professional engineer, cost estimator or similar professional.

² Cost for trails are difficult to estimate as every trail project is different, as terrain, accessibility and other conditions affect the costs. Additionally, volunteers may provide free labor. The chart above attempts to show where volunteer or in-house labor can be used to offset costs. The project leaders should assess their volunteers skills and determine where volunteers may be useful. They will need to pick and choose portions of the chart as they determine how and where volunteers may be useful. "

TYPE	DESCRIPTION ^{1,2}	QTY	UNIT	COST/UNIT (In-House or Vol)	COST (In House or Vol)	COST/UNIT (Contractor)	COST (Contractor)	RESPONSIBLE PARTY
REDUCING DAMAGE & PROTECT THREATENED SPECIES								
Typical Trail Improvement Project	Reducing Damage & Protecting Sensitive Species (By Rerouting Trails)							Y - monitoring and labor
1/4 Mile Earth Surface Example								
	Existing Trail Closure (Install fence section, plantings or debris piles)	1	LS	\$500.00	\$500.00	\$500.00	\$500.00	Contractor, Public Works or Volunteers
	Survey	1	LS	NA	NA	\$3,000.00	\$3,000.00	Licensed Surveyors
	Design New Trail Route & Field Mark	1	LS	\$0.00	\$0.00	\$1,000.00	\$1,000.00	Landscape Architect, Eng or Volunteers
	Hand Clearing	1320	SF	\$0.00	\$0.00	\$3.50	\$4,620.00	Volunteers or Contractors
	Hand Grading	1320	SF	\$0.00	\$0.00	\$2.00	\$2,640.00	Volunteers or Contractors
	Stormwater Management Grading	10	BMP	\$0.00	\$0.00	\$1,000.00	\$10,000.00	Volunteers or Contractors
	Stormwater Management Plantings	10	EA	\$1,500.00	\$15,000.00	\$4,500.00	\$45,000.00	Volunteers or Contractors
	Subtotals:				\$15,500.00		\$66,760.00	
1/4 Mile Paved Surface Example (Potentially Gravity Trail) Example (Potentially Gravity Trail)								
	Existing Trail Removal	6,600	SF	\$1.00	\$6,600.00	\$1.00	\$6,600.00	Contractor or Public Works
	Survey	1	LS	NA	NA	\$5,000.00	\$5,000.00	Licensed Surveyors
	Engineering Design	1	LS	NA	NA	\$50,000.00	\$50,000.00	Prof. Engineer
	New Paved Trail Grading and Installation	6600	SF	\$5.00	\$33,000.00	\$5.00	\$33,000.00	Contractor or Public Works
	Subtotals:				\$39,600.00		\$94,600.00	
PARKING ACCESS								
Parking & Access - New 10 Space Parking Lot Example								
	Engineering Design	1	LS	NA	NA	\$10,000.00	\$10,000.00	Prof. Engineer
	Grading and Installation - 10 Spaces and Drive Aisle	5000	SF	\$5.00	\$25,000.00	\$5.00	\$25,000.00	Contractor or Public Works
	Subtotals:				\$25,000.00		\$35,000.00	

cost estimates – stewardship

TYPE	DESCRIPTION ^{1,2}	QTY	UNIT	COST/ UNIT (In-House)	COST/UNIT (Contractor)	VOLUNTEER APPROPRIATE (Y)
Annual Programs	Hazard Tree Program *staff coordination plus consultant work	on-going	Annually	\$500-\$1000	\$20,000-\$30,000 - Berks County \$60,000-\$90,000 - City of Reading ³ \$2,000-\$3,000 - Berks Nature	N
Annual Programs	Deer Management Program *staff coordination plus consultant work	on-going	Annually	-	\$12,000 - City of Reading \$14,000 - Berks County	N
Signage	Install Boundary Postings - large signs, 24"x24"		EA	\$70		Y - labor
Signage	Install Boundary Postings - small signs, 3.75"x3.75"		EA	\$1		Y - labor
Signage	Boundary Sign Maintenance	on-going	Annually	\$50		Y - monitoring and labor
Signage	Interpretive Signage	1	EA	\$100-\$500		N
Issue Addressing	Invasive Plant Removal (depends on invasive plant density and follow up treatments may be needed, so determining total cost by multiplying per cost times total acreage of natural areas is not an accurate assessment)	on-going	Acre	\$300-\$1000	\$1,000-\$10,000	Y - mechanical or physical removal
Issue Addressing	Trash removal	on-going	Annually	\$4,000		Y - labor
Plantings	Tree Plantings	1	Acre	\$2,500	\$5,000-\$10,000	Y
Plantings	Shrub and Tree Understory Plantings (in-house)	100	Sq Ft	\$400-\$1,000		Y
Staffing	Ranger Position	on-going	Annually	\$100,000		N

¹ Unless otherwise noted in description, line items with both in-house and contractor costs are an either/or option, do not budget for both staff time and contractor time per unit

² Staff time not estimated outside of recommended staff positions for: research and monitoring for pests (SLF, EAB, BLD), protection and disturbance avoidance actions (retaining habitat trees, protecting riparian buffer, retaining downed wood, etc.), regular maintenance (mowing of meadows)

³ Cost estimate based on costs for hazard tree management at Antietam Lake Park. While this may be closer to an ideal number due to the acreage of the City of Reading properties and extensive trails and roads throughout, it is a large number that may be difficult to fully allocate each year. In the case that the actual budget for the year is less than this, the City of Reading should prioritize high traffic areas like parking lots and heavily used trails.

funding sources – possible grant programs*

PROGRAM	USES	POSSIBLE FUNDING, MATCH
Department of Conservation and Natural Resources (DCNR) Community Conservation and Partnership Program (C2P2)	A range of conservation projects including tree plantings, meadow installation, recreation infrastructure, and planning projects.	Depends on type of project: approximately \$100,000-\$250,000 for park development; \$25,000-\$75,000 for planning; \$500,000 maximum for trails; \$30,000-\$250,000 for river conservation; at least \$50,000 for riparian buffers, lawn to meadow, and tree planting, generally 1:1 match
Cornell Lab of Ornithology Small Grant Program	Habitat improvement such as invasive plant control and plantings. Berks Nature would need to be at least a partner applicant.	\$10,000 or \$25,000, match not required but encouraged
National Fish and Wildlife Foundation (NFWF) Delaware Watershed Conservation Fund	Conserve, restore, and protect habitat and improve outdoor recreational opportunities. Projects such as invasive plant management, tree planting, recreation infrastructure.	\$75,000-\$1,500,000 (depends on project type, extent, and number of partners), 1:1 match
Department of Community and Economic Development (DCED) Greenways, Trails, and Recreation Program (GRTP)	Rehabilitation and development of parks, land acquisition for parks, stream and watershed improvement for recreation use.	\$250,000 maximum, 15% match
Department of Community and Economic Development (DCED) Watershed Restoration and Protection Program	BMPs to control nonpoint source pollution, streambank restoration, and water quality monitoring.	\$300,000 maximum, 15% match
Department of Community and Economic Development (DCED) Local Share Account (LSA)	Fairly open as to project type, must "improve the quality of life of citizens in the community."	\$25,000-\$1,000,000, no match requirement
Schuylkill Highlands Conservation Landscape Mini-Grant Program (grant program through DCNR)	Conservation, recreation, and nature-based tourism, such as habitat improvement, restoration projects, signage, recreational amenities.	\$1,000-\$15,000, 1:1 match
Schuylkill River Greenways Schuylkill River Restoration Fund	Projects to improve water quality within the Schuylkill River Watershed with a focus on reducing water pollution, includes projects such as stream restoration and installation of BMPs	\$20,000-\$100,000, 25% match
International Mountain Biking Association (IMBA) Trail Accelerator Program	Professional trail planning and consultation services, not funds for installing trails.	Services provided valued at \$5,000-\$30,000, 1:1 match
Rails to Trails Conservancy Trail Grant	Develop and connect trail networks.	\$5,000-\$25,000
Berks County Community Foundation	Multiple programs/funds. Options may include The Innovation Fund (improving environmental health and climate resiliency) and The Conservation Equity Fund (conservation of open space, environmentally sensitive areas).	Depends on funding program

*This is not a comprehensive list of all possible funding programs. Some federal programs that have been available in recent years were not included if their funding is not guaranteed going forward. Additionally, new funding sources may be created.

invasive plant control techniques

canopy and understory trees

- **Norway maple** can be controlled through mechanical girdling, manual removal, or cutting followed by a stump treatment. Basal bark applications can be used on trees less than 6" in diameter as their bark should be thin enough for the treatment to be effective. Small seedlings can be hand pulled.
- **Princess-Tree and weeping cherry** should be treated with a triclopyr basal bark application during the fall.
- **Tree-of-heaven** should be treated with a triclopyr basal bark application during the fall. Cutting before the tree is dead will result in extensive resprouting. After the tree has died it can be removed by cutting if it poses a hazard.
- **Japanese angelica tree** can be controlled by cutting the trunk and treating the stump with herbicide or using a foliar herbicide treatment.
- **Bamboo** will take multiple applications to control. According to DCNR, for large areas of bamboo, where risks to non-target species are minimal, use a foliar application of five percent glyphosate mixed in water. The bamboo should first be cut back and then herbicides applied to the new leaves. Alternatively, a 25 percent solution of glyphosate mixed in water can be applied to freshly cut stumps.
- **Mimosa** can be controlled with a cut stump application, girdling of larger trees, or hand pulling of small trees, being sure to remove the entire root system.

shrub and vine

- **Autumn olive, privet, barberry, wineberry, winged euonymus, linden viburnum, jetbead, butterfly bush, and shrub honeysuckle (all invasive varieties)** can receive a triclopyr basal bark application or be cut and then treated with an herbicide—stumps can be treated with triclopyr; sprouted foliage can be treated with glyphosate.
- **Small infestations of Japanese knotweed** can be treated with stem injections during the summer. A foliar herbicide should be applied to large infestations or plants 3-6' in height. Taller stems should be cut in June and then treated with an herbicide between August and September when leaves have regrown. It is of the utmost importance to remove all cut materials and properly dispose of them through drying on an impervious surface and then bagging the debris. This will reduce the risk of further spreading through rhizomes. Only herbicides approved for wetland use should be applied along streambanks and wetlands.
- **Multiflora rose** can be managed by allowing the rose rosette disease to reduce populations. If removal is a priority to improve movement through an area, follow the prescription above for autumn olive, etc.
- **Oriental bittersweet, wisteria, English ivy, porcelain berry, winter creeper, and Japanese honeysuckle vines** should be cut at ground level and at least five feet above the ground. Stumps can be treated with triclopyr (Garlon 4TM) and the leaves can be treated with glyphosate. CrossbowTM, which is a mixture of 2,4-D and Garlon 3ATM has been used to effectively control bittersweet.
- **Grape vines** are native and provide food for wildlife. However, when they become overly aggressive they can overwhelm a canopy tree or smother native tree seedlings or shrubs. Then, they should be cut at ground level and at least five feet above the ground. They can be allowed to regrow until they again threaten the health of other plants.

herbaceous

- **Common-reed** can be controlled by applying a wetland approved herbicide such as Rodeo either directly to the stalks or by a drip application into a cut stalk.
- **Garlic-mustard** can be controlled by hand pulling in early spring before the plants have dropped seed. Plants should be bagged and removed from the site to prevent spreading more seed. In heavily invaded areas the basal rosette can be sprayed with glyphosate. Any remaining plants can be hand pulled approximately two weeks later. Garlic-mustard exudes a chemical that inhibits soil fungi that are beneficial to tree seedlings, so it should be a high priority species for control.
- **Japanese hops** can be hand pulled prior to August if it is a small infestation. As much of the roots should be removed as possible and all debris should be bagged and discarded. Larger colonies should be treated with a pre-emergent herbicide followed by a foliar glyphosate application between July and September.
- **Japanese stiltgrass** should be mowed or hand pulled in late summer or treated with glyphosate.
- **Mile-a-minute weed** can be controlled by repeated mowing or herbicide application. Smaller infestations can be hand pulled.
- **Mugwort** can be controlled by applying glyphosate during the growing season over multiple years.
- **Periwinkle** According to DCNR, periwinkle can be managed by "raking the runners back and then mowing the area close to the ground in the spring. This should be followed by foliar application of glyphosate if there is regrowth." Periwinkle's waxy leaves may make herbicides less effective. Planting can still be done in an area with periwinkle. Any fencing or trees tubes will have to be regularly weeded for periwinkle.
- **Pachysandra** According to DCNR, "hand pulling and controlled burning have been used successfully on this plant. Pachysandra can also be controlled with several readily available herbicides, such as glyphosate. A preemergent herbicide can also be applied to the ground to kill the plants before they emerge. This may have less of an impact on desired native vegetation."
- **Reed canary-grass** can be controlled with wetland approved herbicides, or by covering with plastic or ~4 layers of cardboard and ~5 inches of mulch. Hand pulling or edging out by shading or planting fast growing native species can effectively control newer populations. Prescribed grazing can also be effective.
- **Teasel** should be mowed yearly in late spring before flowering.

Where trade names are used no endorsement is implied; Natural Lands and the authors of this document are not liable for problems associated with the use of herbicides described therein.

plant list by management unit

unit 1: oak lane

OAK FOREST	
canopy	
red maple	<i>Acer rubrum</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
American beech	<i>Fagus grandifolia</i>
blackgum	<i>Nyssa sylvatica</i>
scarlet oak	<i>Quercus coccinea</i>
white oak	<i>Quercus alba</i>
chestnut oak	<i>Quercus montana</i>
red oak	<i>Quercus rubra</i>
black oak	<i>Quercus velutina</i>
blackgum	<i>Nyssa sylvatica</i>
understory	
Norway maple	<i>Acer platanoides</i>
red maple	<i>Acer rubrum</i>
serviceberry	<i>Amelanchier sp.</i>
pawpaw	<i>Asimina triloba</i>
florida dogwood	<i>Cornus florida</i>
tuliptree	<i>Liriodendron tulipifera</i>
blackgum	<i>Nyssa sylvatica</i>
bird cherry	<i>Prunus avium</i>
black cherry	<i>Prunus serotina</i>
chestnut oak	<i>Quercus prinus</i>
sassafras	<i>Sassafras albidum</i>
shrub	
witch hazel	<i>Hamamelis virginiana</i>
blackhaw	<i>Viburnum prunifolium</i>
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
mountain laurel	<i>Kalmia latifolia</i>

spicebush	<i>Lindera benzoin</i>
greenbriar	<i>Smilax rotundifolia</i>
poison-ivy	<i>Toxicodendron radicans</i>
herbaceous	
Japanese stiltgrass	<i>Microstegium vimineum</i>
garlic-mustard	<i>Alliaria petiolata</i>
hay-scented fern	<i>Dennstaedtia punctilobula</i>
winged euonymus	<i>Euonymus alatus</i>
wintergreen	<i>Gaultheria procumbens</i>
ferns	<i>Polypodiaceae sp.</i>
highbush blueberry	<i>Vaccinium corymbosum</i>
MIXED HARDWOOD FOREST	
canopy	
red maple	<i>Acer rubrum</i>
black birch	<i>Betula lenta</i>
shagbark hickory	<i>Carya ovata</i>
hickory	<i>Carya sp.</i>
tuliptree	<i>Liriodendron tulipifera</i>
princess-tree	<i>Paulownia tomentosa</i>
red oak	<i>Quercus rubra</i>
black oak	<i>Quercus velutina</i>
understory	
red maple	<i>Acer rubrum</i>
tree-of-heaven	<i>Ailanthus altissima</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
American beech	<i>Fagus grandifolia</i>
sassafras	<i>Sassafras albidum</i>
shrub	
porcelain berry	<i>Ampelopsis brevipedunculata</i>
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
autumn olive	<i>Elaeagnus umbellata</i>
winged euonymous	<i>Euonymus alatus</i>

witch-hazel	<i>Hamamelis virginiana</i>
privet	<i>Ligustrum sp.</i>
spicebush	<i>Lindera benzoin</i>
shrub honeysuckle	<i>Lonicera sp.</i>
multiflora rose	<i>Rosa multiflora</i>
wineberry	<i>Rubus phoenicolasius</i>
brambles	<i>Rubus sp.</i>
herbaceous	
Japanese stiltgrass	<i>Microstegium vimineum</i>
garlic-mustard	<i>Alliaria petiolata</i>
mile-a-minute	<i>Persicaria perfoliata</i>
ferns	<i>Polypodiaceae sp.</i>
periwinkle	<i>Vinca minor</i>

unit 2: list road to skyline drive forest

OAK FOREST	
canopy	
red maple	<i>Acer rubrum</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
American beech	<i>Fagus grandifolia</i>
blackgum	<i>Nyssa sylvatica</i>
scarlet oak	<i>Quercus coccinea</i>
white oak	<i>Quercus alba</i>
chestnut oak	<i>Quercus montana</i>
red oak	<i>Quercus rubra</i>
black oak	<i>Quercus velutina</i>
understory	
Norway maple	<i>Acer platanoides</i>
red maple	<i>Acer rubrum</i>
serviceberry	<i>Amelanchier sp.</i>
pawpaw	<i>Asimina triloba</i>
florida dogwood	<i>Cornus florida</i>
tuliptree	<i>Liriodendron tulipifera</i>

blackgum	<i>Nyssa sylvatica</i>
bird cherry	<i>Prunus avium</i>
black cherry	<i>Prunus serotina</i>
chestnut oak	<i>Quercus prinus</i>
sassafras	<i>Sassafras albidum</i>
shrub	
witch hazel	<i>Hamamelis virginiana</i>
blackhaw	<i>Viburnum prunifolium</i>
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
mountain laurel	<i>Kalmia latifolia</i>
spicebush	<i>Lindera benzoin</i>
greenbriar	<i>Smilax rotundifolia</i>
poison-ivy	<i>Toxicodendron radicans</i>
herbaceous	
Japanese stiltgrass	<i>Microstegium vimineum</i>
garlic-mustard	<i>Alliaria petiolata</i>
hay-scented fern	<i>Dennstaedtia punctilobula</i>
winged euonymus	<i>Euonymus alatus</i>
wintergreen	<i>Gaultheria procumbens</i>
ferns	<i>Polypodiaceae sp.</i>
highbush blueberry	<i>Vaccinium corymbosum</i>
MIXED HARDWOOD FOREST	
canopy	
red maple	<i>Acer rubrum</i>
black birch	<i>Betula lenta</i>
shagbark hickory	<i>Carya ovata</i>
hickory	<i>Carya sp.</i>
tuliptree	<i>Liriodendron tulipifera</i>
princess-tree	<i>Paulownia tomentosa</i>
red oak	<i>Quercus rubra</i>
black oak	<i>Quercus velutina</i>

understory	
red maple	<i>Acer rubrum</i>
tree-of-heaven	<i>Ailanthus altissima</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
American beech	<i>Fagus grandifolia</i>
sassafras	<i>Sassafras albidum</i>
shrub	
porcelain berry	<i>Ampelopsis brevipedunculata</i>
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
autumn olive	<i>Elaeagnus umbellata</i>
winged euonymous	<i>Euonymus alatus</i>
witch-hazel	<i>Hamamelis virginiana</i>
privet	<i>Ligustrum sp.</i>
spicebush	<i>Lindera benzoin</i>
shrub honeysuckle	<i>Lonicera sp.</i>
multiflora rose	<i>Rosa multiflora</i>
wineberry	<i>Rubus phoenicolasius</i>
brambles	<i>Rubus sp.</i>
herbaceous	
Japanese stiltgrass	<i>Microstegium vimineum</i>
garlic-mustard	<i>Alliaria petiolata</i>
mile-a-minute	<i>Persicaria perfoliata</i>
ferns	<i>Polypodiaceae sp.</i>
periwinkle	<i>Vinca minor</i>

unit 3: list road oak forest

OAK FOREST	
canopy	
black birch	<i>Betula lenta</i>
mockernut hickory	<i>Carya tomentosa</i>
American beech	<i>Fagus grandifolia</i>

