Emerson Farm Preserve, Mill Creek Preserve & The Weisel Preserve

Open Space Master Plans

Warrington Township, Bucks County

August 16, 2022

Natural Lands

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WARRINGTON TOWNSHIP

Bucks County, PA

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Prepared by

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Introduction

Three Connected Sites

Warrington Township recognizes the importance of conserving open space, so residents have beautiful places to walk, run, ride, and connect to nature. The Township knows that conserved land can increase property values, beautify a community, soak up stormwater and reduce flooding, provide habitat and food for native animals, and clean the air we breathe. They know too that in order to protect and even improve water quality, the land must be carefully planted and stewarded. In the Weisel Preserve, Emerson Farm Preserve and Mill Creek Preserve, Warrington has conserved three separate, yet connected properties. The entirety of the three sites is within a 4-mile radius. They are connected by Pickertown Road, where all three sites have frontage. The Township's multi-use trail system also links all three sites to each other and beyond. The Bradford Dam Connector trail, which links these three sites, also connects to the Route 202 Trail, a major part of the Circuit. Residents can use the local and regional trail system to travel to and from the three open space preserves!

These sites are also connected by water, as they are all within the Cooks Run-Neshaminy Creek Watershed. All three sites contain either major streams, like the Mill Creek, small tributaries, or ponds. These features are all part of the watershed which feeds the Neshaminy Creek. Conservation and proper stewardship of these site will protect aquatic species, improve water quality and even reduce flooding downstream.

These properties have also historically been part of Warrington's farming community. The corn, soy and hay grown here have driven the local economy while imparting a rural character to the township. As the Township begins stewarding these sites, typical agricultural may no longer be feasible, but a rural aesthetic can be maintained, preserving the community character and links to the past.

Through master planning, the links between these sites will become even stronger. Visitors will use new trails to bring them into the sites. The water flowing through one site will be cleaner before it reaches the next. Visitors will see the same herons roosting in one site, wading and hunting in the

streams of another. As they are restored, the three open spaces will form a corridor of green space, of meadows, of forests, of cleaner water for all the inhabitants of Warrington Township to enjoy.

What is a Master Plan?

A master plan is a specific type of plan which typically shows ideas and concepts in general locations. Master plans are the first ***graphic*** step in designing a site. But the master plan drawing is not the first step in the whole design process. These plans have been informed by a robust process of public dialogue, which includes public meetings, a focus group, key person interviews and site visits with stakeholders. The plans are also based on the consultants' findings after reviewing maps of existing features, township plans and other published documents. Site visits and on the ground investigations have also played a crucial role in the shaping the plans. All this research has allowed us to prepare plans which show the big ideas for how the sites can be used, developed, conserved and stewarded.

Master plans do not typically include enough detail to guide construction. They set the groundwork for the next steps, further study, a more detailed concept or construction drawings. As an example, a master plan might show a bridge over a stream. But further studies may be required to determine where exactly the bridge should be placed, how long and wide the bridge needs to be, where exactly the footers should be set and how the bridge may affect the stream itself. Then, after so much more study, a detailed design would be prepared. This design would provide the answers to the questions above and include details for how to construct and install the bridge. It may also include a detailed cost estimate.

The example of a bridge on a master plan is particularly relevant, as the Mill Creek Master Plan includes several bridges and boardwalks, all of which will require further study and detailed design. But the master plans also include recommendations for landscaping, stewardship, trails, parking areas, picnic areas and other amenities. All of these will require further study, design or specifications before they can be installed.

Furthermore, a master plan is a guide. While these plans have been thoroughly researched, carefully designed and vetted by the community, the recommendations they contain are not set in stone. New opportunities could arise which lead to even greater possibilities for implementation and stewardship. Or, unfortunately, economic influences, such as scarce grant funding, and labor and material shortages could make some of the recommendations infeasible. Conditions today, as the plans are developed, may not be the same when the Township is ready to implement the plans.

Finally, as the master plans are guides, they should be vetted further. When the Township does embark on major improvements or expenditures, those projects should be considered in a public setting. The Board of Supervisors, Township Commissions, Councils and Committees and the public, should continue to work together to implement the master plans as they see fit.

The three sites are connected by trails, roads, and streams. Residents, human and animal, will visit all three, sometimes in the same trip. But each site is different from the others. They each have their own unique features, as well as challenges. Visitors will use each site differently. Therefore, each site has been studied individually and a distinct site analysis and master plan have been prepared for each.

Mill Creek

Emerson Farm Preserve

Municipalities cannot buy every property they wish to conserve. “Buy the best, zone the rest,” is a recommendation supported by many conservation organizations. Emerson Farm Preserve is an example of how zoning can be used to conserve open space. The 103-acre property is being developed into a residential subdivision featuring 123 homes on approximately 35 acres. The remaining land, approximately 68.5 acres, has been conserved as open space, protected with a conservation easement and open to the public. The new homes present some challenges for mixing public space and private lots, but also provide a resident constituency. The residents will likely use the open space, watch over it, care for it and advocate on its behalf.

Existing Features & Site Analysis

Emerson Farm Preserve site has been slowly changing over the course of the master planning project. At the start, the site was still recognizable as a farm, though the crops were gone and the fields had gone fallow. Since then, about 1/3 of the site has been regraded. Roads have been paved, stormwater management basins have been dug and homes have been built. The analysis of this site has focused on the open space areas with consideration for how the residential development will affect and interact with the site in the future.

Development

The developed portion of the site features 123 homes, including single family detached units and duplexes. Conrad Drive, the main street through the development, is lined with single family homes and connects Pickertown and West Street Roads. Duplexes are clustered around a horseshoe shaped loop off of Conrad which also features some internal open space.

The developed area is surrounded by open space. A sliver of preserved woodlands buffer a stream between Conrad Drive and the neighboring property to the east. Narrow bands of open space separate the homes from West Street and Pickertown Roads. To the west, the largest uninterrupted open space area separates the

development from Lower State Road. With so many individual lots abutting the open spaces, encroachment is the greatest concern. The Township and easement holder will need to pay close attention to the yards to ensure that fences are not moved and pools, sheds and other improvements are not placed in the open space.

Neighboring Uses

Quarry

The Eureka Stone Quarry is northwest of the site on the north side of Lower State Road. There is a hedgerow and woods that prevent pedestrians and residents from seeing the quarry. The quarry can be loud during blasting. Dust is visible on the roadway and on plants in the open space. The dust and noise may be considered minor annoyances, as they do not appear to greatly affect the site.

View of the Eureka Stone Quarry from Emerson Farm Preserve

Ball Field

Eureka Stone Quarry owns another parcel at the corner of Lower State and Street Roads, which contains a baseball field. The use does not appear to significantly affect the open space, though it is likely that stormwater runs off the field and into the tributaries which wind through the neighboring woodlands. Additionally, many softballs have left the field and can be found strewn throughout the woods.

Neighborhood

The "Perry Farm at Warrington" subdivision is directly southeast of Emerson Farm Preserve on West State Road. This community contains 48 single family detached homes. This community includes the Bradford Dam connector trail that extends from West State Road to Pickertown Road. Another multi-use trail also follows West State Road and connects this community to Emerson Farm Preserve.

Multi-Use Trails

Emerson Farm Preserve open space is already well served by multi-use trails. The Bradford Dam connector trail is planned to connect the site to the Route 202 Trail to the northwest and to the Bradford Dam Recreation Area to the south. Additionally, the Pickertown Road trail is planned to connect the site to the residents along Pickertown Road to the southeast. This impressive system of multi-use trails will bring other township residents to the site and give Emerson Farm residents the opportunity to bike or walk to other parts of their community.

PNDI

The Pennsylvania Natural Diversity Inventory (PNDI) environmental review for Emerson Farm Preserve indicates that the site is potential habitat for the Great Blue Heron, which is a species of special concern. A heron rookery exists nearby, between Emerson Farm Preserve and the Weisel Preserve. The birds which nest in the trees at the rookery likely fish at all three of open space sites.

Agricultural Fields

Two former agricultural fields exist on the property. The fields have been taken out of agriculture and

been used and stored in the fields during the construction of the housing development. These fields are separated by hedgerows that create distinct “rooms” .They divide up the open space in a way that makes the space feel more comfortable and manageable. The resulting rooms also allow for different stewardship or management practices in pre-defined areas. For instance, one field could be allowed to return to agriculture, while another could be maintained as a meadow. The corn and soy which previously grew on site strengthened the rustic and rural character of the area. A change in land stewardship along the roads could greatly change the character of this area.

Hedgerows

Mature hedgerows divide the site into distinct rooms. The hedgerow along Lower State Road also blocks the view of the quarry, enhancing the interior views at the Preserve. Another hedgerow extends from the south side of the corner outparcel towards Conrad Drive, dividing the open space into two large sections of about 12 acres each. Another hedge row runs parallel to Conrad Drive on the northern side, behind the single-family homes, providing some privacy for the homeowners, but also potentially blocking their views to the open space.

Hedgerows retain the agricultural character, divide the space nicely, provide buffering and screening, and cover and roosting sites for animals. But they also frequently become overrun with invasive species, including vines. Should the hedgerows remain, they will need to be monitored frequently for invasive species.

Woodlands and Streams

Woodlands exist at the westernmost corner of the site, surrounding the ball field and screening it from the new development. The area needs some restoration as the tributaries there are badly eroded and very few native plants are regenerating. This area could host trails in the future, but the health of the woodlands should be addressed first.

A narrow strip of woodlands also exists between the developed area and Perry Farm at Warrington. An unnamed tributary of Mill Creek flows through these woodlands, crossing back and forth between the Preserve and the Perry Farm development. A smaller tributary exists, which captures stormwater from the area below Conrad Drive. These woodlands can provide a riparian buffer to help protect these streams from erosion and pollution.