ash (dying)	<i>Fraxinus sp.</i>
tuliptree	<i>Liriodendron tulipifera</i>
blackgum	<i>Nyssa sylvatica</i>
princess-tree	<i>Paulownia tomentosa</i>
quaking aspen	<i>Populus temuloides</i>
white oak	<i>Quercus alba</i>
chestnut oak	<i>Quercus montana</i>
chinquapin oak	<i>Quercus muehlenbergii</i>
pin oak	<i>Quercus palustris</i>
red oak	<i>Quercus rubra</i>
black oak	<i>Quercus velutina</i>
black locust	<i>Robinia pseudoacacia</i>
understory	
red maple	<i>Acer rubrum</i>
pawpaw	<i>Asimina triloba</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
American holly	<i>Ilex opaca</i>
black cherry	<i>Prunus serotina</i>
black oak	<i>Quercus velutina</i>
sassafras	<i>Sassafras albidum</i>
shrub	
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
witch-hazel	<i>Hamamelis virginiana</i>
privet	<i>Ligustrum sp.</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
multiflora rose	<i>Rosa multiflora</i>
greenbriar	<i>Smilax rotundifolia</i>
poison-ivy	<i>Toxicodendron radicans</i>
lowbush blueberry	<i>Vaccinium angustifolium</i>
highbush blueberry	<i>Vaccinium corymbosum</i>

herbaceous	
white snakeroot	<i>Ageratina altissima</i>
garlic-mustard	<i>Alliaria petiolata</i>
hog-peanut	<i>Amphicarpaea bracteata</i>
bull thistle	<i>Cirsium vulgare</i>
mountain oat grass	<i>Danthonia compressa</i>
hay-scented fern	<i>Dennstaedtia punctilobula</i>
wintergreen	<i>Gaultheria procumbens</i>
rattlesnake plantain	<i>Goodyera pubescens</i>
partridge berry	<i>Mitchella repens</i>
ghost plant	<i>Monotropa uniflora</i>
mile-a-minute	<i>Persicaria perfoliata</i>
periwinkle	<i>Vinca minor</i>
violets	<i>Viola sp.</i>

unit 4: radio tower

OAK FOREST	
canopy	
tree-of-heaven	<i>Ailanthus altissima</i>
black birch	<i>Betula lenta</i>
ash (dying)	<i>Fraxinus sp.</i>
tuliptree	<i>Liriodendron tulipifera</i>
blackgum	<i>Nyssa sylvatica</i>
white oak	<i>Quercus alba</i>
chestnut oak	<i>Quercus montana</i>
chinquapin oak	<i>Quercus muehlenbergii</i>
pin oak	<i>Quercus prinus</i>
red oak	<i>Quercus rubra</i>
black oak	<i>Quercus velutina</i>
black locust	<i>Robinia pseudoacacia</i>
understory	
red maple	<i>Acer rubrum</i>
Japanese angelica tree	<i>Aralia elata</i>
pawpaw	<i>Asimina triloba</i>

black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
American holly	<i>Ilex opaca</i>
black oak	<i>Quercus velutina</i>
sassafras	<i>Sassafras albidum</i>
yew	<i>Taxus sp.</i>
shrub	
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
Japanese knotweed	<i>Fallopia japonica</i>
witch-hazel	<i>Hamamelis virginiana</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
shrub honeysuckle	<i>Lonicera sp.</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
multiflora rose	<i>Rosa multiflora</i>
wineberry	<i>Rubus phoenicolasius</i>
greenbriar	<i>Smilax rotundifolia</i>
poison-ivy	<i>Toxicodendron radicans</i>
lowbush blueberry	<i>Vaccinium angustifolium</i>
highbush blueberry	<i>Vaccinium corymbosum</i>
herbaceous	
white snakeroot	<i>Ageratina altissima</i>
garlic-mustard	<i>Alliaria petiolata</i>
broom sedge	<i>Andropogon virginicus</i>
bull thistle	<i>Cirsium vulgare</i>
mountain oat grass	<i>Danthonia compressa</i>
hay-scented fern	<i>Dennstaedtia punctilobula</i>
pilewort	<i>Erechtites hieraciifolia</i>
wintergreen	<i>Gaultheria procumbens</i>
rattlesnake plantain	<i>Goodyera oblongifolia</i>
partridge berry	<i>Mitchella repens</i>
mile-a-minute	<i>Persicaria perfoliata</i>
spirea	<i>Spirea sp.</i>
periwinkle	<i>Vinca minor</i>

unit 5: radio tower to tower road

OAK FOREST	
canopy	
black birch	<i>Betula lenta</i>
mockernut hickory	<i>Carya tomentosa</i>
ash (dying)	<i>Fraxinus sp.</i>
tuliptree	<i>Liriodendron tulipifera</i>
blackgum	<i>Nyssa sylvatica</i>
princess-tree	<i>Paulownia tomentosa</i>
quaking aspen	<i>Populus tremuloides</i>
white oak	<i>Quercus alba</i>
chestnut oak	<i>Quercus montana</i>
chinquipin oak	<i>Quercus muehlenbergii</i>
pin oak	<i>Quercus palustris</i>
red oak	<i>Quercus rubra</i>
black oak	<i>Quercus velutina</i>
black locust	<i>Robinia pseudoacacia</i>
understory	
red maple	<i>Acer rubrum</i>
pawpaw	<i>Asimina triloba</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
American holly	<i>Ilex opaca</i>
black cherry	<i>Prunus serotina</i>
black oak	<i>Quercus velutina</i>
sassafras	<i>Sassafras albidum</i>
shrub	
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
witch-hazel	<i>Hamamelis virginiana</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
multiflora rose	<i>Rosa multiflora</i>
greenbriar	<i>Smilax rotundifolia</i>

poison-ivy	<i>Toxicodendron radicans</i>
lowbush blueberry	<i>Vaccinium angustifolium</i>
highbush blueberry	<i>Vaccinium corymbosum</i>
herbaceous	
white snakeroot	<i>Ageratina altissima</i>
garlic-mustard	<i>Alliaria petiolata</i>
bull thistle	<i>Cirsium vulgare</i>
mountain oat grass	<i>Danthonia compressa</i>
hay-scented fern	<i>Dennstaedtia punctilobula</i>
wintergreen	<i>Gaultheria procumbens</i>
rattlesnake-plantain	<i>Goodyera pubescens</i>
partridge berry	<i>Mitchella repens</i>
mile-a-minute	<i>Persicaria perfoliata</i>
periwinkle	<i>Vinca minor</i>

unit 6: tower road to haag road

MIXED HARDWOOD FOREST	
canopy	
Norway maple	<i>Acer platanoides</i>
mockernut hickory	<i>Carya tomentosa</i>
tuliptree	<i>Liriodendron tulipifera</i>
red oak	<i>Quercus rubra</i>
understory	
red maple	<i>Acer rubrum</i>
sassafras	<i>Sassafras albidum</i>
shrub	
porcelain berry	<i>Ampelopsis brevipedunculata</i>
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
winged euonymus	<i>Euonymus alatus</i>
witch-hazel	<i>Hamamelis virginiana</i>
spicebush	<i>Lindera benzoin</i>
shrub honeysuckle	<i>Lonicera sp.</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>

wineberry	<i>Rubus phoenicolasius</i>
carrion-flower	<i>Smilax herbacea</i>
herbaceous	
white snakeroot	<i>Ageratina altissima</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>

unit 7: haag road to ferndale trail

DRENKEL FIELD EDGE	
trees	
Norway maple	<i>Acer platanoides</i>
princess-tree	<i>Paulownia tomentosa</i>
bird cherry	<i>Prunus avium</i>
black cherry	<i>Prunus serotina</i>
shrub and vines	
porcelain berry	<i>Ampelopsis brevipedunculata</i>
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
shrub honeysuckle	<i>Lonicera sp.</i>
multiflora rose	<i>Rosa multiflora</i>
wineberry	<i>Rubus phoenicolasius</i>
wisteria	<i>Wisteria sp.</i>
herbaceous	
Japanese stiltgrass	<i>Microstegium vimineum</i>
mile-a-minute	<i>Persicaria perfoliata</i>
periwinkle	<i>Vinca minor</i>

unit 8: stiltgrass savanna

STILTGRASS SAVANNA	
canopy	
Norway maple	<i>Acer platanoides</i>
tree-of-heaven	<i>Ailanthus altissima</i>
black cherry	<i>Prunus serotina</i>
red oak	<i>Quercus alba</i>
black locust	<i>Robinia pseudoacacia</i>

understory	
red maple	<i>Acer rubrum</i>
sassafras	<i>Sassafras albidum</i>
herbaceous	
Japanese stiltgrass	<i>Microstegium vimineum</i>
mile-a-minute	<i>Persicaria perfoliata</i>

unit 9: ferndale trail to pagoda oak forest

OAK FOREST	
canopy	
Norway maple	<i>Acer platanoides</i>
yellow birch	<i>Betula alleghaniensis</i>
black birch	<i>Betula lenta</i>
shagbark hickory	<i>Carya glabra</i>
American beech	<i>Fagus grandifolia</i>
tuliptree	<i>Liriodendron tulipifera</i>
Eastern white pine	<i>Pinus strobus</i>
white oak	<i>Quercus alba</i>
chestnut oak	<i>Quercus montana</i>
red oak	<i>Quercus rubra</i>
understory	
red maple	<i>Acer rubrum</i>
pawpaw	<i>Asimina triloba</i>
black birch	<i>Betula lenta</i>
hornbeam	<i>Carpinus caroliniana</i>
pignut hickory	<i>Carya glabra</i>
hickory	<i>Carya sp.</i>
American chestnut	<i>Castanea dentata</i>
blackgum	<i>Nyssa sylvatica</i>
Eastern white pine	<i>Pinus strobus</i>
black cherry	<i>Prunus serotina</i>
black oak	<i>Quercus velutina</i>
sassafras	<i>Sassafras albidum</i>

shrub	
barberry	<i>Berberis thunbergii</i>
mountain laurel	<i>Kalmia latifolia</i>
wineberry	<i>Rubus phoenicolasius</i>
green briar	<i>Smilax rotundifolia</i>
blueberry	<i>Vaccinium sp.</i>
blackhaw	<i>Viburnum prunifolium</i>
grape	<i>Vitis sp.</i>
herbaceous	
white wood aster	<i>Eurybia divaricata</i>
wintergreen	<i>Gaultheria procumbens</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
partridge berry	<i>Mitchella repens</i>

unit 10: pagoda

OAK FOREST	
canopy	
Norway maple	<i>Acer platanoides</i>
black birch	<i>Betula lenta</i>
American beech	<i>Fagus grandifolia</i>
tuliptree	<i>Liriodendron tulipifera</i>
white oak	<i>Quercus alba</i>
chestnut oak	<i>Quercus montana</i>
understory	
red maple	<i>Acer rubrum</i>
sugar maple	<i>Acer saccharum</i>
tree-of-heaven	<i>Ailanthus altissima</i>
pawpaw	<i>Asimina triloba</i>
yellow birch	<i>Betula alleghaniensis</i>
black birch	<i>Betula lenta</i>
hornbeam	<i>Caprinus caroliniana</i>
pignut hickory	<i>Carya glabra</i>
shagbark hickory	<i>Carya ovata</i>
hickory	<i>Carya sp.</i>

American chestnut	<i>Castanea dentata</i>
flowering dogwood	<i>Cornus florida</i>
American holly	<i>Ilex opaca</i>
blackgum	<i>Nyssa sylvatica</i>
pine	<i>Pinus sp.</i>
Eastern white pine	<i>Pinus strobus</i>
bird cherry	<i>Prunus avium</i>
black cherry	<i>Prunus serotina</i>
red oak	<i>Quercus alba</i>
black oak	<i>Quercus velutina</i>
black locust	<i>Robinia pseudoacacia</i>
sassafras	<i>Sassafras albidum</i>

shrub	
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
witch-hazel	<i>Hamamelis virginiana</i>
English ivy	<i>Hedera helix</i>
mountain laurel	<i>Kalmia latifolia</i>
shrub honeysuckle	<i>Lonicera sp.</i>
jetbead	<i>Rhodotypos scandens</i>
wineberry	<i>Rubus phoenicolasius</i>
greenbriar	<i>Smilax rotundifolia</i>
blueberry	<i>Vaccinium sp.</i>
blackhaw	<i>Viburnum prunifolium</i>
grape	<i>Vitis sp.</i>

herbaceous	
white snakeroot	<i>Ageratina altissima</i>
garlic-mustard	<i>Alliaria petiolata</i>
hay-scented fern	<i>Dennstaedtia punctilobula</i>
white wood aster	<i>Eurybia divaricata</i>
wintergreen	<i>Gaultheria procumbens</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
partridge berry	<i>Mitchella repens</i>
mile-a-minute	<i>Persicaria perfoliata</i>

MIXED HARDWOOD FOREST	
canopy	
Norway maple	<i>Acer platanoides</i>
ash	<i>Fraxinus sp.</i>
black walnut	<i>Juglans nigra</i>
tuliptree	<i>Liriodendron tulipifera</i>
princess-tree	<i>Paulownia tomentosa</i>
Eastern white pine	<i>Pinus strobus</i>
American sycamore	<i>Platanus occidentalis</i>
chestnut oak	<i>Quercus montana</i>
chinquapin oak	<i>Quercus muehlenbergii</i>
red oak	<i>Quercus rubra</i>
black locust	<i>Robinia pseudoacacia</i>
sassafras	<i>Sassafras albidum</i>
basswood	<i>Tilia americana</i>
understory	
red maple	<i>Acer rubrum</i>
tree-of-heaven	<i>Ailanthus altissima</i>
pawpaw	<i>Asimina triloba</i>
black birch	<i>Betula lenta</i>
hornbeam	<i>Carpinus caroliniana</i>
hickory	<i>Carya sp.</i>
American chestnut	<i>Castanea dentata</i>
American beech	<i>Fagus grandifolia</i>
mulberry	<i>Morus sp.</i>
blackgum	<i>Nyssa sylvatica</i>
princess-tree	<i>Paulownia tomentosa</i>
black cherry	<i>Prunus serotina</i>
pin oak	<i>Quercus palustris</i>
staghorn sumac	<i>Rhus typhina</i>
sassafras	<i>Sassafras albidum</i>
American elm	<i>Ulmus americana</i>
slippery elm	<i>Ulmus rubra</i>

shrub	
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
witch-hazel	<i>Hamamelis virginiana</i>
English ivy	<i>Hedera helix</i>
Japanese hops	<i>Humulus japonicus</i>
mountain laurel	<i>Kalmia latifolia</i>
privet	<i>Ligustrum sp.</i>
spicebush	<i>Lindera benzoin</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
shrub honeysuckle	<i>Lonicera sp.</i>
wineberry	<i>Rubus phoenicolasius</i>
greenbriar	<i>Smilax rotundifolia</i>
poison-ivy	<i>Toxicodendron radicans</i>
grape	<i>Vitis sp.</i>
wisteria	<i>Wisteria sp.</i>
herbaceous	
white snakeroot	<i>Ageratina altissima</i>
garlic-mustard	<i>Alliaria petiolata</i>
mugwort	<i>Artemisia vulgaris</i>
hay-scented fern	<i>Dennstaedtia punctilobula</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
mile-a-minute	<i>Persicaria perfoliata</i>
CANOPY GAP	
canopy	
sassafras	<i>Sassafras albidum</i>
shrubs and vines	
barberry	<i>Berberis thunbergii</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
shrub honeysuckle	<i>Lonicera sp.</i>
multiflora rose	<i>Rosa multiflora</i>

herbaceous	
white snakeroot	<i>Ageratina altissima</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
mile-a-minute	<i>Persicaria perfoliata</i>

unit 11: rotary

OAK FOREST	
canopy	
Norway maple	<i>Acer platanoides</i>
black birch	<i>Betula lenta</i>
shagbark hickory	<i>Carya ovata</i>
hickory	<i>Carya sp.</i>
American beech	<i>Fagus grandifolia</i>
ash	<i>Fraxinus sp.</i>
tuliptree	<i>Liriodendron tulipifera</i>
blackgum	<i>Nyssa sylvatica</i>
black cherry	<i>Prunus serotina</i>
white oak	<i>Quercus alba</i>
pin oak	<i>Quercus palustris</i>
chestnut oak	<i>Quercus montana</i>
red oak	<i>Quercus rubra</i>
black oak	<i>Quercus velutina</i>
understory	
red maple	<i>Acer rubrum</i>
sugar maple	<i>Acer saccharum</i>
tree-of-heaven	<i>Ailanthus altissima</i>
pawpaw	<i>Asimina triloba</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
flowering dogwood	<i>Cornus florida</i>
hawthorn	<i>Crataegus sp.</i>
American holly	<i>Ilex opaca</i>
black walnut	<i>Juglans nigra</i>
tuliptree	<i>Liriodendron tulipifera</i>

hop hornbeam	<i>Ostrya virginica</i>
bird cherry	<i>Prunus avium</i>
black cherry	<i>Prunus serotina</i>
white oak	<i>Quercus alba</i>
black locust	<i>Robinia pseudoacacia</i>
sassafras	<i>Sassafras albidum</i>
elm	<i>Ulmus sp.</i>
shrubs and vines	
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
autumn olive	<i>Elaeagnus umbellata</i>
winged euonymus	<i>Euonymus alatus</i>
witch-hazel	<i>Hamamelis virginiana</i>
English ivy	<i>Hedera helix</i>
privet	<i>Ligustrum sp.</i>
spicebush	<i>Lindera benzoin</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
shrub honeysuckle	<i>Lonicera sp.</i>
rhododendron	<i>Rhododendron sp.</i>
multiflora rose	<i>Rosa multiflora</i>
wineberry	<i>Rubus phoenicolasius</i>
blackberry	<i>Rubus sp.</i>
green briar	<i>Smilax sp.</i>
lowbush blueberry	<i>Vaccinium angustifolium</i>
maple leaf viburnum	<i>Viburnum acerifolium</i>
grape vine	<i>Vitis sp.</i>
herbaceous	
garlic-mustard	<i>Alliaria petiolata</i>
Jack-in-the-pulpit	<i>Arisaema triphyllum</i>
hay-scented fern	<i>Dennstaedtia punctilobula</i>
wild yam	<i>Dioscorea villosa</i>
white wood aster	<i>Eurybia divaricata</i>
wintergreen	<i>Gaultheria procumbens</i>
Canada mayflower	<i>Maianthemum canadense</i>