Views and Vistas

The Preserve has a great combination of views within, into and out of the site. There are excellent interior views across the fields towards the woodlands and hedgerows. Many of the less attractive views offsite are conveniently blocked by these hedgerows and wooded areas. These views should be maintained.

The eastern side of Pickertown Road has excellent views into the Reserve and the farmstead on the north side of Pickertown is an attractive feature that can be viewed by park users. As visitors continue to travel west on Pickertown, the quarry becomes visible. The quarry itself may be considered an interesting view, but the dust and noise are not attractive.

Existing Agricultural Field and Hedgerow at Emerson

Meadow condition at Emerson

Master Plan

Connections to Surrounding Neighborhoods

There are several practical connections to surrounding residential areas. Buttercup Boulevard connects to Conrad Drive on the Pickertown road side, allowing nearby residents to access the Preserve. This neighborhood is also connected to the Mill Creek site from Bellflower Boulevard.

The Bradford Dam Connector Trail runs along the southeast side of the Preserve towards West Street Road. The Morningwalk Drive neighborhood can use this trail to access Emerson Farm Preserve, The Weisel Preserve and Mill Creek Preserve using this trail.

Additionally, two schools, Mill Creek Elementary and Central Bucks South High School, are within walking distance of Emerson Farm Preserve. School children who live nearby may cut through the Preserve to utilize the Bradford Dam Connector Trail to walk to school. The schools may also use the Reserve to support their curriculum through field trips or other site based education.

Trails

Residents of the nearby communities and the rest of the Township will come to the Reserve to walk the trails for exercise, to connect to nature or to access the other connected open spaces. The woods, proposed meadows and farm fields offer lovely views and experiences. The trail system just needs to be developed enough to bring people to these beautiful and interesting places.

A series of loop trails is proposed around and through the meadow and agricultural areas. These trail loops will provide options and interested. They'll wind through the meadows and along the edge of the agriculture fields. The trail system will connect to the public parking area. A connecting trail is proposed in the wooded Highest Protection Area. This area requires some restoration before a trail can be established.

The multi-use trails proposed along Pickertown Road and around the site add another layer to the trail system and will bring visitors to the Preserve from neighboring communities. These trails will offer views into the preserve. Passing cyclists, walkers and runners may see the open space and venture in to explore.

Trail Information and Wayfinding

Visitors will need some information about the trail system, particularly in the parking area. When they get out of their cars, or walk into the preserve, they should be greeted by a kiosk featuring a map and other information. Emerson Farm Preserve contains flat terrain and is easily traversable. Maps at these locations should highlight internal trails as well as connections to Mill Creek Preserve, the Weisel Preserve, the Bradford Dam Connector Trail, the Pickertown Road trail and the 202 Parkway Trail. Naming, blazing or signing trails can help people find their way around more easily.

The Township will also implement and encourage visitors to use a smartphone-based application, called Beacon to mark and share their locations. In case of emergency, the app will help others find them in the preserve. Information about the app, including a QR code linked to a download page, could be posted in a kiosk or on a sign at the parking area.

Parking

Eight publicly accessible parking spots are provided on Conrad Drive. This small parking lot will allow residents from outside of the development to come visit the open space by car. The parking area can also act as a gathering place for visitors, an easy place to meet up. The parking area should also include bike racks, to provide site users arriving from the trail or roadway with a place to secure their bicycles while picnicking, or continuing on the trail by foot.

Continuing the Tradition of Agriculture

Historically, Warrington has been an agricultural community. Like much of Bucks County, development has displaced farms and made truck farming more difficult, as leasable lands grow farther and farther apart. By permitting agriculture to remain, Warrington can keep some 'Farm' in Emerson Farm Preserve. Traditionally, corn and soy have been the predominant crops grown in southeastern Pennsylvania. Continued production of these crops in the field along Pickertown Road would help to maintain a small part of the communities' disappearing rural character.

Interior Meadow

The 12 acres between the hedgerow and the wooded area are proposed to be converted to meadow, which will contribute to the agricultural character of the community, enhance the long view with texture and color, and provide habitat for birds and mammals. Trails will be created through and around these meadows, to connect to the multi-use trails, parking and picnic areas and other trails through the preserve. The seed mixes should not include large species which typically grow above 4' in height so as not to block the views of trail users.

This meadow is underlain by three soil types:

- The Abbottstown series consists of deep and very deep, somewhat poorly drained soils.
- The Doylestown series consists of deep, poorly drained soils.
- The Reaville series consists of moderately deep, moderately well and somewhat poorly drained soils.

With so many poorly drained soils at this location, the meadow seed mix will include many species that are well adapted to wet conditions.

This meadow is surrounded by hedgerows, woods and stormwater basins, so views from outside of the site are limited, enhancing a sense of enclosure. For visitors walking the trails, this meadow will offer a sudden pop of color and sunshine. A few homeowners on the north side of Wier Drive will enjoy a beautiful view of the meadow and the birds and other creatures that are sure to call it home.