Japanese stilgrass	<i>Microstegium vimineum</i>
partridge berry	<i>Mitchella repens</i>
aniseroot	<i>Osmorhiza longistylis</i>
mile-a-minute	<i>Persicaria pefoliata</i>
Solomon's-seal	<i>Polygonatum pubescens</i>
polypody fern	<i>Polypodium vulgare</i>
Christmas fern	<i>Polystichum acrostichoides</i>
bloodroot	<i>Sanguinaria canadensis</i>
meadow rue	<i>Thalictrum sp.</i>
bellwort	<i>Uvularia sp.</i>
violets	<i>Viola sp.</i>
Indian cucumber-root	<i>Medeola virginiana</i>
BIRCH POLE STAND WITHIN OAK FOREST	
canopy	
tree-of-heaven	<i>Ailanthus altissima</i>
black birch	<i>Betula lenta</i>
bird cherry	<i>Prunus avium</i>
black cherry	<i>Prunus serotina</i>
shrubs and vines	
oriental bittersweet	<i>Celastrus orbiculatus</i>
witch-hazel	<i>Hamamelis virginiana</i>
shrub honeysuckle	<i>Lonicera sp.</i>
wineberry	<i>Rubus phoenicolasius</i>
grapevine	<i>Vitis sp.</i>
herbaceous	
garlic-mustard	<i>Alliaria petiolata</i>
Jack-in-the-pulpit	<i>Arisaema triphyllum</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
mile-a-minute	<i>Persicaria perfoliata</i>
PREVIOUSLY CLEARED AREA WITHIN OAK FOREST	
canopy	
Norway maple	<i>Acer platanoides</i>
black birch	<i>Betula lenta</i>
tuliptree	<i>Liriodendron tulipifera</i>

conifers	<i>Pinaceae sp.</i>
red oak	<i>Quercus rubra</i>
understory	
red maple	<i>Acer rubrum</i>
pagoda dogwood	<i>Cornus alternifolia</i>
sassafras	<i>Sassafras albidum</i>
shrub and vine	
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
spicebush	<i>Lindera benzoin</i>
shrub honeysuckle	<i>Lonicera sp.</i>
jetbead	<i>Rhodotypos scandens</i>
wineberry	<i>Rubus phoenicolasius</i>
blackhaw viburnum	<i>Viburnum prunifolium</i>
herbaceous	
garlic-mustard	<i>Alliaria petiolata</i>
Jack-in-the-pulpit	<i>Arisaema triphyllum</i>
wild geranium	<i>Geranium maculatum</i>
periwinkle	<i>Vinca minor</i>
violets	<i>Viola sp.</i>
MIXED HARDWOOD FOREST	
canopy	
black birch	<i>Betula lenta</i>
tuliptree	<i>Liriodendron tulipifera</i>
white oak	<i>Quercus alba</i>
black oak	<i>Quercus velutina</i>
understory	
black cherry	<i>Prunus serotina</i>
weeping cherry	<i>Prunus sp.</i>
sassafras	<i>Sassafras albidum</i>
shrubs and vines	
barberry	<i>Berberis thunbergii</i>
mountain laurel	<i>Kalmia latifolia</i>
wineberry	<i>Rubus phoenicolasius</i>

greenbriar	<i>Smilax rotundifolia</i>
blueberry	<i>Vaccinium sp.</i>
mapleleaf viburnum	<i>Viburnum acerifolium</i>
herbaceous	
Canada mayflower	<i>Maianthemum canadense</i>
bellwort	<i>Uvularia sp.</i>
SKUNK CABBAGE SEEP	
trees	
red maple	<i>Acer rubrum</i>
shrubs	
barberry	<i>Berberis thunbergii</i>
herbaceous	
skunk-cabbage	<i>Symplocarpus foetidus</i>

unit 12: palustrine forest

PALUSTRINE FOREST WEST	
canopy	
American beech	<i>Fagus grandifolia</i>
tuliptree	<i>Liriodendron tulipifera</i>
white oak	<i>Quercus alba</i>
pin oak	<i>Quercus palustris</i>
understory	
red maple	<i>Acer rubrum</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
red oak	<i>Quercus rubra</i>
shrub	
barberry	<i>Berberis thunbergii</i>
multiflora rose	<i>Rosa multiflora</i>
lowbush blueberry	<i>Vaccinium angustifolium</i>
highbush blueberry	<i>Vaccinium corymbosum</i>
arrowood viburnum	<i>Viburnum dentatum</i>

herbaceous	
sedges	<i>Carex sp.</i>
deer-tongue	<i>Dichanthelium clandestinum</i>
wintergreen	<i>Gaultheria procumbens</i>
jewelweed	<i>Impatiens capensis</i>
partridgeberry	<i>Michella repens</i>
Japanese stiltgrass	
Microstegium vimineum	
cinnamon fern	<i>Osmundastrum cinnamomeum</i>
arrow-arum	<i>Peltandra virginica</i>
skunk-cabbage	<i>Symplocarpus foetidus</i>

PALUSTRINE FOREST EAST	
canopy	
red maple	<i>Acer rubrum</i>
black birch	<i>Betula lenta</i>
tuliptree	<i>Liriodendron tulipifera</i>
pin oak	<i>Quercus palustris</i>
red oak	<i>Quercus rubra</i>
understory	
yellow birch	<i>Betula alleghaniensis</i>
American holly	<i>Ilex opaca</i>
shrub	
greenbriar	<i>Smilax rotundifolia</i>
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
multiflora rose	<i>Rosa multiflora</i>
highbush blueberry	<i>Vaccinium angustifolium</i>
lowbush blueberry	<i>Vaccinium corymbosum</i>
herbaceous	
sedges	<i>Carex sp.</i>
horse-balm	<i>Collinsonia canadensis</i>
hay-scented fern	<i>Dennstaedtia punctilobula</i>
jewelweed	<i>Impatiens capensis</i>

Japanese stiltgrass	
Microstegium vimineum	
cinnamon fern	<i>Osmundastrum cinnamomeum</i>
arrow-arum	<i>Peltandra virginica</i>
tearthumb	<i>Persicaria sagittata</i>
skunk-cabbage	<i>Symplocarpus foetidus</i>

unit 13: hill road west mixed hardwood forest

MIXED HARDWOOD FOREST	
canopy	
red maple	<i>Acer rubrum</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
ash (dying)	<i>Fraxinus sp.</i>
tuliptree	<i>Liriodendron tulipifera</i>
white oak	<i>Quercus alba</i>
red oak	<i>Quercus rubra</i>
black oak	<i>Quercus velutina</i>
understory	
red maple	<i>Acer rubrum</i>
tree-of-heaven	
Ailanthus altissima	
pawpaw	<i>Asimina triloba</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
black cherry	<i>Prunus serotina</i>
chestnut oak	<i>Quercus montana</i>
sassafras	<i>Sassafras albidum</i>
shrub	
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
winged euonymus	<i>Euonymus alatus</i>
witch-hazel	<i>Hamamelis virginiana</i>
privet	<i>Ligustrum sp.</i>

spicebush	<i>Lindera benzoin</i>
Japanese honeysuckle	
Lonicera japonica	
shrub honeysuckle	
Lonicera sp.	
sweet mock orange	<i>Philadelphus coronarius</i>
multiflora rose	<i>Rosa multiflora</i>
wineberry	<i>Rubus phoenicolasius</i>
greenbriar	<i>Smilax rotundifolia</i>
blueberry	<i>Vaccinium sp.</i>
maple leaf viburnum	<i>Viburnum acerifolium</i>
linden viburnum	
Viburnum dilatatum	
grape	<i>Vitis sp.</i>
herbaceous	
garlic-mustard	<i>Alliaria petiolata</i>
hay-scented fern	<i>Dennstaedtia punctilobula</i>
boneset	<i>Eupatorium perfoliatum</i>
white wood aster	<i>Eurybia divaricata</i>
common hops	<i>Humulus lupulus</i>
Japanese stiltgrass	
Microstegium vimineum	
Virginia creeper	<i>Parthenocissus quinquefolia</i>
mile-a-minute	<i>Persicaria perfoliata</i>
periwinkle	<i>Vinca minor</i>

unit 14: hill road east mixed hardwood forest

MIXED HARDWOOD FOREST	
canopy	
sugar maple	<i>Acer saccharum</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
American beech	<i>Fagus grandifolia</i>
black walnut	<i>Juglans nigra</i>
tuliptree	<i>Liriodendron tulipifera</i>
Eastern white pine	<i>Pinus strobus</i>

pin oak	<i>Quercus palustris</i>
red oak	<i>Quercus rubra</i>
black locust	<i>Robinia pseudoacacia</i>
understory	
red maple	<i>Acer rubrum</i>
tree-of-heaven	<i>Ailanthus altissima</i>
pawpaw	<i>Asimina triloba</i>
sassafras	<i>Sassafras albidum</i>
shrub	
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
privet	<i>Ligustrum sp.</i>
spicebush	<i>Lindera benzoin</i>
shrub honeysuckle	<i>Lonicera japonica</i>
multiflora rose	<i>Rosa multiflora</i>
wineberry	<i>Rubus phoenicolasius</i>
grape	<i>Vitis sp.</i>
herbaceous	
white snakeroot	<i>Ageratina altissima</i>
garlic-mustard	<i>Alliaria petiolata</i>
Jack-in-the-pulpit	<i>Arisaema triphyllum</i>
hay-scented fern	<i>Dennstaedtia punctilobula</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
mile-a-minute	<i>Persicaria perfoliata</i>
violets	<i>Viola sp.</i>

unit 15: list to hill road oak forest

OAK FOREST	
canopy	
American beech	<i>Fagus grandifolia</i>
tuliptree	<i>Liriodendron tulipifera</i>
white oak	<i>Quercus alba</i>
chestnut oak	<i>Quercus montana</i>
red oak	<i>Quercus rubra</i>

black oak	<i>Quercus velutina</i>
understory	
red maple	<i>Acer rubrum</i>
pawpaw	<i>Asimina triloba</i>
American beech	<i>Fagus grandifolia</i>
blackgum	<i>Nyssa sylvatica</i>
black cherry	<i>Prunus serotina</i>
sassafras	<i>Sassafras albidum</i>
shrub	
barberry	<i>Berberis thunbergii</i>
mountain laurel	<i>Kalmia latifolia</i>
spicebush	<i>Lindera benzoin</i>
wineberry	<i>Rubus phoenicolasius</i>
greenbriar	<i>Smilax rotundifolia</i>
blueberry	<i>Vaccinium sp.</i>
maple leaved viburnum	<i>Viburnum acerifolium</i>
herbaceous	
hay-scented fern	<i>Dennstaedtia punctilobula</i>
wintergreen	<i>Gaultheria procumbens</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
partridge berry	<i>Mitchella repens</i>
aniseroot	<i>Osmorhiza longistylis</i>

unit 16: old orchard

MIXED HARDWOOD FOREST	
canopy	
Norway maple	<i>Acer platanoides</i>
black birch	<i>Betula lenta</i>
American beech	<i>Fagus grandifolia</i>
black walnut	<i>Juglans nigra</i>
tuliptree	<i>Liriodendron tulipifera</i>
bamboo	<i>Phyllostachys sp.</i>
pin oak	<i>Quercus palustris</i>
black oak	<i>Quercus velutina</i>

understory	
red maple	<i>Acer rubrum</i>
tree-of-heaven	<i>Ailanthus altissima</i>
pawpaw	<i>Asimina triloba</i>
black birch	<i>Betula lenta</i>
hornbeam	<i>Carpinus caroliniana</i>
sassafras	<i>Sassafras albidum</i>
shrub	
grape	<i>Vitis sp.</i>
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
autumn-olive	<i>Elaeagnus umbellata</i>
English ivy	<i>Hedera helix</i>
privet	<i>Ligustrum sp.</i>
spicebush	<i>Lindera benzoin</i>
shrub honeysuckle	<i>Lonicera sp.</i>
wineberry	<i>Rubus phoenicolasius</i>
greenbriar	<i>Smilax rotundifolia</i>
blackhaw	<i>Viburnum prunifolium</i>
herbaceous	
garlic-mustard	<i>Alliaria petiolata</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
mile-a-minute	<i>Persicaria perfoliata</i>

unit 17: egelman upland

MIXED HARDWOOD FOREST TO OAK FOREST*	
canopy	
shagbark hickory	<i>Carya ovata</i>
American beech	<i>Fagus grandifolia</i>
tuliptree	<i>Liriodendron tulipifera</i>
chestnut oak	<i>Quercus montana</i>
red oak	<i>Quercus rubra</i>

understory	
pawpaw	<i>Asimina triloba</i>
hickory	<i>Carya sp.</i>
white oak	<i>Quercus alba</i>
sassafras	<i>Sassafras albidum</i>
slippery elm	<i>Ulmus ruba</i>
shrub	
barberry	<i>Berberis thunbergii</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
rhododendron	<i>Rhododendron sp.</i>
wineberry	<i>Rubus phoenicolasius</i>
greenbriar	<i>Smilax rotundifolia</i>
grape	<i>Vitis sp.</i>
herbaceous	
white snakeroot	<i>Ageratina altissima</i>
garlic-mustard	<i>Alliaria petiolata</i>
white wood aster	<i>Eurybia divaricata</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
periwinkle	<i>Vinca minor</i>

*Plant diversity is fairly consistent across this area, but dominance shifted from mixed hardwoods to oak as moving uphill

unit 18: egelman east

MIXED HARDWOOD FOREST WEST OF STREAM	
canopy	
Norway maple	<i>Acer platanoides</i>
sugar maple	<i>Acer saccharum</i>
tuliptree	<i>Liriodendron tulipifera</i>
white oak	<i>Quercus alba</i>
black locust	<i>Robinia psuedoacacia</i>
understory	
red maple	<i>Acer rubrum</i>
black birch	<i>Betula lenta</i>
white birch	<i>Betula papyrifera</i>

catalpa	<i>Catalpa bignonioides</i>
sassafras	<i>Sassafras albidum</i>
elm	<i>Ulmus sp.</i>
shrub	
porcelain berry	<i>Ampelopsis brevipedunculata</i>
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
leatherwood	<i>Dirca palustris</i>
witch-hazel	<i>Hamamelis virginiana</i>
spicebush	<i>Lindera benzoin</i>
shrub honeysuckle	<i>Lonicera sp.</i>
jetbead	<i>Rhodotypos scandens</i>
multiflora rose	<i>Rosa multiflora</i>
bramble	<i>Rubus sp.</i>
grape	<i>Vitis sp.</i>
herbaceous	
white snakeroot	<i>Ageratina altissima</i>
hog-peanut	<i>Amphicarpaea bracteata</i>
mugwort	<i>Artemisia vulgaris</i>
common milkweed	<i>Asclepias syriaca</i>
deer-tongue grass	<i>Dichanthelium boscii</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
periwinkle	<i>Vinca minor</i>
violets	<i>Viola sp.</i>
MIXED HARDWOOD FOREST EAST OF STREAM	
canopy	
American beech	<i>Fagus grandifolia</i>
ash	<i>Fraxinus sp.</i>
black walnut	<i>Juglans nigra</i>
tuliptree	<i>Liriodendron tulipifera</i>
blackgum	<i>Nyssa sylvatica</i>
Eastern white pine	<i>Pinus strobus</i>
chestnut oak	<i>Quercus montana</i>

red oak	<i>Quercus rubra</i>
understory	
black birch	<i>Betula lenta</i>
shrub	
witch-hazel	<i>Hamamelis virginiana</i>
barberry	<i>Berberis thunbergii</i>
spicebush	<i>Lidera benzoin</i>
shrub honeysuckle	<i>Lonicera sp.</i>
wineberry	<i>Rubus phoenicolasius</i>
poison-ivy	<i>Toxicodendron radicans</i>
herbaceous	
hog-peanut	<i>Amphicarpaea bracteata</i>
mugwort	<i>Artemisia vulgaris</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
bellwort	<i>Uvularia sp.</i>

unit 19: haag road to egelman

OAK FOREST	
canopy	
Norway maple	<i>Acer platanoides</i>
red maple	<i>Acer rubrum</i>
black birch	<i>Betula lenta</i>
hickory	<i>Carya sp.</i>
American beech	<i>Fagus grandifolia</i>
tuliptree	<i>Liriodendron tulipifera</i>
bird cherry	<i>Prunus avium</i>
white oak	<i>Quercus alba</i>
chestnut oak	<i>Quercus montana</i>
red oak	<i>Quercus rubra</i>
understory	
flowering dogwood	<i>Cornus florida</i>
sassafras	<i>Sassafras albidum</i>

shrub	
greenbriar	<i>Smilax rotundifolia</i>
barberry	<i>Berberis thunbergii</i>
witch-hazel	<i>Hamamelis virginiana</i>
mountain laurel	<i>Kalmia latifolia</i>
wineberry	<i>Rubus phoenicolasius</i>
blueberry	<i>Vaccinium sp.</i>
maple leaf viburnum	<i>Viburnum acerifolium</i>
herbaceous	
hay-scented fern	<i>Dennstaedtia punctilobula</i>
white wood aster	<i>Eurybia divaricata</i>
violets	<i>Viola sp.</i>

*The Mixed Hardwood Forest within this management unit has the same plant composition, but has a lower proportion of oak trees.

unit 20: rose valley creek

OAK FOREST	
canopy	
Norway maple	<i>Acer platanoides</i>
yellow birch	<i>Betula alleghaniensis</i>
pignut hickory	<i>Carya glabra</i>
shagbark hickory	<i>Carya ovata</i>
American beech	<i>Fagus grandifolia</i>
ash (dead)	<i>Fraxinus sp.</i>
black walnut	<i>Juglans nigra</i>
tuliptree	<i>Liriodendron tulipifera</i>
princess-tree	<i>Paulownia tomentosa</i>
white oak	<i>Quercus alba</i>
chestnut oak	<i>Quercus montana</i>
pin oak	<i>Quercus palustris</i>
red oak	<i>Quercus rubra</i>
black oak	<i>Quercus velutina</i>
black locust	<i>Robinia psuedoacacia</i>
basswood	<i>Tilia americana</i>

understory	
box elder	<i>Acer negundo</i>
red maple	<i>Acer rubrum</i>
mimosa	<i>Albizia julibrissin</i>
black birch	<i>Betula lenta</i>
hornbeam	<i>Carpinus caroliniana</i>
hickory	<i>Carya sp.</i>
flowering dogwood	<i>Cornus florida</i>
black walnut	<i>Juglans nigra</i>
bird cherry	<i>Prunus avium</i>
sassafras	<i>Sassafras albidum</i>
American elm	<i>Ulmus americana</i>
shrub	
porcelain berry	<i>Ampelopsis brevipedunculata</i>
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
Japanese knotweed	<i>Fallopia japonica</i>
English ivy	<i>Hedera helix</i>
Japanese hops	<i>Humulus japonicus</i>
shrub honeysuckle	<i>Lonicera sp.</i>
wineberry	<i>Rubus phoenicolasius</i>
greenbriar	<i>Smilax rotundifolium</i>
linden viburnum	<i>Viburnum dilatatum</i>
blackhaw	<i>Viburnum prunifolium</i>
grape	<i>Vitis sp.</i>
wisteria	<i>Wisteria sp.</i>
herbaceous	
white snakeroot	<i>Ageratina altissima</i>
garlic-mustard	<i>Alliaria petiolata</i>
wintergreen	<i>Gaultheria procumbens</i>
jewelweed	<i>Impatiens capensis</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
Christmas fern	<i>Polystichum acrostichoides</i>
periwinkle	<i>Vinca minor</i>

RIPARIAN FOREST	
canopy	
red oak	<i>Acer rubra</i>
sugar maple	<i>Acer saccharum</i>
ash (dead)	<i>Fraxinus sp.</i>
black walnut	<i>Juglans nigra</i>
tuliptree	<i>Liriodendron tulipifera</i>
basswood	<i>Tilia americana</i>
understory	
Norway maple	<i>Acer platanoides</i>
sugar maple	<i>Acer saccharum</i>
American elm	<i>Ulmus americana</i>
shrub	
spicebush	<i>Lindera benzoin</i>
porcelain berry	<i>Ampelopsis brevipedunculata</i>
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
Japanese knotweed	<i>Fallopia japonica</i>
English ivy	<i>Hedera helix</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
wineberry	<i>Rubus phoenicolasius</i>
herbaceous	
white snakeroot	<i>Ageratina altissima</i>
garlic-mustard	<i>Alliaria petiolata</i>
hog-peanut	<i>Amphicarpaea bracteata</i>
helianthus	<i>Helianthus sp.</i>
jewelweed	<i>Impatiens capensis</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
poison-ivy	<i>Toxicodendron radicans</i>

unit 21: pendora oak forest

OAK FOREST	
canopy	
Norway maple	<i>Acer platanoides</i>
red oak	<i>Acer rubra</i>
black birch	<i>Betula lenta</i>
American beech	<i>Fagus grandifolia</i>
tuliptree	<i>Liriodendron tulipifera</i>
American sycamore	<i>Platanus occidentalis</i>
white oak	<i>Quercus alba</i>
pin oak	<i>Quercus palustris</i>
understory	
black birch	<i>Betula lenta</i>
shrub	
witch-hazel	<i>Hamamelis virginiana</i>
mountain laurel	<i>Kalmia latifolia</i>
jetbead	<i>Rhodotypos scandens</i>
herbaceous	
white snakeroot	<i>Ageratina altissima</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>

unit 22: antietam road east

OAK MIXED HARDWOOD MID TO LOW ELEVATIONS	
canopy	
sugar maple	<i>Acer saccharum</i>
tree-of-heaven	<i>Ailanthus altissima</i>
black birch	<i>Betula lenta</i>
bitternut hickory	<i>Carya cordiformis</i>
pignut hickory	<i>Carya glabra</i>
American beech	<i>Fagus grandifolium</i>
tuliptree	<i>Liriodendron tulipifera</i>
bird cherry	<i>Prunus avium</i>
white oak	<i>Quercus alba</i>
chestnut oak	<i>Quercus montana</i>
red oak	<i>Quercus rubra</i>
understory	
red maple	<i>Acer rubrum</i>
hickory	<i>Carya sp.</i>
hackberry	<i>Celtis occidentalis</i>
hawthorne	<i>Crataegus sp.</i>
hop hornbeam	<i>Ostrya virginiana</i>
black cherry	<i>Prunus serotina</i>
sassafras	<i>Sassafras albidum</i>
shrub	
barberry	<i>Berberis thunbergii</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
witch-hazel	<i>Hamamelis virginiana</i>
privet	<i>Ligustrum sp.</i>
spicebush	<i>Lindera benzoin</i>