The meadows and forests will provide food and habitat for a variety of birds, mammals, insects and even reptiles. The meadow habitats can be supplemented with bird boxes, chimneys and other types of bird houses. They can also be outfitted with amenities for birders, such as bird blinds, mounted scopes and informational signage to help identify common species.

Forest Health

The forested area around the ballfield requires restoration before trails are developed. The stream banks of the small tributaries should be stabilized with riparian plants, hazardous trees should be removed, and new trees should be planted to ensure water temperatures in the tributaries remain low. Additionally, invasive plant species must be managed, and native species re-established wherever possible, to ensure a healthy forest well into the future.

Amenities

Kiosks, Signs, and Blazing

Three kiosks or signs are proposed. One is proposed at the intersection of Conrad Drive and Pickertown Road across from Buttercup Boulevard. This will orient pedestrians and cyclists using the existing, paved multiuse trail. The kiosk or sign here should also welcome visitors to the open space.

A wayfinding sign and kiosk is also proposed in the small parking area on Conrad Drive. This sign should make it clear that many of the trails through the meadow and agricultural areas are loops with limited connections to the external trails that connect to other sites. These trails are natural surface trails where bikes are not permitted. The third sign will orient users entering from the Pickertown Road multiuse trail to the agricultural field entrance.

Trails should also be signed or blazed in accordance with a corresponding trail map. These markers should let users know what trail they are on. This can help in an emergency. Additionally, a sign and blazing system should be designed to consider different visual abilities, such as colorblindness, and should incorporate measures to make them more accessible, such as symbols, words or textures.

Bird Boxes

Bird Boxes and chimneys can be placed in the meadow area. The meadow habitats can also be outfitted with amenities for birders, such as bird blinds, mounted scopes, and informational signage to help identify common species. Local birders and groups such as Bucks County Birders and Aark Wildlife Rehabilitation and Education Center may be able to advise the Township as to which kinds of structures are appropriate based on bird species observed in the area.

Boundary Markers

The eased open space and private yards should be clearly delineated to avoid encroachment and trespassing. Fencing is the most expensive and most effective option. However, markers such as cornerposts could also be used. Some of the residents have already installed fencing on their own. The Township should install additional fencing or markers to clearly demonstrate the limits of each property.

Conclusion

Emerson Farm Preserve is a good example of a creative solution to two common issues – another suburban development boom and conservation of open space for public use. Warrington has recognized that they can use the development process to conserve open space, protect woodlands, wetlands and streams, expand their trail systems and connect their residents to nature, to recreation and to each other. When the open space is restored to its fullest potential, the healthy woodlands, lush meadows, and clean water, will make Emerson Farm Preserve a wonderful place to live.

Stewardship Plan

Emerson Farm Preserve features a range of vegetation covers including forests, hedgerows, and fallow agricultural fields/meadows. Three streams flow through the property, all of which are unnamed tributaries to Mill Creek. The two streams near the western boundary are intermittent streams and merge together within the property. Historical aerial photography shows that much of the property was cleared for agriculture prior to 1937. The two forest areas along the eastern boundary and scattered hedgerows were the only trees present in 1937. Significant afforestation along the western boundary occurred after 1971.

Plant Communities

Four plant communities were identified at the Preserve. These were delineated based on cover type, dominant plants, and hydrologic conditions. Map 9: *Emerson - Plant Communities and Stewardship Features* shows the location of the plant communities as well as notable stewardship features and issues. A plant list that includes all species identified during the site visit is included after the plant community descriptions.

Agricultural Fields/Meadows (+/- 74.4 acres)

The agricultural fields/meadows are currently transitioning out of agriculture. The fields are dominated by cool-season grasses. Native plants present include jumpseed and thoroughwort. At the time of the site visit, there were few invasive plants. The low presence of invasive plants and the regeneration of native plants makes this a strong candidate for conversion to a native meadow. Based on the layout of the new development, there will be newly created fragmented areas from this community. These fragmented areas should be converted to forest or native terrestrial meadows. Converting these areas to forest will improve the riparian buffer along the eastern stream and will increase habitat value. Converting these areas to meadow will also improve the riparian buffer, though to a lesser extent than the forests. Meadows can also provide habitat for pollinators and increase habitat diversity.

Native plants are starting to re-establish in the agricultural fields

Ash-Mixed Hardwood Forest (+/- 11.5 acres)

The ash-mixed hardwood forest is located in an area previously used for agriculture. This forest area is degraded by invasive plants, which are particularly dominant in the shrub and vine layer. The ash trees are dying or already dead due to emerald ash borer. There is little to no tree regeneration, which further compromises the future of this forest. The tree canopy becomes denser and healthier near the baseball field. However, there is still no tree regeneration in this area. In order to maintain this area as a forest, the invasive plants will need to be controlled and tree planting may be needed to restore the canopy. Additionally, the low regeneration is indicative of heavy browsing pressure from deer. This should also be addressed to improve the health of this community.