Japanese honeysuckle	<i>Lonicera japonica</i>
shrub honeysuckle	<i>Lonicera sp.</i>
multiflora rose	<i>Rosa multiflora</i>
wineberry	<i>Rubus phoenicolasius</i>
brambles	<i>Rubus sp.</i>
poison ivy	<i>Toxicodendron radicans</i>
herbaceous	
hay-scented fern	<i>Dennstaedtia punctilobula</i>
wintergreen	<i>Gualtheria procumbens</i>
garlic-mustard	<i>Alliaria petiolata</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
OAK MIXED HARDWOOD FOREST RIDGETOP	
canopy	
red oak	<i>Quercus rubra</i>
dead ash	<i>Fraxinus sp.</i>
black walnut	<i>Juglans nigra</i>
understory	
sassafras	<i>Sassafras albidum</i>
shrub and vine	
spicebush	<i>Lindera benzoin</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
privet	<i>Ligustrum sp.</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
shrub honeysuckle	<i>Lonicera sp.</i>
wineberry	<i>Rubus phoenicolasius</i>
herbaceous	
garlic-mustard	<i>Alliaria petiolata</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>

unit 23: antietam lake park

See 2018 Antietam Lake Park Natural Resources Stewardship Plan for plant lists.

climate change tree vulnerability

The following tables show the modeled vulnerability of tree species within the Piedmont region. Two scenarios were run with different emission conditions, with the second scenario modeling higher emissions. Tree species with only one vulnerability ranking indicate the same level of vulnerability under either scenario. Modeling was done by the Northern Institute of Applied Climate Science and included in the Pennsylvania Department of Conservation and Natural Resources' 2018 Climate Change Adaptation and Mitigation Plan. Invasive plants were not included. Vulnerability was not modeled for all native tree species present within the Preserve.

unit 1: oak lane

OAK FOREST	
canopy	
increase or decrease	sassafras (<i>Sassafras albidum</i>)
no change or decrease	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus prinus</i>)
	red oak (<i>Quercus rubra</i>)
	black oak (<i>Quercus velutina</i>)
decrease	black birch (<i>Betula lenta</i>)
	black cherry (<i>Prunus serotina</i>)
understory	
increase	American holly (<i>Ilex opaca</i>)
no change	blackgum (<i>Nyssa sylvatica</i>)
increase or decrease	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	flowering dogwood (<i>Cornus florida</i>)
	American beech (<i>Fagus grandifolia</i>)
MIXED HARDWOOD FOREST	
canopy	
no change or decrease	red oak (<i>Acer rubra</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	black oak (<i>Quercus velutina</i>)

understory	
increase	American holly (<i>Ilex opaca</i>)
increase or decrease	sassafras (<i>Sassafras albidum</i>)
no change or decrease	flowering dogwood (<i>Cornus florida</i>)

unit 2: list road to skyline drive forest

OAK FOREST	
canopy	
no data available	hickory (<i>Carya sp.</i>)
increase	white oak (<i>Quercus alba</i>)
no change	blackgum (<i>Nyssa sylvatica</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	American beech (<i>Fagus grandifolia</i>)
	scarlet oak (<i>Quercus coccinea</i>)
	chestnut oak (<i>Quercus montana</i>)
	red oak (<i>Quercus rubra</i>)
	black oak (<i>Quercus velutina</i>)
decrease	black birch (<i>Betula lenta</i>)
understory	
no data available	serviceberry (<i>Amelanchier sp.</i>)
	bird cherry (<i>Prunus avium</i>)
no change	blackgum (<i>Nyssa sylvatica</i>)

increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	flowering dogwood (<i>Cornus florida</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus prinus</i>)
decrease	black cherry (<i>Prunus serotina</i>)

MIXED HARDWOOD FOREST	
canopy	
no data available	hickory (<i>Carya sp.</i>)
increase	shagbark hickory (<i>Carya ovata</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	red oak (<i>Quercus rubra</i>)
	black oak (<i>Quercus velutina</i>)
decrease	black birch (<i>Betula lenta</i>)
understory	
no data available	hickory (<i>Carya sp.</i>)
increase or decrease	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	American beech (<i>Fagus grandifolia</i>)
decrease	black birch (<i>Betula lenta</i>)

unit 3: list road oak forest

OAK FOREST	
canopy	
no data available	ash (dying) (<i>Fraxinus sp.</i>)
increase	mockernut hickory (<i>Carya tomentosa</i>)
	white oak (<i>Quercus alba</i>)
	chinquapin oak (<i>Quercus muehlenbergii</i>)

increase or no change	pin oak (<i>Quercus palustris</i>)
no change	blackgum (<i>Nyssa sylvatica</i>)
no change or decrease	American beech (<i>Fagus grandifolia</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus montana</i>)
	red oak (<i>Quercus rubra</i>)
	black oak (<i>Quercus velutina</i>)
	black locust (<i>Robinia pseudoacacia</i>)
decrease	black birch (<i>Betula lenta</i>)
	quaking aspen (<i>Populus tremuloides</i>)
understory	
no data available	hickory (<i>Carya sp.</i>)
increase	American holly (<i>Ilex opaca</i>)
increase or no change	black oak (<i>Quercus velutina</i>)
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	black birch (<i>Betula lenta</i>)
decrease	black cherry (<i>Prunus serotina</i>)

unit 4: radio tower

OAK FOREST	
canopy	
no data available	ash (dying) (<i>Fraxinus sp.</i>)
increase	white oak (<i>Quercus alba</i>)
	chinquapin oak (<i>Quercus muehlenbergii</i>)
increase or no change	pin oak (<i>Quercus palustris</i>)
no change	blackgum (<i>Nyssa sylvatica</i>)

no change or decrease	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus montana</i>)
	red oak (<i>Quercus rubra</i>)
	black oak (<i>Quercus velutina</i>)
	black locust (<i>Robinia pseudoacacia</i>)
decrease	black birch (<i>Betula lenta</i>)
understory	
no data available	hickory (<i>Carya sp.</i>)
	yew (<i>Taxus sp.</i>)
increase	American holly (<i>Ilex opaca</i>)
increase or no change	black oak (<i>Quercus velutina</i>)
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
decrease	black birch (<i>Betula lenta</i>)

unit 5: radio tower to tower road

OAK FOREST	
canopy	
no data available	ash (dying) (<i>Fraxinus sp.</i>)
increase	white oak (<i>Quercus alba</i>)
	chinquapin oak (<i>Quercus muehlenbergii</i>)
increase or no change	pin oak (<i>Quercus palustris</i>)
	black oak (<i>Quercus velutina</i>)
no change	blackgum (<i>Nyssa sylvatica</i>)
no change or decrease	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus montana</i>)
	red oak (<i>Quercus rubra</i>)
	black oak (<i>Quercus velutina</i>)
	black locust (<i>Robinia pseudoacacia</i>)

decrease	black birch (<i>Betula lenta</i>)
	quaking aspen (<i>Populus tremuloides</i>)
understory	
no data available	hickory (<i>Carya sp.</i>)
increase	American holly (<i>Ilex opaca</i>)
increase or no change	black oak (<i>Quercus velutina</i>)
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
decrease	black birch (<i>Betula lenta</i>)
	black cherry (<i>Prunus serotina</i>)

unit 6: tower road to haag road

MIXED HARDWOOD FOREST	
canopy	
increase	mockernut hickory (<i>Carya tomentosa</i>)
no change or decrease	tuliptree (<i>Liriodendron tulipifera</i>)
	red oak (<i>Quercus rubra</i>)
understory	
increase or decrease	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)

unit 7: haag road to ferndale trail

OAK FOREST	
canopy	
no data available	ash (dying) (<i>Fraxinus sp.</i>)
	bird cherry (<i>Prunus avium</i>)
increase	mockernut hickory (<i>Carya tomentosa</i>)
	white oak (<i>Quercus alba</i>)
	chinquapin oak (<i>Quercus muehlenbergii</i>)
increase or no change	pin oak (<i>Quercus palustris</i>)
	black oak (<i>Quercus velutina</i>)
no change	blackgum (<i>Nyssa sylvatica</i>)
no change or decrease	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus prinus</i>)
	red oak (<i>Quercus rubra</i>)
	black locust (<i>Robinia pseudoacacia</i>)
decrease	black birch (<i>Betula lenta</i>)
understory	
increase	mockernut hickory (<i>Carya tomentosa</i>)
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
decrease	black birch (<i>Betula lenta</i>)
DRENKEL FIELD EDGE	
trees	
no data available	bird cherry (<i>Prunus avium</i>)
decrease	black cherry (<i>Prunus serotina</i>)

unit 8: stiltgrass savanna

STILTGRASS SAVANNAH	
trees	
decrease	black cherry (<i>Prunus serotina</i>)
no change or decrease	red oak (<i>Quercus rubra</i>)
	black locust (<i>Robinia pseudoacacia</i>)

unit 9: ferndale trail to pagoda oak forest

OAK FOREST	
canopy	
increase	shagbark hickory (<i>Carya glabra</i>)
	white oak (<i>Quercus alba</i>)
no change or decrease	American beech (<i>Fagus grandifolia</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus montana</i>)
	red oak (<i>Quercus rubra</i>)
	yellow birch (<i>Betula alleghaniensis</i>)
decrease	black birch (<i>Betula lenta</i>)
	Eastern white pine (<i>Pinus strobus</i>)
	understory
no data available	hornbeam (<i>Carpinus caroliniana</i>)
	hickory (<i>Carya sp.</i>)
increase or no change	black oak (<i>Quercus velutina</i>)
no change	American chestnut (<i>Castanea dentata</i>)
	blackgum (<i>Nyssa sylvatica</i>)
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	pignut hickory (<i>Carya glabra</i>)

decrease	black birch (<i>Betula lenta</i>)
	Eastern white pine (<i>Pinus strobus</i>)
	black cherry (<i>Prunus serotina</i>)

unit 10: pagoda

OAK FOREST	
canopy	
increase	white oak (<i>Quercus alba</i>)
no change or decrease	American beech (<i>Fagus grandifolia</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus montana</i>)
decrease	black birch (<i>Betula lenta</i>)
understory	
no data available	hornbeam (<i>Carpinus caroliniana</i>)
	hickory (<i>Carya sp.</i>)
	pine (<i>Pinus sp.</i>)
	bird cherry (<i>Prunus avium</i>)
increase	American holly (<i>Ilex opaca</i>)
increase or no change	black oak (<i>Quercus velutina</i>)
no change	American chestnut (<i>Castanea dentata</i>)
	blackgum (<i>Nyssa sylvatica</i>)
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	shagbark hickory (<i>Carya ovata</i>)
	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	sugar maple (<i>Acer saccharum</i>)
	pignut hickory (<i>Carya glabra</i>)
	flowering dogwood (<i>Cornus florida</i>)
	red oak (<i>Quercus alba</i>)
	black locust (<i>Robinia pseudoacacia</i>)

decrease	yellow birch (<i>Betula alleghaniensis</i>)
	black birch (<i>Betula lenta</i>)
	Eastern white pine (<i>Pinus strobus</i>)
	black cherry (<i>Prunus serotina</i>)

MIXED HARDWOOD FOREST	
canopy	
no data available	ash (<i>Fraxinus sp.</i>)
increase	American sycamore (<i>Platanus occidentalis</i>)
	chinquapin oak (<i>Quercus muehlenbergii</i>)
increase or decrease	sassafras (<i>Sassafras albidum</i>)
no change or decrease	black walnut (<i>Juglans nigra</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus montana</i>)
	red oak (<i>Quercus rubra</i>)
	black locust (<i>Robinia pseudoacacia</i>)
decrease	Eastern white pine (<i>Pinus strobus</i>)
	basswood (<i>Tilia americana</i>)
understory	
no data available	hornbeam (<i>Carpinus caroliniana</i>)
	hickory (<i>Carya sp.</i>)
	staghorn sumac (<i>Rhus typhina</i>)
increase	American holly (<i>Ilex opaca</i>)
increase or no change	mulberry (<i>Morus sp.</i>)
	pin oak (<i>Quercus palustris</i>)
no change	American chestnut (<i>Castanea dentata</i>)
	blackgum (<i>Nyssa sylvatica</i>)
	slippery elm (<i>Ulmus rubra</i>)
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	American elm (<i>Ulmus americana</i>)
	sassafras (<i>Sassafras albidum</i>)

no change or decrease	red maple (<i>Acer rubrum</i>)
	American beech (<i>Fagus grandifolia</i>)
decrease	black birch (<i>Betula lenta</i>)
	black cherry (<i>Prunus serotina</i>)

CANOPY GAP	
canopy	
increase or decrease	sassafras (<i>Sassafras albidum</i>)

unit 11: rotary

OAK FOREST	
canopy	
no data available	hickory (<i>Carya sp.</i>)
	ash (<i>Fraxinus sp.</i>)
increase	shagbark hickory (<i>Carya ovata</i>)
	white oak (<i>Quercus alba</i>)
increase or no change	pin oak (<i>Quercus palustris</i>)
no change	blackgum (<i>Nyssa sylvatica</i>)
no change or decrease	American beech (<i>Fagus grandifolia</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus montana</i>)
	red oak (<i>Quercus rubra</i>)
decrease	black oak (<i>Quercus velutina</i>)
	black birch (<i>Betula lenta</i>)
	black cherry (<i>Prunus serotina</i>)
understory	
no data available	hickory (<i>Carya sp.</i>)
	hawthorn (<i>Crataegus sp.</i>)
	bird cherry (<i>Prunus avium</i>)
	elm (<i>Ulmus sp.</i>)

increase	American holly (<i>Ilex opaca</i>)
	white oak (<i>Quercus alba</i>)
increase or no change	hop hornbeam (<i>Ostrya virginica</i>)
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	sugar maple (<i>Acer saccharum</i>)
	flowering dogwood (<i>Cornus florida</i>)
	black walnut (<i>Juglans nigra</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	black locust (<i>Robinia pseudoacacia</i>)
decrease	black birch (<i>Betula lenta</i>)
	black cherry (<i>Prunus serotina</i>)

BIRCH POLE STAND WITHIN OAK FOREST	
canopy	
no data available	bird cherry (<i>Prunus avium</i>)
decrease	black birch (<i>Betula lenta</i>)
	black cherry (<i>Prunus serotina</i>)

PREVIOUSLY CLEARED AREA WITHIN OAK FOREST	
canopy	
no data available	conifers (<i>Pinaceae sp.</i>)
no change or decrease	tuliptree (<i>Liriodendron tulipifera</i>)
	red oak (<i>Quercus rubra</i>)
decrease	black birch (<i>Betula lenta</i>)
understory	
no data available	pagoda dogwood (<i>Cornus alternifolia</i>)
increase or decrease	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)

MIXED HARDWOOD FOREST	
canopy	
increase	white oak (<i>Quercus alba</i>)
increase or no change	black oak (<i>Quercus velutina</i>)
no change or decrease	tuliptree (<i>Liriodendron tulipifera</i>)
decrease	black birch (<i>Betula lenta</i>)
understory	
no data available	weeping cherry (<i>Prunus sp.</i>)
increase or decrease	sassafras (<i>Sassafras albidum</i>)
decrease	black cherry (<i>Prunus serotina</i>)
SKUNK CABBAGE SEEP	
trees	
no change or decrease	red maple (<i>Acer rubrum</i>)

unit 12: palustrine forest

PALUSTRINE FOREST EAST	
canopy	
increase or no change	pin oak (<i>Quercus palustris</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	red oak (<i>Quercus rubra</i>)
decrease	black birch (<i>Betula lenta</i>)
understory	
increase	American holly (<i>Ilex opaca</i>)
decrease	yellow birch (<i>Betula alleghaniensis</i>)

unit 13: hill road west mixed hardwood forest

MIXED HARDWOOD FOREST	
canopy	
no data available	hickory (<i>Carya sp.</i>)
	ash (<i>dying</i>) (<i>Fraxinus sp.</i>)
increase	white oak (<i>Quercus alba</i>)
increase or no change	black oak (<i>Quercus velutina</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	red oak (<i>Quercus rubra</i>)
decrease	black birch (<i>Betula lenta</i>)
understory	
no data available	hickory (<i>Carya sp.</i>)
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	chestnut oak (<i>Quercus montana</i>)
decrease	black birch (<i>Betula lenta</i>)
	black cherry (<i>Prunus serotina</i>)

unit 14: hill road east mixed hardwood forest

MIXED HARDWOOD FOREST	
canopy	
no data available	hickory (<i>Carya sp.</i>)
increase or no change	pin oak (<i>Quercus palustris</i>)
no change or decrease	sugar maple (<i>Acer saccharum</i>)
	American beech (<i>Fagus grandifolia</i>)
	black walnut (<i>Juglans nigra</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	red oak (<i>Quercus rubra</i>)
	black locust (<i>Robinia pseudoacacia</i>)
decrease	black birch (<i>Betula lenta</i>)
	Eastern white pine (<i>Pinus strobus</i>)
understory	
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)

unit 15: list to hill road oak forest

OAK FOREST	
canopy	
increase	white oak (<i>Quercus alba</i>)
increase or no change	black oak (<i>Quercus velutina</i>)
no change or decrease	American beech (<i>Fagus grandifolia</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus prinus</i>)
	red oak (<i>Quercus rubra</i>)

understory	
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change	blackgum (<i>Nyssa sylvatica</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	American beech (<i>Fagus grandifolia</i>)
decrease	black cherry (<i>Prunus serotina</i>)

unit 16: old orchard

MIXED HARDWOOD FOREST	
canopy	
increase or no change	pin oak (<i>Quercus palustris</i>)
	black oak (<i>Quercus velutina</i>)
no change or decrease	American beech (<i>Fagus grandifolia</i>)
	black walnut (<i>Juglans nigra</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
decrease	black birch (<i>Betula lenta</i>)
understory	
no data available	hornbeam (<i>Carpinus caroliniana</i>)
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
decrease	black birch (<i>Betula lenta</i>)

unit 17: egelman upland

MIXED HARDWOOD FOREST TO OAK FOREST*	
canopy	
increase	shagbark hickory (<i>Carya ovata</i>)
no change or decrease	American beech (<i>Fagus grandifolia</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus montana</i>)
	red oak (<i>Quercus rubra</i>)
understory	
no data available	hickory (<i>Carya sp.</i>)
increase	white oak (<i>Quercus alba</i>)
increase or decrease	pawpaw (<i>Asimina triloba</i>)
	sassafras (<i>Sassafras albidum</i>)
no change	slippery elm (<i>Ulmus ruba</i>)

*Plant diversity is fairly consistent across this area, but dominance shifted from mixed hardwoods to oak as moving uphill

unit 18: egelman east

MIXED HARDWOOD FOREST WEST OF STREAM	
canopy	
increase	white oak (<i>Quercus alba</i>)
no change or decrease	sugar maple (<i>Acer saccharum</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	black locust (<i>Robinia psuedoacacia</i>)
understory	
no data available	white birch (<i>Betula papyrifera</i>)
	catalpa (<i>Catalpa bignonioides</i>)
	elm (<i>Ulmus sp.</i>)
increase or decrease	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
decrease	black birch (<i>Betula lenta</i>)

MIXED HARDWOOD FOREST EAST OF STREAM	
canopy	
no data available	ash (<i>Fraxinus sp.</i>)
no change	blackgum (<i>Nyssa sylvatica</i>)
no change or decrease	American beech (<i>Fagus grandifolia</i>)
	black walnut (<i>Juglans nigra</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus montana</i>)
	red oak (<i>Quercus rubra</i>)
	Eastern white pine (<i>Pinus strobus</i>)
understory	
decrease	black birch (<i>Betula lenta</i>)

unit 19: haag road to egelman

OAK FOREST*	
canopy	
no data available	hickory (<i>Carya sp.</i>)
	bird cherry (<i>Prunus avium</i>)
increase	white oak (<i>Quercus alba</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	American beech (<i>Fagus grandifolia</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus prinus</i>)
	red oak (<i>Quercus rubra</i>)
	black birch (<i>Betula lenta</i>)
understory	
increase or decrease	sassafras (<i>Sassafras albidum</i>)
no change or decrease	flowering dogwood (<i>Cornus florida</i>)