The hedgerows contain mature native trees

Hedgerows (+/- 5.5 acres)

Hedgerows are present across the agricultural field/meadow. The canopy trees are predominantly native species. However, the shrub and vine layer is heavily colonized by invasive plants. There is a wet area that potentially includes a spring within the hedgerows (see Map 9: *Emerson - Plant Communities and Stewardship Features)*. This area contains wetland indicator plants including silver maple and willow. The hedgerows can be left in place, but the invasive plants should be controlled.

Red Oak-Mixed Hardwood Forest (+/-5.4 acres)

There are two areas of red oak-mixed hardwood forest along the eastern border. These areas are mature forest and are the highest quality ecological areas within the Preserve. However, the fact that these are small, isolated patches limits their value for wildlife habitat. The canopy trees are predominantly native species. Like the previous communities, this area also has a heavy concentration of invasive plants in the shrub and vine layer. Oak seedlings were noted during the site visit, but regeneration of native plants is still low. As noted previously, this is indicative of a high deer population and competition from invasive plants. These areas should be protected from development due to the mature native trees.

Plant Communities

Agricultural Fields/Meadows

Herbaceous	
garlic-mustard	***Alliaria petiolata***
aster	*Asteraceae* sp.
thoroughwort	*Eupatorium* sp.
jumpseed	*Persicaria virginiana*
foxtail	*Setaria* sp.
purpletop	*Tridens flavus*

Ash-Mixed Hardwood Forest

Canopy Trees	
Norway maple	***Acer platanoides***
red maple	*Acer rubrum*
ash (dead)	*Fraxinus* sp.
Understory Trees	
black walnut	*Juglans nigra*
Eastern red-cedar	*Juniperus virginiana*
pin oak	*Quercus palustris*
sassafras	*Sassafras albidum*
elm	*Ulmus* sp.
Shrub and Vine	
porcelain-berry	***Ampelopsis brevipedunculata***
oriental bittersweet	***Celastrus orbiculatus***
autumn-olive	***Elaeagnus umbellata***
privet	***Ligustrum* sp.**
spicebush	*Lindera benzoin*
Japanese honeysuckle	***Lonicera japonica***
amur honeysuckle	***Lonicera maackii***
multiflora rose	***Rosa multiflora***
wineberry	***Rubus phoenicolasius***
brambles	*Rubus* sp.
blackhaw	*Viburnum prunifolium*
grape	*Vitis* sp.
Herbaceous	
white-snakeroot	*Ageratina altissima*
common mugwort	***Artemisia vulgaris***
boneset	*Eupatorium perfoliatum*
Japanese stiltgrass	***Microstegium vimineum***
tearthumb	*Persicaria sagittata*
jumpseed	*Persicaria virginiana*
black snakeroot	*Sanicula marilandica*
goldenrod	*Solidago* sp.

Hedgerow

Canopy Trees	
red maple	*Acer rubrum*
shagbark hickory	*Carya ovata*
ash (dead)	*Fraxinus* sp.
pin oak	*Quercus palustris*
Understory Trees	
Norway maple	***Acer platanoides***
Silver maple	*Acer saccharinum*
hickory	*Carya* sp.
Eastern red-cedar	*Juniperus virginiana*
crabtree	*Malus sp.*
Callery pear	***Pyrus calleryana***
willow	*Salix* sp.
elm	*Ulmus* sp.
Shrub and Vine	
autumn-olive	***Elaeagnus umbellata***
winged euonymus	***Euonymus alatus***
Japanese honeysuckle	***Lonicera japonica***
Virginia creeper	*Parthenocissus quinquefolia*
multiflora rose	***Rosa multiflora***
wineberry	***Rubus phoenicolasius***
Herbaceous	
thistle	*Cirsium* sp.
seedbox	*Ludwigia alternifolia*
Japanese stiltgrass	***Microstegium vimineum***
pokeweed	*Phytolacca americana*
goldenrod	*Solidago* sp.

Plant Communities

Red Oak-Mixed Hardwood Forest

Canopy Trees

Norway maple	***Acer platanoides***
red maple	*Acer rubrum*
pignut hickory	*Carya glabra*
shagbark hickory	*Carya ovata*
black walnut	*Juglans nigra*
white oak	*Quercus alba*
pin oak	*Quercus palustris*
red oak	*Quercus rubra*

Understory Trees

red maple	*Acer rubrum*
black walnut	*Juglans nigra*
crabapple	*Malus* sp.
bird cherry	*Prunus avium*
black cherry	*Prunus serotina*
Callery pear	***Pyrus calleryana***

Shrub and Vines

oriental bittersweet	***Celastrus orbiculatus***
privet	***Ligustrum* sp.**
spicebush	*Lindera benzoin*
Japanese honeysuckle	***Lonicera japonica***
shrub honeysuckle	***Lonicera* sp.**
multiflora rose	***Rosa multiflora***
wineberry	***Rubus phoenicolasius***
brambles	*Rubus* sp.
greenbriar	*Smilax rotundifolia*
poison-ivy	*Toxicodendron radicans*

Herbaceous

garlic-mustard	***Alliaria petiolata***
aster	*Asteracea* sp.
Japanese stiltgrass	***Microstegium vimineum***
jumpseed	*Persicaria virginiana*
pokeweed	*Phytolacca americana*
goldenrod	*Solidago* sp.