*The Mixed Hardwood Forest within this management unit has the same plant composition, but has a lower proportion of oak trees.

unit 20: rose valley creek

OAK FOREST	
canopy	
no data available	ash (<i>dead</i>) (<i>Fraxinus sp.</i>)
increase	shagbark hickory (<i>Carya ovata</i>)
	white oak (<i>Quercus alba</i>)
increase or no change	pin oak (<i>Quercus palustris</i>)
	black oak (<i>Quercus velutina</i>)
no change or decrease	pignut hickory (<i>Carya glabra</i>)
	American beech (<i>Fagus grandifolia</i>)
	black walnut (<i>Juglans nigra</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus prinus</i>)
	red oak (<i>Quercus rubra</i>)
	black locust (<i>Robinia psuedoacacia</i>)
	yellow birch (<i>Betula alleghaniensis</i>)
	basswood (<i>Tilia americana</i>)
	understory
no data available	hornbeam (<i>Carpinus caroliniana</i>)
	hickory (<i>Carya sp.</i>)
	bird cherry (<i>Prunus avium</i>)
increase or no change	box elder (<i>Acer negundo</i>)
increase or decrease	sassafras (<i>Sassafras albidum</i>)
	American elm (<i>Ulmus americana</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
	flowering dogwood (<i>Cornus florida</i>)
	black walnut (<i>Juglans nigra</i>)
decrease	black birch (<i>Betula lenta</i>)

RIPARIAN FOREST	
canopy	
no data available	ash (<i>dead</i>) (<i>Fraxinus sp.</i>)
no change or decrease	red oak (<i>Acer rubra</i>)
	sugar maple (<i>Acer saccharum</i>)
	black walnut (<i>Juglans nigra</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
decrease	basswood (<i>Tilia americana</i>)
understory	
increase or decrease	American elm (<i>Ulmus americana</i>)
no change or decrease	sugar maple (<i>Acer saccharum</i>)

unit 21: pendora oak forest

OAK FOREST	
canopy	
increase	American sycamore (<i>Platanus occidentalis</i>)
	white oak (<i>Quercus alba</i>)
increase or no change	pin oak (<i>Quercus palustris</i>)
no change or decrease	red oak (<i>Acer rubra</i>)
	American beech (<i>Fagus grandifolia</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
decrease	black birch (<i>Betula lenta</i>)
understory	
decrease	black birch (<i>Betula lenta</i>)

unit 22: antietam road east

OAK MIXED HARDWOOD MID TO LOW ELEVATIONS	
canopy	
no data available	bird cherry (<i>Prunus avium</i>)
increase	bitternut hickory (<i>Carya cordiformis</i>)
	white oak (<i>Quercus alba</i>)
no change or decrease	sugar maple (<i>Acer saccharum</i>)
	pignut hickory (<i>Carya glabra</i>)
	American beech (<i>Fagus grandifolia</i>)
	tuliptree (<i>Liriodendron tulipifera</i>)
	chestnut oak (<i>Quercus prinus</i>)
red oak (<i>Quercus rubra</i>)	
decrease	black birch (<i>Betula lenta</i>)
understory	
no data available	hickory (<i>Carya sp.</i>)
	hawthorne (<i>Crataegus sp.</i>)
increase or no change	hackberry (<i>Celtis occidentalis</i>)
	hop hornbeam (<i>Ostrya virginiana</i>)
increase or decrease	sassafras (<i>Sassafras albidum</i>)
no change or decrease	red maple (<i>Acer rubrum</i>)
decrease	black cherry (<i>Prunus serotina</i>)
OAK MIXED HARDWOOD FOREST RIDGETOP	
canopy	
no data available	dead ash (<i>Fraxinus sp.</i>)
no change or decrease	red oak (<i>Quercus rubra</i>)
	black walnut (<i>Juglans nigra</i>)
understory	
increase or decrease	sassafras (<i>Sassafras albidum</i>)

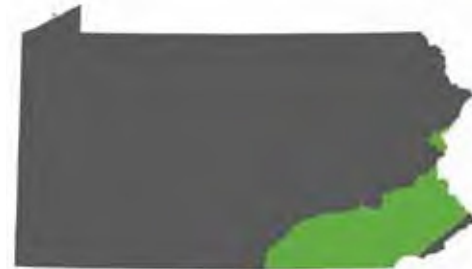
unit 23: antietam lake park

See 2018 Antietam Lake Park Natural Resources Stewardship Plan for plant lists.

Pennsylvania Department of Conservation and Natural Resources June 2018

CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES PIEDMONT (PENNSYLVANIA SUBREGION 5)

Pennsylvania's forests will be affected by a changing climate during this century. A team of forest managers and researchers created an assessment that describes the vulnerability of forests in the Mid-Atlantic region (<https://forestadaptation.org/mid-atlantic/vulnerability-assessment>). This handout is summarized from the full assessment, but focuses on one region in Pennsylvania. Model results for additional regions can be found online at (<https://forestadaptation.org/PA-DISTRIB>).



TREE SPECIES INFORMATION:

The DISTRIB model of the Climate Change Tree Atlas uses inputs of tree abundance, climate, and environmental attributes to simulate current and future species habitat under two climate scenarios. Results for "low" and "high" climate scenarios can be compared on page 2 of this handout.

Remember that models are just tools, and they're not perfect. Output from DISTRIB does not consider many biological or disturbance factors which favor or limit tree establishment, growth, or mortality. For example, the susceptibility of ash species to emerald ash borer is causing widespread mortality and it will likely do even worse than the model suggests. For the 30 most common species, we present such factors not included in the model that may cause species to do better or worse than models suggest.

Despite their limitations, models provide useful information about future expectations. It's important to think of these projections as indicators of potential change in the amount of suitable habitat for a species, but that human choices and other factors will continue to influence tree distribution, movement, and forest composition at individual sites.

CONTACT:

Greg Czarnecki (gczarnecki@pa.gov)
Climate Change & Research Coordinator,
PA Department of Conservation and Natural Resources.

Patricia Leopold (pleopold@mtu.edu)
Mid-Atlantic Climate Change Response
Framework Coordinator, NIACS.



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SPECIES	ADDITIONAL CONSIDERATIONS
LIKELY TO DECREASE	
Black cherry	Establishes from seed or sprout, adapted to fire
Eastern white pine	Good disperser, but susceptible to drought and insects
Sweet birch	Susceptible to drought, fire topkill, and insects
White ash	Emerald ash borer causes widespread mortality
MAY DECREASE	
American beech	Susceptible to beech diseases, very shade tolerant
Black locust	Susceptible to fire topkill
Black walnut	Drought-tolerant, susceptible to insects and fire topkill
Chestnut oak	Widespread and tolerant of drought and shade
Eastern hemlock	Intolerant of shade, fire, and drought
Flowering dogwood	Shade tolerant
Northern red oak	Susceptible to insect pests
Pignut hickory	Susceptible to bark beetles and drought
Red maple	Competitive colonizer in many sites, disturbance-tolerant
Scarlet oak	Establishes from seed or sprout, susceptible to fire and disease
Sugar maple	Grows across a variety of sites, tolerates shade
Virginia pine	Intolerant of shade and pollution
Yellow-poplar	Competitive colonizer tolerant of diverse sites
NO CHANGE	
Blackgum	Shade tolerant, fire adapted
MIXED MODEL RESULTS	
American elm	Requires specific habitat, intolerant of fire and drought
Pawpaw	Shade tolerant; susceptible to drought
Sassafras	Early-successional colonizer, susceptible to fire topkill
Silver maple	Early-successional colonizer, susceptible to fire topkill and drought
MAY INCREASE	
Black oak	Early colonizer, but susceptible to locust borer & heart rot
Boxelder	Shade tolerant
Pin oak	Susceptible to insect pests and disease
LIKELY TO INCREASE	
Eastern redcedar	Drought tolerant, shade intolerant, susceptible to fire and insects
Mockernut hickory	Susceptible to fire topkill
Sweetgum	Establishes by seed or sprouting, susceptible to fire and drought
Sycamore	Generally tolerant of a wide range of soils
White oak	Fire-adapted, grows on a variety of sites

SOURCE: Prasad, AM; Iverson, LR; Peters, MP; Matthews, SN. 2014. Climate change tree atlas. Northern Research Station, U.S. Forest Service, Delaware, OH. <http://www.nrs.fs.fed.us/atlas>.

FUTURE PROJECTIONS

The DISTRIB model uses Forest Inventory and Analysis (FIA) data to calculate an Importance Value (IV) for each species on the landscape in order to evaluate potential IV's at the end of this century (2070 – 2099). Those changes are classified in the table below as:

- ▲ INCREASE
Projected increase of >20% by 2100
- NO CHANGE
Little change (<20%) projected by 2100
- ▼ DECREASE
Projected decrease of >20% by 2100
- ★ NEW HABITAT
Tree Atlas projects new habitat for species not currently present

ADAPTABILITY

Factors not included in the Tree Atlas model, such as the ability to respond favorably to disturbance, may make a species more or less able to adapt to future stressors. Specific considerations are provided on page 1 for the 30 most abundant species.

- + high
Species may perform better than modeled
- medium
- low
Species may perform worse than modeled

SPECIES	FIA IV	MODEL RELIABILITY	LOW CLIMATE CHANGE (PCMB1)	HIGH CLIMATE CHANGE (GFDL A1FI)	ADAPT
American basswood	10	M	▼	▼	○
American beech	152	H	●	▼	○
American chestnut	15	M	●	●	○
American elm	60	M	▼	▲	○
American holly	0	H	★	★	○
American hornbeam	44	M	●	●	○
Balsam poplar	0	H	▼	▼	○
Bear oak; scrub oak	27	L	▲	▲	○
Bigtooth aspen	30	H	▼	▼	○
Bitternut hickory	12	L	▲	▲	+
Black cherry	472	H	▼	▼	-
Black hickory	0	H	★	★	○
Black locust	51	L	●	▼	○
Black oak	217	H	●	▲	○
Black walnut	85	M	●	▼	○
Black willow	13	L	▼	▲	-
Blackgum	189	H	●	●	+
Boxelder	119	M	▲	●	+
Butternut	34	L	▼	▼	-
Chestnut oak	365	M	●	▼	+
Chinkapin oak	1	M	▲	▲	○
Chokecherry	18	L	●	▼	○
Cucumbertree	1	H	●	▼	○
Eastern cottonwood	8	L	▼	▲	○
Eastern hemlock	70	H	●	▼	-
Eastern hophornbeam	32	M	●	▲	+
Eastern redbud	13	M	▲	▲	○
Eastern redcedar	94	M	▲	▲	○
Eastern white pine	61	H	▼	▼	○
Flowering dogwood	189	H	●	▼	○
Gray birch	9	M	▼	●	○
Green ash	25	M	▼	▲	○
Hackberry	24	M	●	▲	+
Honeylocust	1	L	▼	▲	+
Loblolly pine	2	H	▲	▲	○
Mockernut hickory	93	H	▲	▲	+
Mountain maple	1	H	●	▼	+
Northern catalpa	12	L	▼	●	○
Northern red oak	303	H	●	▼	+
Northern white-cedar	0	H	▼	▼	○
Nuttall oak	0	H	●	●	+
Osage-orange	1	M	▼	▲	+
Paper birch	1	H	▼	▼	○
Pawpaw	49	L	▲	▼	○
Persimmon	4	M	▲	▲	+
Pignut hickory	108	H	●	▼	○
Pin cherry	8	M	●	▼	○
Pin oak	47	L	▲	●	-
Pitch pine	37	H	▼	▼	○
Quaking aspen	3	H	▼	▼	○
Red maple	727	H	●	▼	+
Red mulberry	8	L	●	▲	○
Red pine	14	M	▼	▼	○
Red spruce	2	H	▼	▼	-
River birch	8	L	●	▲	○
Sassafras	200	H	▲	▼	○
Scarlet oak	90	H	●	▼	○
Serviceberry	21	M	●	▼	○
Shagbark hickory	22	M	▲	▲	○
Shortleaf pine	1	H	▲	▲	○
Shumard oak	0	H	NA	★	+
Silver maple	46	M	▼	▲	+
Slippery elm	33	M	●	●	○
Sourwood	0	H	★	★	+
Southern red oak	1	H	▲	▲	+
Striped maple	6	H	▼	▼	○
Sugar maple	125	H	●	▼	+
Swamp white oak	14	L	●	▼	○
Sweet birch	161	H	▼	▼	-
Sweetgum	68	H	▲	▲	○
Sycamore	45	M	▲	▲	○
Tamarack (native)	9	H	▼	▼	-
Virginia pine	45	H	●	▼	○
Water tupelo	10	M	●	▲	-
White ash	619	H	▼	▼	-
White oak	202	H	▲	▲	+
White spruce	15	M	●	●	○
Winged elm	0	H	★	★	○
Yellow birch	16	H	▼	▼	○
Yellow-poplar	325	H	●	▼	+

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PNDI

Pennsylvania Department of Conservation and Natural Resources
 PNDI Receipt: project_receipt_mp3_habitat_818458_DRAFT_1.pdf

Project Search ID: PNDI-818458

1. PROJECT INFORMATION

Project Name: **MP3 Habitat**
 Date of Review: **7/14/2024 12:04:28 PM**
 Project Category: **Forest Stewardship Plan**
 Project Area: **4,209.48 acres**
 County(s): **Berks**
 Township/Municipality(s): **ALSACE TOWNSHIP; EXETER TOWNSHIP; LOWER ALSACE TOWNSHIP; MT PENN; MUHLENBERG TOWNSHIP; READING**
 ZIP Code:
 Quadrangle Name(s): **BIRDSBORO; READING; TEMPLE**
 Watersheds HUC 8: **Schuylkill**
 Watersheds HUC 12: **Angelica Creek-Schuylkill River; Antietam Creek; Laurel Run-Schuylkill River**
 Decimal Degrees: **40.352180, -75.887736**
 Degrees Minutes Seconds: **40° 21' 7.8496" N, 75° 53' 15.8495" W**

This is a draft receipt for information only. It has not been submitted to jurisdictional agencies for review.

2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	Conservation Measure	No Further Review Required, See Agency Comments
PA Department of Conservation and Natural Resources	Potential Impact	FURTHER REVIEW IS REQUIRED, See Agency Response
PA Fish and Boat Commission	No Known Impact	No Further Review Required
U.S. Fish and Wildlife Service	Conservation Measure	No Further Review Required, See Agency Comments

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate there may be potential impacts to threatened and endangered and/or special concern species and resources within the project area. If the response above indicates "No Further Review Required" no additional communication with the respective agency is required. If the response is "Further Review Required" or "See Agency Response," refer to the appropriate agency comments below. Please see the DEP Information Section of this receipt if a PA Department of Environmental Protection Permit is required.

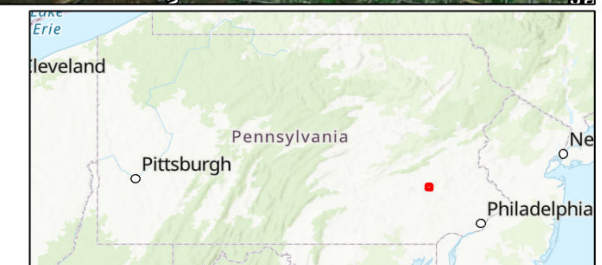
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MP3 Habitat



- Buffered Project Boundary
- Project Boundary

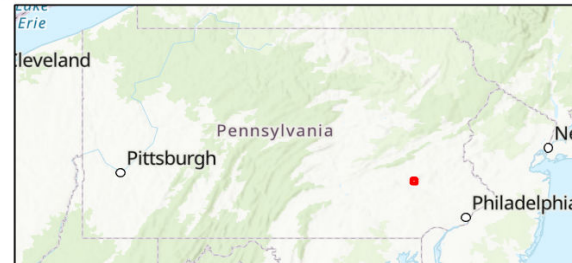


Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

MP3 Habitat



- Buffered Project Boundary
- Project Boundary



Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are **valid for two years** (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt. The jurisdictional agencies **strongly advise against** conducting surveys for the species listed on the receipt prior to consultation with the agencies.

PA Game Commission RESPONSE:

Conservation Measure: Potential impacts to state and federally listed species which are under the jurisdiction of both the Pennsylvania Game Commission (PGC) and the U.S. Fish and Wildlife Service may occur as a result of this project. As a result, the PGC defers comments on potential impacts to federally listed species to the U.S. Fish and Wildlife Service. No further coordination with the Pennsylvania Game Commission is required at this time.

PA Department of Conservation and Natural Resources RESPONSE:

Further review of this project is necessary to resolve the potential impact(s). Please send project information to this agency for review (see WHAT TO SEND).

DCNR Species: (Note: The Pennsylvania Conservation Explorer tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below. After desktop review, if a botanical survey is required by DCNR, we recommend the DCNR Botanical Survey Protocols, available here: <https://conservationexplorer.dcnr.pa.gov/content/survey-protocols>)

Scientific Name	Common Name	Current Status	Proposed Status	Survey Window
Sensitive Species**		Special Concern Species*	Special Concern Species*	One flight from March-April in the south, May-June in the north
Sensitive Species**		Special Concern Species*	Threatened	Flowers April - May

PA Fish and Boat Commission RESPONSE:

No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

U.S. Fish and Wildlife Service RESPONSE:

Pennsylvania Department of Conservation and Natural Resources
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Conservation Measure: Voluntary implementation of the following recommendations will contribute to the conservation and recovery of endangered and threatened species. -- In order to conserve wetland-dependent species of concern, protect wetlands along with their surface and groundwater recharge areas. In order to maintain or improve wetland water quality, conserve at least a 300-foot wide upland buffer around each wetland, as well as a 50-100 foot wide buffer on each side of waterways (perennial and intermittent rivers, streams, creeks, and tributaries). When adequately vegetated, this upland buffer will act to filter pollutants (e.g., sediment, fertilizers, pesticides, road salt, oil), and stabilize streambanks (preventing or minimizing erosion). Avoid any construction, earth disturbance, and chemical application (e.g., fertilizer, pesticide) in the wetland and upland buffer. If other activities are being considered (e.g., timber harvesting, agricultural use, land development, streambank stabilization, tree planting, control of exotic plant species), conduct a review under those project categories.

Conservation Measure: Voluntary implementation of the following recommendation(s) will contribute to the conservation and recovery of endangered and threatened species. To conserve foraging and roosting habitat for endangered bats, while also carrying out the proposed conservation, restoration, or stewardship project/activity, conserve and protect forested areas. Emphasis should be placed on retaining (or restoring, if not already present) mature forests with at least 60% canopy closure. Also, retain all hickory trees, and large diameter (>12 inches d.b.h.) snags, dying, and injured trees to ensure a continuing supply of potential roost trees for bats. If agricultural lands are proposed for inclusion in the conservation project/activity, use Integrated Pest Management, with an emphasis on avoiding or minimizing the use of chemical pesticides, and review this project under the appropriate "Agriculture/Farming" project categories. If any timber harvesting or tree cutting is proposed, review this project under the category "Timber harvesting and Vegetation Management" -- "Timber sale/harvest."

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.

** Sensitive Species - Species identified by the jurisdictional agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

WHAT TO SEND TO JURISDICTIONAL AGENCIES

If project information was requested by one or more of the agencies above, upload* or email the following information to the agency(s) (see AGENCY CONTACT INFORMATION). Instructions for uploading project materials can be found [here](#). This option provides the applicant with the convenience of sending project materials to a single location accessible to all three state agencies (but not USFWS).

*If information was requested by USFWS, applicants must email, or mail, project information to IR1_ESPenn@fws.gov to initiate a review. USFWS will not accept uploaded project materials.

Check-list of Minimum Materials to be submitted:

___ Project narrative with a description of the overall project, the work to be performed, current physical characteristics of the site and acreage to be impacted.

___ A map with the project boundary and/or a basic site plan (particularly showing the relationship of the project to the physical features such as wetlands, streams, ponds, rock outcrops, etc.)

In addition to the materials listed above, USFWS REQUIRES the following

___ **SIGNED** copy of a Final Project Environmental Review Receipt

The inclusion of the following information may expedite the review process.