Recommendations

Through discussions with the Township, it was determined that the conservation priorities are passive recreation, maintaining the property's agricultural legacy, and sustainable native plant communities. Each of these three priorities can support and enhance the others. Agricultural fields and healthy native plant communities will provide scenic interest and beauty for passive recreation. Additionally, there are many health benefits to spending time in nature. Agricultural fields can benefit from the pollinators present in natural plant communities. The natural plant communities will also provide a buffer between the streams and agriculture, thereby protecting water quality. Connecting people to native plant communities through passive recreation can build public support for maintenance of these resources.

The greatest threats to the property are deer and invasive plants, which together can compromise the sustainability of the forests and edge out native plants from all plant communities. Invasive species can frequently outcompete our native species. Deer contribute to the problem by primarily eating native plants and avoiding browsing on invasive species. Once the deer decimate native plants, the invasive species can thrive with little competition. Controlling deer and invasive plants should be a high priority for management. The loss of ash trees by the emerald ash borer is another key issue as it has accelerated forest decline.

Climate change is another major threat to the sustainability of the natural systems. According to DCNR's Climate Change Mitigation and Adaptation Plan, this region of Pennsylvania is expected to experience rising temperatures, increased precipitation, and heavier storms. These changes are likely to effect plant hardiness and stormwater intensity. This can affect plant survival and regeneration, as well as what species are appropriate to plant when planning for the future. It also increases the importance of riparian buffers and natural vegetation to slow and infiltrate stormwater to reduce flooding and protect water quality.

The recommendations table on the following page reflects the identified conservation priorities and threats while also capturing a greater scope of stewardship issues and opportunities.

Japanese stiltgrass is one invasive plant that is prevalent at the property

Emerson Farm Preserve

Conservation Priorities:	Passive recreation
	Sustainable native plant communities
	Maintaining agricultural legacy
Top Strategies:	Control deer
	Control invasive plants
	Remove hazard trees

Priority	Stewardship Recommendations	Season	Who could implement?*	Whole Preserve	Agricultural Fields/Meadows	Ash-Mixed Hardwood Forest	Red Oak-Mixed Hardwood Forest	Hedgerows
Forest Communities								
1	Protect mature forests from disturbance	Year-round	Staff			■	■	■
2	Use forestry mower to clear invasive plants in the heavily invaded areas of the ash-mixed hardwood forest where there is little to no canopy trees	Spring or Fall	Staff or Contractor			■		
2	Replant areas cleared of invasive plants; protect seedlings from deer and use a diversity of plants predicted to be resilient to climate change	Spring or Fall	Staff or Volunteers			■	■	■
3	Increase understory diversity by planting shrubs; protect seedlings from deer	Spring or Fall	Staff or Volunteers			■	■	
Agricultural Fields/Meadows								
1	Manage agricultural areas to avoid erosion and minimize chemical use	Year-round	Staff and Farmer		■			
2	Convert newly fragmented areas to forest or native meadow	Spring or Fall	Staff, Contractor, or Volunteers		■			
2	Mow meadows once annually	Nov-March	Staff		■			
2	Add 2nd mowing of 1/2-1/3 of meadow in the summer if needed to control invasive plants	July	Staff		■			
Hedgerows								
2	Retain hedgerows as divide between meadow area, agricultural fields, and housing	Year-round	Staff					■
Deer Management								
1	Implement a deer management program utilizing a hunting program and/or a deer cull with professional sharpshooters	Dependent on approach chosen	Staff	■				
2	Protect new plantings and natural regeneration as needed	Year-round	Staff	■				
2	Monitor property for deer impact by assessing impact on plants (browsing evidence and level of regeneration)	Spring/Summer	Staff or Volunteers	■				