___ Color photos keyed to the basic site plan (i.e. showing on the site plan where and in what direction each photo was taken and the date of the photos)

___ Information about the presence and location of wetlands in the project area, and how this was determined (e.g., by a qualified wetlands biologist), if wetlands are present in the project area, provide project plans showing the location of all project features, as well as wetlands and streams.

Pennsylvania Department of Conservation and Natural Resources
PNDI Receipt: project_receipt_mp3_habitat_818458_DRAFT_1.pdf

Project Search ID: PNDI-818458

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. Two review options are available to permit applicants for handling PNDI coordination in conjunction with DEP's permit review process involving either T&E Species or species of special concern. Under sequential review, the permit applicant performs a PNDI screening and completes all coordination with the appropriate jurisdictional agencies prior to submitting the permit application. The applicant will include with its application, both a PNDI receipt and/or a clearance letter from the jurisdictional agency if the PNDI Receipt shows a Potential Impact to a species or the applicant chooses to obtain letters directly from the jurisdictional agencies. Under concurrent review, DEP, where feasible, will allow technical review of the permit to occur concurrently with the T&E species consultation with the jurisdictional agency. The applicant must still supply a copy of the PNDI Receipt with its permit application. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. The applicant and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at <https://conservationexplorer.dcnr.pa.gov/content/resources>.

Pennsylvania Department of Conservation and Natural Resources
PNDI Receipt: [project_receipt_mp3_habitat_818458_DRAFT_1.pdf](#)

Project Search ID: PNDI-818458

5. ADDITIONAL INFORMATION

The PNDI environmental review website is a preliminary screening tool. There are often delays in updating species status classifications. Because the proposed status represents the best available information regarding the conservation status of the species, state jurisdictional agency staff give the proposed statuses at least the same consideration as the current legal status. If surveys or further information reveal that a threatened and endangered and/or special concern species and resources exist in your project area, contact the appropriate jurisdictional agency/agencies immediately to identify and resolve any impacts.

For a list of species known to occur in the county where your project is located, please see the species lists by county found on the PA Natural Heritage Program (PNHP) home page (www.naturalheritage.state.pa.us). Also note that the PNDI Environmental Review Tool only contains information about species occurrences that have actually been reported to the PNHP.



Firewood Cutting and Bat Habitat Conservation Measures

DCNR and the PA Game Commission jointly recently received a permit from the US Fish and Wildlife Service for impacts to the federally endangered Indiana bat and the federally threatened northern long-eared bat, during forest management activities on state lands. Sustainable forest management activities include timber harvesting, prescribed fire, firewood cutting, roads and trail maintenance or construction and fencing operations. The [Bat Habitat Conservation Plan](#) identifies activities that may impact bats and presents avoidance strategies and mitigation called conservation measures.

Firewood collection on state forest land provides the public an opportunity to secure a source of sustainable fuel along roadsides. Standing dead trees along roads also provide important habitat for the Indiana and northern long-eared bats. They roost and rear their young in the cavities and loose bark of standing dead trees. Therefore, the Bat Habitat Conservation Plan identified conservation measures to avoid and minimize impacts to bats through firewood cutting when it is most critical to do so.

Bat habitat varies across the state. Each forest district adapts its own strategy based upon local circumstances and prescribed strategies of the conservation plan. These variances include the numbers of roads closed; the durations of closure and prohibitions of removing standing materials. Contact your local [district office](#) for specific details of how these conservation measures are applied in your area.

Bat Habitat & Life Cycle

Bats use different habitat regions during different times of the year according to their life cycles. Mid-November through March, bats hibernate in caves, mines, or other sheltered areas. While there may be local variations, most bats emerge from hibernation beginning in April through the first half of May. Bats are vulnerable during this period because they are still “waking up” from torpor and roost in standing dead trees. June through July, bats use standing dead trees to rear their young. Bat pups are born in summer and cannot fly until August. Migration, swarming, and mating begins in the latter half of August and continues through the first half of November. Bats then return to their caves to begin hibernation in mid-November.

Firewood Conservation Measures

Limiting collection of standing dead trees in important bat habitat areas minimizes impacts to bats and complies with DCNR’s US Fish and Wildlife permit. The following are conservation measures for firewood cutting:

- 1. Do not cut standing dead trees from May 15-August 31 in certain areas where bats have a high likelihood of using them for maternity colonies.**

Rationale: This minimizes potential impacts to maternity colonies, when pups are most vulnerable.

- 2. Do not cut standing dead trees Apr 1-May 14 and Sept. 1-Nov. 1 along certain roads in areas where bats have a high likelihood of using them for roosting, mating and swarming**

Rationale: This minimizes potential impacts to bats when they emerge, congregate, roost, and mate.

Frequently Asked Questions:

What is the Bat Habitat Conservation Plan and why do we need one?

The Bat Habitat Conservation Plan (HCP) is a requirement for obtaining an incidental take permit from the US Fish and Wildlife Service for the take of Indiana and northern long-eared bats while carrying out our normal forestry activities. DCNR and the PA Game Commission jointly applied and were issued a permit for forestry management activities (timber sales, prescribed fire, fencing, roads/trails, and firewood program). The HCP is a requirement of the permit and it lays out how we will minimize, mitigate, and monitor impacts to the federally listed bat species while we carry out our missions. The HCP allows us to get credit for the work we do that provides habitats for bats, while minimizing and

mitigating for the potential impacts and gives us flexibility to plan long-term. Please see the [Bat HCP FAQ](#) document on our website for more information. The complete Bat HCP and other supporting materials can be found on US Fish and Wildlife Service’s [website](#).

Why is firewood cutting being singled out as an activity?

Each forest management activity that DCNR and PGC carries out was analyzed for potential impacts to bats and their habitats. Some activities had a negative impact while others had positive impacts. Activities that create habitat had positive impacts to bats. Firewood collection had a negative impact to bats because it targets standing dead trees along roads, the preferred habitat bats need to complete their life cycle. By limiting the removal of standing dead trees in certain areas with the highest potential to be used by bats, we are minimizing the impact and satisfying our permit requirement. Other areas may be free from firewood conservation measures, or open during other times of the year. Call [your local district office](#) for more information and suggestions.

How can we still have timber sales if I can’t cut firewood?

Timber sales and firewood both have conservation measures included in the HCP to avoid, minimize, and mitigate impacts to bats. Both activities must avoid cutting roost trees (trees with cavities or peeling bark) in bat habitat areas and during certain time periods and locations to avoid impacting bats. Timber sales in the vicinities of firewood closures are often contractually suspended during the same periods of closure. In addition, firewood cutting is often restricted near active harvesting areas as a normal procedure to account for public safety and the safety of the logging crew.

How do we determine which roads are closed?

Contact [your local district office](#) for specific information about where/when you may and may not cut standing dead trees for firewood. Bat habitat is not evenly distributed across all state forests. Some districts, or some roads within some districts, are within the bat habitat areas and others are not. In addition, because each district must manage firewood permitting individually, some districts may choose to close tracts or other methods, to make their process more streamlined. This FAQ provides general guidelines and background, but for specific information on what roads are open or closed, please contact your district office.

Why is the season for closure as long as it is?

Firewood cutting restrictions are targeted to the timing of the bats’ life cycle. They are most vulnerable when they congregate in the spring after hibernation, when baby bats cannot yet fly during the summer, and when they form swarms and mate in the fall. These are the time periods, in certain areas of state forest lands, when the firewood collection conservation measures are enacted. Consider collecting firewood in other areas of the state forest that are not within the bat habitat areas, or during another time period. Contact your [local district office](#) for specific information on which roads are open for collection.

What districts have the firewood collection conservation measures?

- Spring/Fall firewood conservation measure (Apr.1 - May 14, Sept 1-Nov 1.):
 - Designated roads in Districts Rothrock, Bald Eagle, Pinchot
- Summer firewood conservation measure (May 15-Aug 31):
 - Designated roads in Districts Michaux, Buchanan, Tuscarora, Forbes, Rothrock, Gallitzin, Bald Eagle, Moshannon, Sproul, Pinchot, Tiadaghton, Elk, Tioga, William Penn, Loyalsock

Where can I get more information?

Contact [your local district](#) office for specific information about what roads are open or closed in your area. Additional information is available on our website. Visit the [Bat HCP FAQ page](#), which we will be updating regularly for annual report updates. To access the complete Bat HCP, and supporting federal documents, you may visit the US Fish and Wildlife Services’ [website](#).

eBird bird species

Below is a list of bird species identified by the public within the Mount Penn Preserve area and recorded through eBird as of July 31, 2024.

Acadian Flycatcher	Cerulean Warbler	House Sparrow	Red-winged Blackbird
American Black Duck	Chestnut-sided Warbler	House Wren	Ring-billed Gull
American Crow	Chimney Swift	Indigo Bunting	Ring-necked Pheasant
American Kestrel	Chipping Sparrow	Killdeer	Rock Pigeon
American Redstart	Common Grackle	Least Flycatcher	Rose-breasted Grosbeak
American Robin	Common Loon	Lincoln's Sparrow	Ruby-crowned Kinglet
American Woodcock	Common Nighthawk	Little Blue Heron	Ruby-throated Hummingbird
Bald Eagle	Common Raven	Louisiana Waterthrush	Ruddy Duck
Baltimore Oriole	Common Yellowthroat	Magnolia Warbler	Rusty Blackbird
Barn Swallow	Cooper's Hawk	Mallard	Scarlet Tanager
Barred Owl	Dark-eyed Junco	Merlin	Sharp-shinned Hawk
Bay-breasted Warbler	Dickcissel	Mourning Dove	Snow Goose
Belted Kingfisher	Double-crested Cormorant	Mourning Warbler	Song Sparrow
Black Vulture	Downy Woodpecker	Mute Swan	Spotted Sandpiper
Black-and-white Warbler	Eastern Bluebird	Nashville Warbler	Swainson's Thrush
Black-bellied Plover	Eastern Kingbird	Northern Cardinal	Swamp Sparrow
Black-billed Cuckoo	Eastern Phoebe	Northern Flicker	Tennessee Warbler
Blackburnian Warbler	Eastern Screech-Owl	Northern Harrier	Tree Swallow
Black-capped Chickadee	Eastern Towhee	Northern Mockingbird	Tufted Titmouse
Blackpoll Warbler	Eastern Whip-poor-will	Northern Parula	Turkey Vulture
Black-throated Blue Warbler	Eastern Wood-Pewee	Northern Rough-winged Swallow	Veery
Black-throated Green Warbler	European Starling	Olive-sided Flycatcher	Warbling Vireo
Blue Grosbeak	Evening Grosbeak	Orchard Oriole	White-breasted Nuthatch
Blue Jay	Field Sparrow	Osprey	White-crowned Sparrow
Blue-gray Gnatcatcher	Fish Crow	Ovenbird	White-eyed Vireo
Blue-headed Vireo	Fox Sparrow	Palm Warbler	White-throated Sparrow
Blue-winged Warbler	Gadwall	Peregrine Falcon	Wild Turkey
Bobolink	Golden Eagle	Philadelphia Vireo	Willow Flycatcher
Broad-winged Hawk	Golden-crowned Kinglet	Pied-billed Grebe	Wilson's Warbler
Brown Creeper	Gray Catbird	Pileated Woodpecker	Winter Wren
Brown Thrasher	Gray-cheeked Thrush	Pine Siskin	Wood Duck
Brown-headed Cowbird	Great Blue Heron	Pine Warbler	Wood Thrush
Bufflehead	Great Crested Flycatcher	Prairie Warbler	Worm-eating Warbler
Canada Goose	Great Horned Owl	Purple Finch	Yellow Warbler
Canada Warbler	Green Heron	Red-bellied Woodpecker	Yellow-bellied Flycatcher
Cape May Warbler	Hairy Woodpecker	Red-breasted Nuthatch	Yellow-bellied Sapsucker
Carolina Chickadee	Hermit Thrush	Red-eyed Vireo	Yellow-billed Cuckoo
Carolina Wren	Hooded Merganser	Red-headed Woodpecker	Yellow-breasted Chat
Caspian Tern	Hooded Warbler	Red-shouldered Hawk	Yellow-rumped Warbler
Cedar Waxwing	House Finch	Red-tailed Hawk	Yellow-throated Vireo

Protecting Trails with Native Plants

A common issue on trails within the preserve is erosion. Trail erosion can be caused by wear from use but is most often caused by the action of stormwater runoff. The movement of water over unstabilized soil can scour channels across trails and into the surrounding landscape. Unaddressed erosion can lead to loss of trail surface and additional erosion issues downslope.

In areas where vegetation has been cleared to allow for trail construction, thought should be given to the replacement of native vegetation. These plantings, strategically located, will help to "armor" the trail route and keep it in place by holding soil with their roots. They also work to collect stormwater runoff through their roots, which limits the amount of runoff travelling further down the mountain and causing additional issues. By selecting native plants, which often feature deeper roots systems than non-natives, the soil along trails can be stabilized. This in turn leads to fewer maintenance issues downslope and can help to protect against flooding in abutting neighborhoods.



Determine the direction of flow onto, across, and off the trail



Plant native shrubs/woody perennials alongside and downslope from the trail to best capture runoff.

trail stabilization checklist

- Determine the direction of water flow.** Viewing the topography of the trail segment from a variety of angles should indicate which way is "down".
- Determine the boundaries of the trail route.** Is it too wide? Too narrow? Think about what trail users need on a given segment. Marking paint can be helpful for sketching out the boundaries of the trail surface.
- Choose your plants.** We recommend native plants in order to further support native wildlife populations on the preserve. Given the active use of trails, the best option for "armoring" their edges is a shrub or woody perennial, which will hold up to contact with hikers and bikers. Refer to the recommended plant list in Appendix XX.

Avoiding "Water Slides"

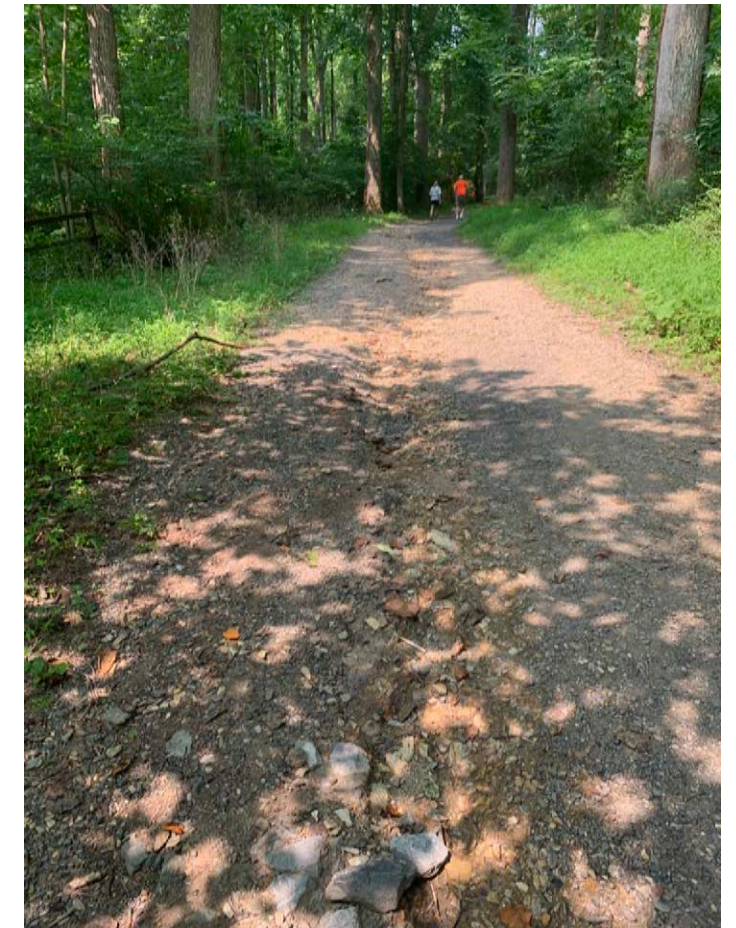
A fall line trail is a segment of trail that runs perpendicular to the contour of a slope; that is, it runs straight downhill. While trails of this type can be convenient as a shortest possible route for trail users, they frequently are prone to erosion - they also provide the shortest possible route for stormwater runoff, which can pick up significant velocity and scour channels into trail surfaces.

Where trails exist on the fall line, the best option is to reroute the trail, adding some back and forth curves across the face of the slope. This type of alternative trail route is sometimes referred to as a "climbing turn." Instead of allowing a direct route for water to flow down the slope face, a climbing turn trail creates opportunity for water to run off the trail surface into the surrounding vegetated areas.

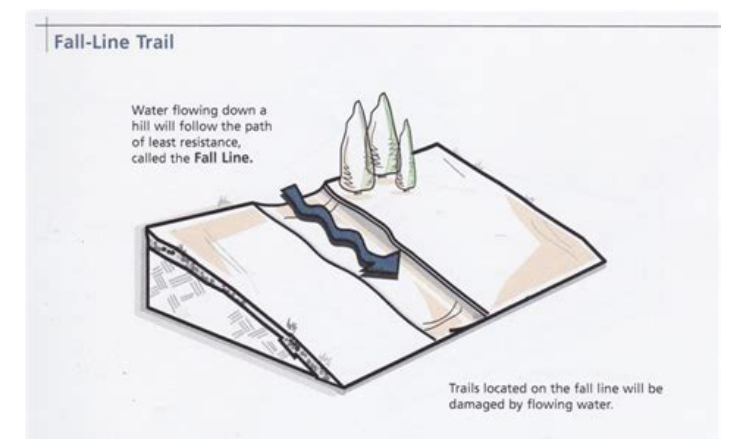
When laying out the new route for a fall line trail, consideration should be given to possible impacts on the surrounding landscape (e.g. compromising the integrity of tree roots). Use flagging tape to identify trees or other features that should be protected when laying out a new trail route.

fall line trail checklist

- Identify problem trail segments.** There are a number of fall line trails present on the preserve. Prioritize those experiencing significant erosion while considering the surrounding area that would be impacted by a rerouting of the trail.
- Reroute the trail.** The new trail route (a "climbing turn") should provide enough undulation to avoid giving water runoff a direct route down a given slope. The new route does not have to consist of switchbacks (i.e. sharp turns back and forth across the face of a slope); gentle curves across the slope will provide sufficient change in direction to ensure that water is not able to channelize directly downward.



The trail leading directly uphill from the Antietam Lake parking lot is an example of a fall line trail - one suffering from erosion



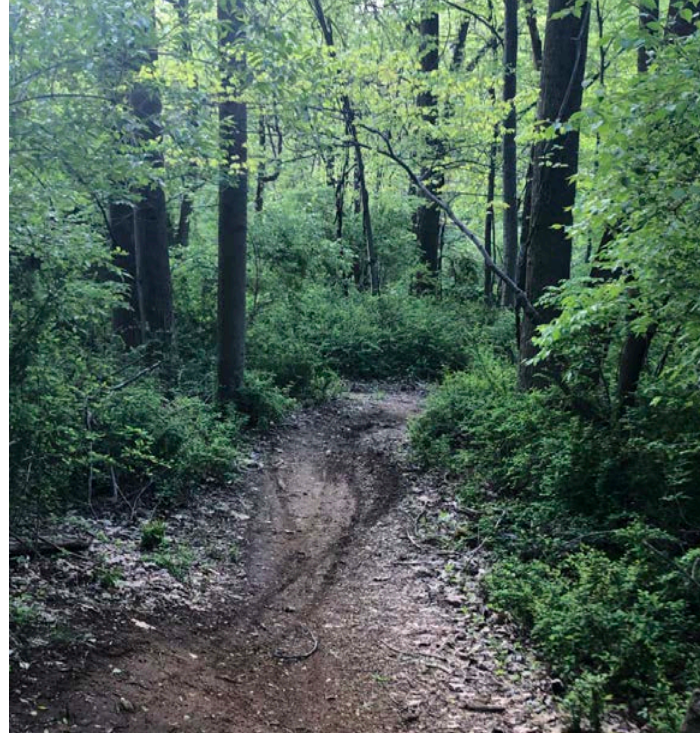
Fall line trail illustration - bikeandmountain.com

Dealing with Water on the Trail

Throughout the preserve are low areas where water tends to pool. When trails cross these areas, the condition of the trail suffers. Typically, even when pooled water is not visible, these low areas are identifiable through the presence of a muddy condition - think of areas where the ground surface is soft enough for bicycle tires or boots to leave deep impressions.