Priority	Stewardship Recommendations	Season	Who could implement?*	Whole Preserve	Agricultural Fields/Meadows	Ash-Mixed Hardwood Forest	Red Oak-Mixed Hardwood Forest	Hedgerows
Invasive Plants								
1	Monitor for and prevent colonization of new species	Year-round	Staff	■				
1	Control invasive plants and prevent their spread. Community prioritization: 1. Red Oak-Mixed Hardwood Forest 2. Ash-Mixed Hardwood Forest 3. Hedgerows 4. Agricultural Fields/Meadows	Based upon the vegetation communities habitat value priority ranking, begin focused invasive removal using techniques described below.	Staff	■				
1	Mow meadows twice annually if invasive plants are dominant - the full meadow once in Nov-March and 1/3-1/2 of the meadow once in July. Recommendations related to meadows below are for more targeted treatments and can be used in tandem with a second mowing if needed.	Nov-March and July	Staff		■			
1	Control **Norway maple** through mechanical girdling, manual removal, or a cut stump treatment. A basal bark application can be used for trees with 6" dbh or smaller.	Fall	Staff or Contractor			■	■	■
1	Control **Callery pear** through mechanical girdling, manual removal, or a cut stump treatment. A basal bark application can be used for trees with 6" dbh or smaller.	Fall	Staff or Contractor				■	■
1	Control **Japanese honeysuckle** by cutting vines at ground level and at 5 feet above the ground, treat the stumps with herbicide	Anytime - cut vines at ground level and at 5 feet above the ground; Fall - cut and herbicide stumps	Staff, Contractor, or Volunteers			■	■	■
1	Control **oriental bittersweet** by cutting vines at ground level and at 5 feet above the ground, treat the stumps with herbicide	Anytime - cut vines at ground level and at 5 feet above the ground; Fall - cut and herbicide stumps	Staff, Contractor, or Volunteers			■	■	
1	Control **porcelain-berry** by cutting vines at ground level and at 5 feet above the ground, treat the stumps with herbicide	Anytime - cut vines at ground level and at 5 feet above the ground; Fall - cut and herbicide stumps	Staff, Contractor, or Volunteers			■		
1	Control **winged euonymus** through a basal bark application or cut stump treatment	Fall	Staff or Contractor					■
1	Control **garlic-mustard** by hand pulling in the early spring before flowering or with an herbicide treatment for larger populations	Early Spring and summer	Staff, Contractor, or Volunteers		■		■	

Priority	Stewardship Recommendations	Season	Who could implement?*	Whole Preserve	Agricultural Fields/Meadows	Ash-Mixed Hardwood Forest	Red Oak-Mixed Hardwood Forest	Hedgerows
Invasive Plants								
2	Control **autumn-olive** through a basal bark application or cut stump treatment	Fall	Staff or Contractor			■		■
2	Control **shrub honeysuckle** through a basal bark application or cut stump treatment	Fall	Staff or Contractor			■	■	
2	Control **privet** through a basal bark application or cut stump treatment	Fall	Staff or Contractor			■	■	
2	Control **wineberry** through a basal bark application or cut stump treatment	Fall	Staff or Contractor			■	■	■
3	Control **mugwort** by applying herbicide	Spring	Staff or Contractor			■		
3	Control **Japanese stiltgrass** by applying herbicide	Late summer	Staff or Contractor			■	■	■
4	Control **multiflora rose** through a basal bark application or cut stump treatment. Alternatively, multiflora rose can be killed naturally by the rose rosette disease if present.	Fall	Staff or Volunteers			■	■	■
2	Revegetate as needed after invasive control	Spring or Fall	Staff or Volunteers	■				
3	Educate visitors through interpretive signs about ways to prevent the spread of invasive plants.	Anytime	Staff	■				
Exotic Pests								
1	Monitor for emerald ash borer	Year-round	Staff			■	■	
1	Identify and remove potentially hazardous ash trees	Year-round	Staff			■	■	■
1	Follow quarantine requirements for emerald ash borer and spotted lanternfly	Year-round	Staff	■				
2	Replant as needed to replace ash trees	Spring or Fall	Staff or Volunteers			■		
3	Utilize circle traps for spotted lanternfly	May-July	Staff or Volunteers	■				
3	Scrape spotted laternfly egg masses	Fall - Winter	Staff or Volunteers	■				
Water Quality								
1	Expand extent of riparian buffer to 100ft on each side the stream	Spring-Fall	Staff		■	■	■	
1	Restore existing riparian buffer by controlling deer and invasives and adding plantings where needed	Year-round	Staff		■	■	■	

Priority	Stewardship Recommendations	Season	Who could implement?*	Whole Preserve	Agricultural Fields/Meadows	Ash-Mixed Hardwood Forest	Red Oak-Mixed Hardwood Forest	Hedgerows
Wildlife Enhancement								
2	Leave dead wood and snags for wildlife habitat	Year-round	Staff or Volunteers			■	■	
2	Leave brush piles for wildlife	Year-round	Staff or Volunteers			■	■	
3	Install bird (kestrel, bluebird) and bat boxes	Year-round	Volunteers	■				
Hazards and Debris								
1	Monitor for and remove hazard trees	Annually and after severe storms	Staff	■				
3	Remove trash piles	Anytime	Staff or Volunteers			■		
Boundary Encroachment and Illegal Use								
1	Mark open space boundaries with vinyl markers and maintain as needed	Anytime	Staff	■				
1	Monitor property regularly for encroachment	Year-round	Staff	■				
2	Recruit trail ambassadors and park monitors	Anytime	Staff	■				
Climate Change								
1	Increase plant biodiversity, choosing non-invasive species predicted to be resilient to climate change	Spring or Fall	Staff or Volunteers	■				
3	Monitor changes in precipitation and temperature, noting effects on plant or wildlife health	Year-round	Staff or Volunteers	■				
Volunteers								
2	Recruit regular volunteers to help with park management	Anytime	Staff	■				

*Volunteers should not apply herbicide unless they have proper certification and personal protective equipment

Mill Creek Preserve

Warrington Township recognized the importance of protecting water quality in the Mill Creek and saw the potential to create a public nature preserve in a highly visible site, in walking distance to surrounding neighborhoods. So, in 2018, the Township acquired the property from the Eureka Stone Quarry and subsequently placed a conservation easement on it, protecting it from development forever. The Township used a grant from the Land and Water Conservation Fund to complete the purchase. That grant requires the site to be restored to a more natural state, eliminating agriculture form the property. Warrington has also continued to develop their township wide trail system, which will connect even more residents to Mill Creek Preserve. Now, Warrington seeks to complete the transformation of the site from agriculture to a nature preserve through master planning.