In considering how to address a wet area, it is important to identify the surrounding ecosystem. While rerouting a trail around a wet area is the best course of action, it may not be possible to relocate a trail without causing even more disturbance. In these cases, bog bridges, boardwalks and other structure may be the best option for raising a trail above the wet soil without disrupting the surroundings.

In cases where a trail can easily be rerouted for a short distance, consider planting the abandoned trail segment, both to prevent users from traveling through it, and to avoid having invasive species move into the disturbed areas of soil.



A wet segment of trail in the Preserve.



An example of a small footbridge crossing a shallow channel.

wet area checklist

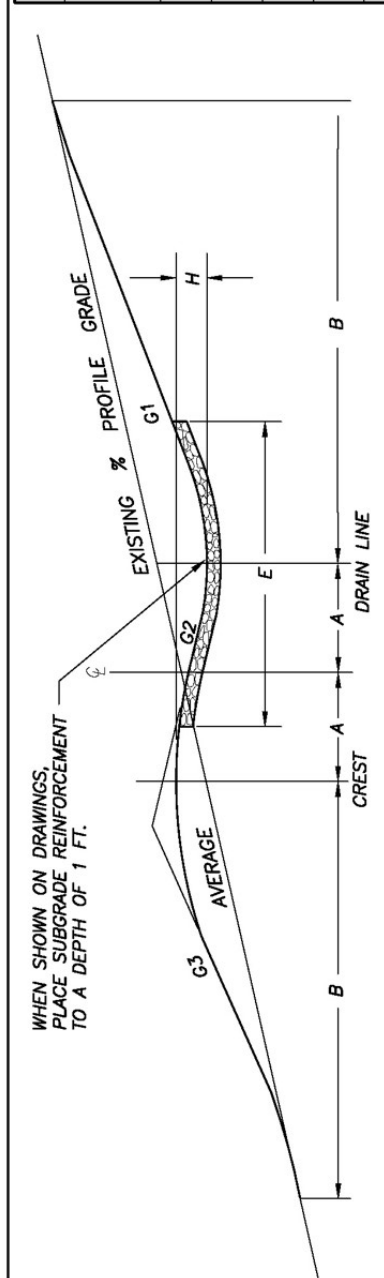
- **Identify areas where water is pooling/gathering on the trail.** One easy way to identify these problem areas is to look for footprint or tire track marks deep in the trail surface.
- **Consider rerouting the trail.** If the surrounding area is not ecologically sensitive (i.e. the trail is not located in a wetland but simply a low spot in the surrounding landscape), the trail can simply be rerouted around the wet area, and logs and/or new plantings utilized to keep trail users out.
- **Utilize a bog bridge or footbridge.** Bog bridges and footbridges are simple wooden structures that lift the pedestrian/biking surface off the ground. They can be easily built and installed by public works staff or volunteers. The US Forest Service provides several designs for bridges appropriate for use on trails: <https://www.fs.usda.gov/t-d/pubs/htmlpubs/htm07232804/page07.htm>

USDAFS rolling dip detail

% PROFILE GRADE	CONST. GRADE		DEPTH (H)	REINFORCEMENT	
	G1	G2		LENGTH (E)	CUBIC YARDS
0 TO 4	-7	2	0.6'	20'	12
5 TO 6	-10	2	0.6'	20'	12
7 TO 8	-13	2	0.5'	20'	12
9 TO 10	-16	2	0.5'	30'	18
OVER 10 % NOT RECOMMENDED					

REINFORCEMENT GRADATION	
SIEVE SIZE	% PASSING
12"	100%
2"	20-80%
3/4"	0-40%
# 200	0-10%

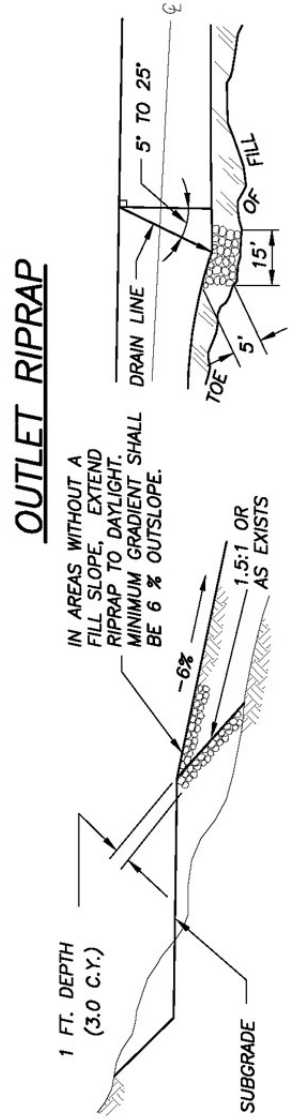
- WATERBAR CONSTRUCTION NOTES:**
- WATERBARS ARE USUALLY CONSTRUCTED BY ANGLE DOZERS. WATERBARS SHALL HAVE A CLEAN OUTLET AND BE CONSTRUCTED SO THEY WILL NOT FAIL THROUGH ALL WEATHER USE.
 - THE WATERBAR DRAIN LINE SHALL BE SKEWED 5' TO 25'.
 - WATERBARS SHALL BE CONSTRUCTED SO THAT DRAINLINE EXCAVATION IS APPROXIMATELY 6" INTO SOLID SOIL AND THE TOP OF COMPACTED WATERBAR IS 12" ABOVE THE DRAINLINE.
 - NOT BE LESS THAN SIXTEEN FEET (16').
 - CROSS SLOPE OF THE DRAIN LINE SHALL BE EQUIVALENT TO THE CROSS SLOPE OF THE ROAD PLUS TWO PERCENT (2%).



% PROFILE GRADE	LENGTH		DEPTH (H)	
	A	B	OUTSIDE EDGE	INSIDE EDGE
0 TO 4	6'	10'	1.5'	0.8'
5 TO 8	6'	10'	1.5'	0.8'
9 TO 12	6'	12'	1.5'	0.8'
13 TO 16	7'	15'	1.0'	0.8'
17 & OVER	7'	20'	1.0'	0.8'

PROFILE VIEW

- ROLLING DIP CONSTRUCTION NOTES:**
- THE CROSS SLOPE OF THE ROADBED SHALL BE MAINTAINED THROUGH THE DIP.
 - THE DRAIN LINE SHALL BE PERPENDICULAR TO THE CENTER LINE OF THE ROADBED.
 - PLACE CLASS II OUTLET RIPRAP WHEN SHOWN ON THE DRAWINGS. REFER TO OUTLET RIPRAP DETAIL BELOW.
 - FOR DIPS ON AGGREGATE SURFACED ROADS, REDUCE (H) DEPTH BY 0.2 FT.
 - WATERBAR AND DIP CONSTRUCTION TOLERANCES SHALL BE IN ACCORDANCE FP-03 SUPPLEMENTAL SPECIFICATION 204.13(d); TOLERANCE CLASS A.
 - SUBGRADE REINFORCEMENT MATERIAL SHALL BE CONSIDERED INCIDENTAL TO DIP CONSTRUCTION.



OUTLET RIPRAP

PLAN VIEW

CROSS SECTION VIEW

	TYPICAL DETAILS KLAMATH NATIONAL FOREST YREKA, CALIFORNIA	ROLLING DIP AND WATER BAR TYPICAL	DRAWING NAME SHEET I
DESIGNED: _____ DRAWN: _____ CHECKED: _____	DATE: _____ DATE: _____ DATE: _____	REVISION BY: _____ DATE: _____	DRAWING NAME SHEET I

emergency info

safety and emergency access

The trail system is confusing and visitors routinely get lost. When out for a leisurely hike or ride, this can be a mild inconvenience, or even a fun challenge, to find their way again. But what if someone gets lost as darkness approaches? Or gets hurt and can't find their way out. Even an injury as simple as a twisted ankle can make it difficult to hike out of this site. And what if a rider sustains a more severe injury, requiring professional medical attention? Any of these scenarios could require an injured visitor to need to explain their location over the phone to a 911 or other EMS dispatcher. Its hard to rescue someone in distress if you can't find them. And even if they know the location, does the local EMS have the equipment to allow them to safely retrieve them?

The mountain is a respite, a place to get away from the day to day and enjoy recreation in nature. The secluded nature of the Mount Penn Preserve is one of its charms. The entire mountain can't be made easily accessible, but some of the recommendations in the plan, combined with the following, can make it safer.

safe habits

Visitors should be encouraged to practice some safer habits, to help protect themselves. These recommendations are frequently repeated to runners, walkers and cyclists in their communities. While they are not new, they are still effective. Visitors should be encouraged and reminded frequently to:

- Visit in pairs or groups- a buddy can help an injured person make it out of the site, go for help or stay calm while contacting emergency personnel.
- Use apps and technology – most of the site has good, reliable cell signal. Many modern apps, such as Glympse and Google Maps allow users to share their location with friends. Before heading into the site, visitors should use these apps to connect with

friends at home. This would allow others to help find a preserve visitor should they be rendered unconscious and alone or if emergency services need to find them.

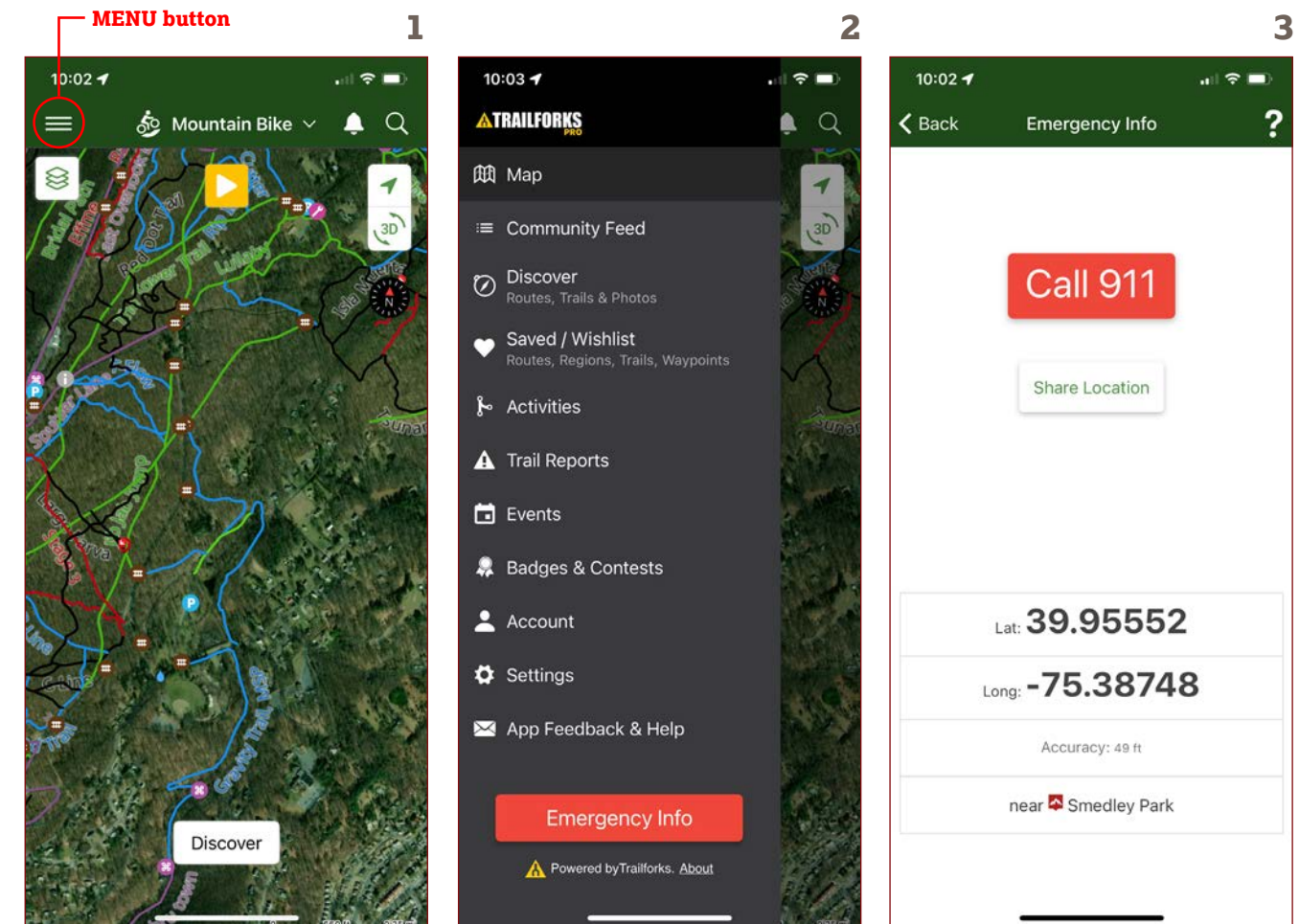
- Share your plans – before heading out to the Mount Penn Preserve, tell someone where you're going, and be as specific as possible, naming an area of the mountain, a specific parking location, park or trail. Visitors can even tell their friends what they are wearing, when they are going and when they expect to return.

These simple habits can be reenforced through messaging on signage at the preserve, on Mount Penn printed materials and emails and other communications.

trail forks app emergency features

Many visitors use an app called Trail Forks to help navigate the site. Visitors, local EMS, Search & Rescue and other emergency response agencies should use Trail Forks and familiarize themselves with the emergency features. Trail Forks is a wiki- based app, meaning users generate and moderate the content. Visitors can add trails to the map and a local moderator can edit the information. Trail Forks is the most current and accurate source of trail information related to the Mount Penn Preserve.

The app's main menu, accessed by pressing the three lines button, features a large red button labeled "Emergency Info." When a user pushes the red Emergency Info button, the app opens a screen which offers emergency assistance options, including a "Call 911," button and a "Share Location" button. If a user pushes the Call 911 button, the app will call the local emergency number. If a user pushes the "Share Location" button, the user's location is shared with Trail Forks servers, which search and rescue teams can access and view to help locate missing people. The Emergency Info Screen also shows the users current latitude and longitude, as well as the nearest trail. Simply familiarizing visitors, police, emergency response crews and local agencies with this existing, widely used tool, could help improve search and rescue on the preserve.



1. The Trail Forks app's main menu is accessed by pressing the three lines button.
2. When pressed, the dropdown menu appears and features a large red button labeled "Emergency Info."
3. When a user pushes the red Emergency Info button, the app opens a screen which offers emergency assistance options, including a "Call 911," button and a "Share Location" button.

signage featuring latitude and longitude

A new, unified, professionally designed sign system is one of the most important improvements recommended in this plan. While Trail Forks does provide latitude and longitude, not all visitors use the app. Therefore, the new signage system should incorporate precise location information, such as latitude and longitude, or a system of other measurements, like mile markers. The combination of more information on signage and trail markers, with new trail names and a more legible trail system, should help visitors get a better understanding of where they are on the preserve.

EMS gators at fire stations

Nearly everyone who visits, manages or is responsible for the Mount Penn Preserve has concerns about safety at the site. If a visitor has a major injury, or even a minor injury, can they be retrieved from the site? The recommendations above regarding apps, locations, and signage, and other recommendations regarding trail naming and legibility, should help to make visitors easier to find. However, it is unclear whether the surrounding communities have the proper equipment to traverse the mountain and rescue an injured person.

In most cases, ambulances do not leave paved streets. Fire engines are not equipped or meant to go off road in these conditions either. Therefore, we recommend each of the municipalities that are part of the MP3 acquire and house an EMS equipped off-road, heavy-duty gator. These vehicles are small and nimble enough to travel along most of the trails on site. They are tough enough to climb the hills and traverse the rockiest trails.

Gators should be kept at each fire station that could be called to an emergency at the Mount Penn Preserve. They should be trailered and ready to roll at moment's notice. If kept at the fire stations, the fire fighters can perform routine cleaning and maintenance and keep them locked up with their other vehicles. They will always know



EMS gators, such as the examples pictured here, should be kept at each fire station.

their location and condition and can ensure they are not damaged or vandalized.

Pricing for the gator vehicles starts around \$50,000, but outfitting them for EMS purposes, can add more to the cost, typically another \$10,000 to \$20,000. Like any vehicle, the final cost will depend on the options chosen. We recommend considering multiple uses, like search and rescue and firefighting, which may lead to purchase of a single gator, with multiple swappable features and trailers.

rangers, volunteers and wilderness first aid

Response time is a critical factor in an emergency. While firefighters, EMS and others may need to take time to get to Mount Penn Preserve and determine the best access point, others who can help may already be on site. That is, if they are trained and expected to help. Rangers and volunteers could be required, encouraged or at least supported in learning wilderness first aid.

The plan recommends instituting a ranger program as well as organizing and formalizing a volunteer corps. Rangers would be paid staff, so incorporating more skills, like wilderness first aid, may affect job descriptions, hiring and salary. However, as they would already be onsite, they could be key to a quick response. A ranger, even without wilderness first aid training, may be able to quickly find a visitor in need, assess the situation and relay more information to EMS or other first responders. Rangers would already be connected to local police and emergency personnel through phone and radio. They should also be equipped with GPS or other location finding equipment.

The plan recommends that volunteers should be used for a variety of tasks, ranging from trail building and invasive plant management to simply acting as ambassadors. Like rangers, volunteers could potentially be a first contact with an injured or lost visitor who has called for help. With training, volunteers could potentially assist with medical emergencies. Without training, they may at least be able to quickly find and comfort a visitor and quickly communicate with emergency responders. This would require volunteers to be given radios or other communication tools to contact or be contacted by emergency personnel.

conclusion

Keeping everyone safe at the Mount Penn Preserve will take some effort from everyone, ranging from the visitors themselves up to the budget and decision makers in each community. Visitors can use tried and true, simple methods like sharing their plans. Communities of volunteers can pitch in to help find and communicate with visitors. Local governments can do their best to equip the local emergency management services with the best modern vehicles, tools and equipment. Accidents will happen, people will get lost and injured, but the entire community can help make the Mount Penn Preserve as safe as possible.

sample ordinance

Chapter 22

PARKS AND OPEN SPACE

§ 22-1.	Active parks.	§ 22-5.	Timber Top Trail.
§ 22-2.	Passive parks and open space lands.	§ 22-6.	Hogs' Hollow Trail at Paradise Farm.
§ 22-3.	East Branch Brandywine Trail and Plum Run Trail.	§ 22-7.	Service animals.
§ 22-4.	Properties with recreational/conservation easements.	§ 22-8.	Posting of rules and regulations.
		§ 22-9.	Violations and penalties.

[HISTORY: Adopted by the Board of Supervisors of the Township of East Bradford 7-11-2024 by Ord. No. 01-2024.¹ Amendments noted where applicable.]

§ 22-1. Active parks.

The following rules and regulations for all East Bradford Township active parks, including but not limited to East Bradford Park and Copeland School Park, shall be complied with by all persons within those parks:

- A. Parks are open daily from sunrise to sunset and closed to all uses from sunset to sunrise except by special permit issued by East Bradford Township.
- B. Barbecues, cookouts, grilling and open fires are prohibited except within the picnic grills provided for such purpose. Any picnic grill fire shall be completely extinguished before the person who started the fire leaves the park. Hot ashes or burning materials shall not be dumped into any trash receptacles or elsewhere within the park.
- C. Parking is restricted to the parking areas provided. Overnight parking and camping/sleeping is prohibited except by special permit issued by East Bradford Township.
- D. Pets shall be leashed and under control at all times with a leash no longer than six feet. Pets are not allowed on any amphitheater, playgrounds, ball fields, volleyball courts, basketball courts or tennis courts at any time. Pet owners are required to clean up after their pets and deposit any used pet waste bags in a trash receptacle. Pet owners are encouraged to use pet waste bags when provided in the park.
- E. Wheeled recreational apparatuses and devices that include skateboards, scooters, e-scooters, rollerblades, bikes and e-bikes are permitted on designated shared-use pathways and trails within the active parks, subject to the following rules and regulations:
 - (1) Any use and/or misuse of a wheeled recreational apparatus or device that damages park property, including but not limited to park furnishings and surfaces, is strictly prohibited.
 - (2) No wheeled recreational apparatus or device shall exceed 10 miles per hour.

¹ Editor's Note: This ordinance also superseded former Ch. 22, Parks and Open Space, Regulation of, adopted 1-13-2004 by Ord. No. 1-2004; amended in its entirety 9-13-2016 by Ord. No. 5-2016.

- (3) No wheeled apparatus or device shall exceed 100 pounds.
- (4) No electrically assisted wheeled apparatus or device shall have a motor that exceeds 750 watts.
- (5) Bicycles and e-bicycles shall have fully functional, operable pedals.
- F. Alcoholic beverages and smoking are prohibited within the parks.
- G. Disorderly conduct, including the use of indecent language, excessive noise or sound amplification equipment, is prohibited. Any noise shall be deemed excessive and in violation of this regulation if it disturbs the peace of any individual or impedes the peaceable use of the park or any adjacent residence or business.
- H. Littering is prohibited, and all refuse shall be placed in trash receptacles (if provided) or removed by the person(s) generating the refuse. Recycling is required within all parks. Recycling bins shall be used when provided, or, alternatively, recycling shall be removed and taken home.
- I. Vandalism to park property and facilities, including defacing or damaging park property, unauthorized trail construction, and destroying/removing vegetation, is prohibited.
- J. Metal detecting, digging/excavation, and construction of any type are prohibited.
- K. Disturbing wildlife, unless part of an organized wildlife management program authorized by East Bradford Township, is prohibited. Driving whitetail deer as defined by the Pennsylvania Game Commission within or from park property is considered disturbing wildlife and is prohibited. Additionally, baiting/feeding wildlife or placing wildlife attractants within park property is considered disturbing wildlife and is prohibited.
- L. Discharge of firearms is prohibited. Slingshots, airsoft and paintball guns, BB and pellet guns, air rifles, archery equipment, rockets, fireworks, explosives or other dangerous materials are prohibited unless a special permit has been issued by East Bradford Township. Hunting is prohibited on and across park property unless it is part of a Township-approved wildlife management program.
- M. Motorized vehicles are allowed only in designated areas, except for official business, emergencies, or power-driven mobility devices for use by persons who have mobility impairments.
- N. Golfing is prohibited.
- O. Radio-controlled vehicles, including but not limited to cars, trucks, airplanes, drones and helicopters, are prohibited.
- P. Use of ball fields, picnic pavilions, and amphitheaters by organized groups of 15 or more persons is prohibited without a permit obtained from East Bradford Township.
- Q. Use of ball fields or tennis and pickleball courts for professional lessons is prohibited, except by professionals hired by East Bradford Township for that purpose or with a special permit issued by East Bradford Township.
- R. The following specific rules and regulations shall be followed by anyone using a park tennis or pickleball court:
 - (1) Limit time when others are waiting.
 - (a) Singles: one hour maximum.

- (b) Doubles: 1 1/2 hour maximum.
- (2) Use of tennis and pickleball courts is on a first-come-first-served basis; no reservations.
 - (3) No professional lessons are allowed, except by professionals hired by East Bradford Township for that purpose or with a special permit issued by East Bradford Township.
 - (4) Players are expected to observe all rules of tennis and pickleball etiquette.
 - (5) Only tennis shoes shall be worn. Black-soled shoes or boots are not permitted.
 - (6) Activities other than tennis and pickleball are not permitted on the courts.
 - (7) Skateboards, scooters, e-scooters, rollerblades, bicycles and e-bicycles are not permitted on the courts.
 - (8) Pets are not allowed on the courts.
 - (9) Radios and sound amplification equipment are not permitted on the courts.
- S. The following specific rules and regulations apply to anyone using a park basketball court:
- (1) Use of courts is on a first-come-first-served basis; no reservations.
 - (2) Players are expected to observe the rules of basketball etiquette.
 - (3) Skateboards, scooters, e-scooters, rollerblades, bicycles, and e-bicycles are not permitted on the court.
 - (4) Pets are not allowed on the court.
 - (5) No professional lessons are allowed except by professionals hired by East Bradford Township for that purpose, or with a special permit issued by East Bradford Township.
 - (6) Activities other than basketball are not permitted on the court.
 - (7) Radios and sound amplification equipment are not permitted on the court.

§ 22-2. Passive parks and open space lands.

The following rules and regulations for all East Bradford Township passive recreation parks and open space lands and eased lands, including but not limited to Brandywine Farm, Jane Reed Park, Shaw's Bridge Park, Harry J. Waite Nature Area, Ingram's Mill Nature Area, Sugars Bridge Nature Area, Harmony Hill Nature Area, M. John Johnson Nature Center, Sconnelltown Park, Paradise Valley Nature Area, Starr Farm Park, Mt. Bradford Preserve, Jefferis Ford Nature Area, Skelp Level Park, and the Plum Run Preserve, shall be complied with by all persons within those parks:

- A. Parks are open daily from sunrise to sunset and closed to all uses from sunset to sunrise except by special permit issued by East Bradford Township.
- B. Barbecues, cookouts, grilling and open fires are strictly prohibited in all passive parks.
- C. Parking is restricted to the parking areas provided. Overnight parking and camping/sleeping is prohibited except by special permit issued by East Bradford Township.
- D. Pets shall either be leashed or under immediate control at all times by a responsible person, excepting

- the Plum Run Preserve where pets shall be leashed and under control at all times with a leash no longer than six feet. Pet owners are required to clean up after their pets and deposit any used pet waste bags in a trash receptacle. Pet owners are encouraged to use pet waste bags when provided in the park.
- E. Wheeled recreational apparatuses and devices that include skateboards, scooters, e-scooters, rollerblades, bikes, and e-bikes are permitted on designated shared-use pathways and trails within the passive parks, subject to the following rules and regulations:
 - (1) Any use and/or misuse of a wheeled recreational apparatus or device that damages park property, including but not limited to park furnishings and surfaces, is strictly prohibited.
 - (2) No wheeled recreational apparatus or device shall exceed 15 miles per hour.
 - (3) No wheeled recreational apparatus or device shall exceed 100 pounds.
 - (4) No electrically-assisted wheeled apparatus or device shall have a motor that exceeds 750 watts.
 - (5) Bicycles and e-bicycles shall have fully functional, operable pedals.
 - F. Alcoholic beverages and smoking are prohibited within the parks.
 - G. Disorderly conduct, including the use of indecent language, excessive noise or sound amplification equipment, is prohibited. Any noise shall be deemed excessive and in violation of this regulation if it disturbs the peace of any individual or impedes the peaceable use of the park or any adjacent residence or business.
 - H. Littering is prohibited, and all refuse shall be placed in trash receptacles (if provided) or removed by the person(s) generating the refuse. Recycling is required within all parks. Recycling bins shall be used when provided, or, alternatively, recycling shall be removed and taken home.
 - I. Vandalism to park property and facilities, including defacing or damaging park property, unauthorized trail construction, and destroying/removing vegetation, is prohibited.
 - J. Metal detecting, digging/excavation, and construction of any type are prohibited.
 - K. Disturbing wildlife, unless part of an organized wildlife management program authorized by East Bradford Township, is prohibited. Driving whitetail deer as defined by the Pennsylvania Game Commission within or from park property is considered disturbing wildlife and is prohibited. Additionally, baiting/feeding wildlife or placing wildlife attractants within park property is considered disturbing wildlife and is prohibited.
 - L. Discharge of firearms is prohibited. Slingshots, airsoft and paintball guns, BB and pellet guns, air rifles, archery equipment, rockets, fireworks, explosives or other dangerous materials are prohibited unless a special permit has been issued by East Bradford Township. Hunting is prohibited on and across park property unless it is part of a Township-approved wildlife management program.
 - M. Motorized vehicles are allowed only in designated areas, except for official business, emergencies, or power-driven mobility devices for use by persons who have mobility impairments.
 - N. Golfing is prohibited.
 - O. Radio-controlled vehicles, including but not limited to cars, trucks, airplanes, drones and helicopters, are prohibited at all parks except Starr Farm Park, which allows radio-controlled airplanes and

helicopters only.

§ 22-3. East Branch Brandywine Trail and Plum Run Trail.

The following rules and regulations for the paved East Branch Brandywine Trail and the paved Plum Run Trail shall be complied with by all persons using the trails:

- A. The following uses are permitted on the East Branch Brandywine Trail and the Plum Run Trail:
- (1) Walking and jogging.
 - (2) Cycling, e-cycling, scooters, and e-scooters with speed limited to 15 miles per hour or less.
 - (3) Skateboards and rollerblades.
 - (4) Power-driven mobility devices for use by persons who have mobility impairments.
 - (5) Strollers, including those connected to bicycles.
 - (6) Cross-country skiing.
 - (7) Snowshoeing.
- B. The following uses are prohibited on the East Branch Brandywine Trail and the Plum Run Trail:
- (1) Equestrian use; horseback riding.
 - (2) Motorcycles, dirt bikes, and bicycles or e-bicycles that do not have fully functional, operable pedals.
 - (3) Wheeled recreational apparatuses and devices, including but not limited to bicycles, e-bicycles, scooters, and e-scooters that exceed 100 pounds or that have electric motors that exceed 750 watts. Permitted wheeled recreational apparatuses and devices are not allowed to exceed 15 miles per hour.
 - (4) Snowmobiles.
 - (5) ATVs, except for official business or emergencies.
 - (6) Rockets and radio-controlled vehicles, including but not limited to cars, trucks, airplanes, drones and helicopters.
 - (7) Sleeping/camping without a special permit obtained from East Bradford Township.
- C. Parking is restricted to the parking areas provided. Overnight parking and camping/sleeping are prohibited without a special permit obtained from East Bradford Township.
- D. Pets shall be leashed and under control at all times with a leash no longer than six feet. Pet owners are required to clean up after their pets and deposit any used pet waste bags in a trash receptacle. Pet owners are encouraged to use pet waste bags provided along the trail.
- E. Alcoholic beverages and smoking are prohibited on the trail and adjoining Township properties.
- F. Discharge of firearms is prohibited. Slingshots, airsoft and paintball guns, BB and pellet guns, air rifles, archery equipment, fireworks, rockets, explosives or other dangerous materials are prohibited. Hunting is prohibited.

- G. Disorderly conduct, including the use of indecent language, excessive noise or sound amplification equipment, is prohibited. Any noise shall be deemed excessive and in violation of this regulation if it disturbs the peace of any individual or impedes the peaceable use of the park or any adjacent residence or business.
- H. Littering is prohibited, and all refuse shall be placed in trash receptacles (if provided) or removed by the person(s) generating the refuse. Recycling is required within all parks and open spaces. Recycling bins shall be used when provided, or alternatively, recycling shall be removed and taken home.
- I. Vandalism to park/trails property and facilities, including defacing or damaging park property, unauthorized trail construction, and destroying/removing vegetation, is prohibited.
- J. Metal detecting, digging/excavation, and construction of any type are prohibited.
- K. Disturbing wildlife, unless part of an organized wildlife management program authorized by East Bradford Township, is prohibited. Driving whitetail deer as defined by the Pennsylvania Game commission within or from the park property is considered disturbing wildlife and is prohibited. Additionally, baiting/feeding wildlife or placing wildlife attractants within park property is considered disturbing wildlife and is prohibited.
- L. Use of picnic areas by organized groups of 15 or more persons is prohibited without a permit obtained from East Bradford Township.
- M. Motorized vehicles are allowed only in designated areas, except for official business, emergencies, or power-driven mobility devices for use by persons who have mobility impairments.

§ 22-4. Properties with recreational/conservation easements.

The following rules and regulations apply to properties where property owners have granted recreational/conservation easements to East Bradford Township, but are not owned by the Township, with the exception of Timber Top Trail and Hogs' Hollow Trail at Paradise Farm, which are regulated by §§ 22-5 and 22-6, respectively. These rules and regulations shall be complied with by all persons within those lands:

- A. Public access trail easements are open daily from sunrise to sunset and closed to all uses from sunset to sunrise except by special permit issued by East Bradford Township.
- B. Parking is restricted to the parking areas provided. Overnight parking and camping/sleeping is prohibited except by special permit issued by East Bradford Township.
- C. Public access is limited to the marked trails only. The public is not permitted on areas that are not marked trails.
- D. Smoking is prohibited.
- E. Fires are prohibited.
- F. Alcoholic beverages are prohibited.
- G. Motorized vehicles are prohibited except for official business, emergencies, or power-driven mobility devices for use by persons who have mobility impairments.
- H. Pets shall be leashed and under control at all times with a leash no longer than six feet.
- I. Children shall be accompanied by an adult.

- J. Hunting is prohibited within easements.
- K. Discharge of firearms is prohibited. Slingshots, airsoft and paintball guns, BB and pellet guns, air rifles, archery equipment, rockets, fireworks, explosives or other dangerous materials are prohibited.
- L. All wheeled recreational apparatuses and devices, which includes, but is not limited to, skateboards, scooters, e-scooters, rollerblades, bikes, and e-bikes are prohibited.
- M. Rockets and radio-controlled vehicles, including but not limited to cars, trucks, airplanes, drones and helicopters, are prohibited.
- N. Disorderly conduct, including the use of indecent language, excessive noise or sound amplification equipment, is prohibited. Any noise shall be deemed excessive and in violation of this regulation if it disturbs the peace of any individual or impedes the peaceable public use of the lands or any adjacent residence or business.
- O. Littering is prohibited, and all refuse shall be placed in trash receptacles (if provided) or removed by the person(s) generating the refuse.
- P. Vandalism, including defacing, damaging or removing property, unauthorized trail construction, disturbing wildlife and destroying/removing vegetation, is prohibited.
- Q. Metal detecting, digging/excavation, and construction of any type are prohibited.
- R. Disturbing wildlife, unless part of an organized wildlife management program authorized by the property owner or East Bradford Township, is prohibited. Driving whitetail deer as defined by the Pennsylvania Game Commission within or from the property is considered disturbing wildlife and is prohibited. Additionally, baiting/feeding wildlife or placing wildlife attractants within the property is considered disturbing wildlife and is prohibited.

§ 22-5. Timber Top Trail.

The following rules and regulations apply to Timber Top Trail. These rules and regulations shall be complied with by all persons within those lands:

- A. The trail easement is open daily from sunrise to sunset and closed to all uses from sunset to sunrise except by special permit issued by East Bradford Township. Hours may be further restricted during hunting season.
- B. Parking is restricted to the parking areas provided. Overnight parking and camping/sleeping are prohibited without a special permit obtained from East Bradford Township.
- C. Public access is limited to the marked trails only. The public is not permitted on areas that are not marked trails.
- D. Smoking is prohibited.
- E. Fires are prohibited.
- F. Alcoholic beverages are prohibited.
- G. Overnight camping/sleeping is prohibited.
- H. Motorized vehicles are prohibited except for official business, emergencies, or power-driven mobility devices for use by persons who have mobility impairments.

- I. Pets are prohibited (i.e., no dogs), with the exception of horses for equestrian use.
- J. Children shall be accompanied by an adult.
- K. Hunting is permitted only with written permission of the landowner. Written permission to hunt shall be carried by hunters at all times while on the site. Public access hours may be further restricted during the hunting season.
- L. Except those lawfully hunting on the property, the discharge of firearms and archery equipment is prohibited. Slingshots, airsoft and paintball guns, BB and pellet guns, air rifles, rockets, fireworks, explosives or other dangerous materials are prohibited.
- M. All wheeled recreational apparatuses and devices, which includes, but is not limited to, skateboards, scooters, e-scooters, rollerblades, bikes, and e-bikes are prohibited.
- N. Disorderly conduct, including the use of indecent language, excessive noise or sound amplification equipment, is prohibited. Any noise shall be deemed excessive and in violation of this regulation if it disturbs the peace of any individual or impedes the peaceable public use of the lands or any adjacent residence or business.
- O. Littering is prohibited, and all refuse shall be placed in trash receptacles (if provided) or removed by the person(s) generating the refuse.
- P. Vandalism, including defacing, damaging or removing property, disturbing wildlife, unauthorized trail construction, and destroying/removing vegetation, is prohibited. Additionally, metal detecting, digging/excavation, and construction of any type is prohibited.
- Q. The use of rockets or radio-controlled vehicles, including but not limited to cars, trucks, airplanes, drones and helicopters, is prohibited.

§ 22-6. Hogs' Hollow Trail at Paradise Farm.

The following rules and regulations apply to the Hogs' Hollow Trail at Paradise Farm. These rules and regulations shall be complied with by all persons using this trail:

- A. The public access trail easement is open daily from sunrise to sunset and closed to all uses from sunset to sunrise except by special permit issued by Paradise Farm Camps or East Bradford Township. Hours may be further restricted during hunting season.
- B. Parking is restricted to the parking areas provided at Harmony Hill Nature Area. Overnight parking and camping/sleeping is prohibited except by special permit issued by East Bradford Township.
- C. Pets are prohibited (i.e., no dogs, no horses).
- D. Hogs' Hollow Trail is strictly pedestrian access only. Equestrian use and all wheeled recreational apparatuses and devices, which includes, but is not limited to, skateboards, scooters, e-scooters, rollerblades, bikes, and e-bikes are prohibited.
- E. Smoking is prohibited.
- F. Fires are prohibited.
- G. Overnight camping/sleeping is prohibited.
- H. Alcoholic beverages are prohibited.

- I. Motorized vehicles of any kind are prohibited, except those authorized by East Bradford Township, CCWA - Paradise Farm Camps, emergency personnel, or power-driven mobility devices for use by persons who have mobility impairments.
- J. Littering is prohibited. All refuse shall be removed by the person(s) generating the refuse.
- K. Disorderly conduct, including the use of indecent language, excessive noise or sound amplification equipment, is prohibited. Any noise shall be deemed excessive and in violation of this regulation if it disturbs the peace of any individual or impedes the peaceable use of the park or any adjacent residence or business.
- L. Vandalism to property and facilities, including defacing or damaging property, disturbing wildlife, unauthorized trail construction, and destroying/removing vegetation, is prohibited. Additionally, metal detecting, digging/excavation, and construction of any type is prohibited.
- M. Hunting is permitted only with written permission of the landowner. Written permission to hunt shall be carried by hunters at all times while on the site. Public access hours may be further restricted during hunting season.
- N. Except for those lawfully hunting on the property, the discharge of firearms and archery equipment is prohibited. Slingshots, airsoft and paintball guns, BB and pellet guns, air rifles, rockets, fireworks, explosives or other dangerous materials are prohibited.
- O. The use of rockets or radio-controlled vehicles, including but not limited to cars, trucks, airplanes, drones and helicopters, is prohibited.

§ 22-7. Service animals.

For purposes of this chapter, a service animal is a dog or miniature horse which has been individually trained to do work or perform tasks for the benefit of an individual with a disability. The tasks performed by the service animal shall be directly related to the individual's disability. Emotional support, therapy, comfort or companion animals are not service animals. Where this chapter precludes a pet or an animal, a service animal shall be permitted provided it is under the control of its handler. A service animal may be excluded from Township active or passive parks, trails, open space, or easements, when the animal's behavior poses a direct threat to the health or safety of others, or where otherwise permitted by law.

§ 22-8. Posting of rules and regulations.

The rules and regulations described above in §§ 22-1 through 22-3 shall be conspicuously posted in all East Bradford Township active and passive recreation parks and open spaces and shall be maintained and updated as necessary. The rules and regulations described above in § 22-4 through § 22-6 shall be conspicuously posted at all properties with recreational easements and shall be maintained and updated as necessary at properties where property owners have given recreation/conservation easements to East Bradford Township for as long as the recreation/conservation easement remains in effect. The posting required by this section shall be placed and maintained by the East Bradford Township Code Enforcement Officer or their designee.

§ 22-9. Violations and penalties.

In accordance with the Second Class Township Code, 53 P.S. § 67203(b), any person who violates the rules and regulations adopted within this chapter, as set forth above, commits a summary offense. The Board of Supervisors of East Bradford Township or its designee shall enforce the above rules and regulations by

an action brought before the District Justice with competent jurisdiction in the same manner provided for the enforcement of summary offenses under the Pennsylvania Rules of Criminal Procedure. Any person violating any one of the above-described rules and regulations shall pay a fine not exceeding \$1,000 and/or shall be imprisoned for a period of not more than 90 days per violation. A separate offense for violating the above-described rules and regulations shall arise for each day the offender violates a rule or regulation and for each rule or regulation violated. The Township may pursue any other remedies available at law or in equity.



1031 Palmers Mill Road
Media, PA 19063
610-353-5587
natlands.org