The master plan envisions a site which can serve the environment, connect people to nature, and provide ecosystem services. New meadow and tree plantings will protect the Mill Creek, improve water quality, increase groundwater recharge, and reduce soil erosion and sedimentation, while providing food and habitat for native birds, insects, mammals, amphibians and even fish. Trails, a small parking lot and picnic area, will bring people into the site, encourage them to explore the meadows, forests and streambanks and connect them to nature. A restored site will also help to soak up stormwater and infiltrate it into the ground, before it flows into the Mill Creek, potentially reducing downstream flooding. More trees and native plants will help to clean the air and provide fresh oxygen, for residents and animals alike. Through this master plan, Mill Creek Preserve can improve quality of life for residents throughout the township. *(This master plan narrative describes natural features generally. For more information about plant communities and species, please see the Resource Management Plan, prepared by Natural Lands in 2019.)*

Existing Features & Site Analysis

Mill Creek Preserve is aptly named, as the main stem of the Mill Creek, which flows through

the center of the site, has shaped the landscape of the preserve and beyond. The creek, its associated tributaries, wetlands, and hydric soils have driven the historic use of the site as well. Dry areas, upland, have been farmed, while the wetter lowlands and some wet forest, have remained wooded. The creek has similarly affected the conservation easement. The wettest areas, along and surrounding the creek and its tributaries, are within the highest protection areas (HPA), while the drier, upland areas are in the standard protection area (SPA). In its new life as a nature preserve, the Mill Creek will remain as the focal point, continuing to drive decisions around land management and use.

Hydrology

The Mill Creek flows from west to east through the middle of the property. Two small tributaries drain the residential subdivision to the northwest, and flow through the wet woodlands into the main stem. Another tributary runs from Pickertown Road, through existing woodlands and into the Mill Creek. The existing meadows and fallow fields, formerly in agriculture, send sheet flow into the creek. The tributaries are all fairly well buffered, but some additional tree plantings would strengthen the riparian buffers and better protect them.

Mill Creek

A band of wetlands, floodplains and hydric soils follow the main stem of the Mill Creek. These features keep the ground fairly wet, which is likely why the woodlands have been allowed to regrow over the past 50 years. The areas along the creek were farmed at least as recently as 1971 but have likely been found to be too wet for cost-effective agriculture. These hydrologic features should continue to remain protected with wooded buffers.

Agriculture

As the site was purchased with Land and Water Conservation Fund dollars, agriculture was required to cease by 2022. The fields between Lower State Road and the creek, and those in the northern portion of the site, have been farmed at least since the 1930's. The northwestern field has recently been allowed to go fallow, returning to a naturalized meadow. The other three fields have ceased agricultural production and will be allowed to grow fallow until they can be seeded or planted with native meadow or tree species. By eliminating agriculture, the Township also eliminates the harmful effects of tilling and erosion, which typically allows topsoil to degrade and wash into the local waterways. Replanting these sites will help to stabilize the soil, refresh, and rebuild the topsoil and the communities that live within it.

Hedgerows

The open fields are defined by hedgerows, which surround them and separate them. Hedgerows have some benefits and some issues. They provide places for raptors to roost and hunt. They can provide wildlife corridors, places where small mammals can move under cover. They also add definition to a space, breaking up a large field into smaller, more comfortable, and more manageable spaces. However, hedgerows also tend to harbor invasive plant species, such as multi-flora rose. For this reason, hedgerows which run through the site will be absorbed by reforestation around them. Those that exist along site boundaries will remain.

Forests

According to Natural Lands' Resource Management Plan, prepared in 2019, the site is home to three different forest communities. These include an Eastern Red-Cedar Woodland/Shrubland, Green Ash – Mixed Hardwood Floodplain Forest and a Mixed Hardwood Forest. The mixed hardwood forest exists along the forest edges and hedgerows. The red-cedar forest/shrubland exists in a triangular space behind the fire house. These communities will likely persist through the master plan process.

The Green Ash mixed hardwood forest may require more attention over time. Ash trees have been decimated by the Emerald Ash Borer, an Asian beetle which kills ash trees. The remaining ash trees will likely die over the next few years. As the trees die, more sunlight will be able to reach the forest floor, activating the seed bank and allowing new seedlings to sprout. In these areas, it will be very important to follow the recommendations in the resource management plan – specifically invasive species and deer management- to ensure that a healthy, diverse, and native understory regenerates.

Pennsylvania Natural Diversity Index (PNDI)

The most recent PNDI project receipt reports a potential impact, with further PA Game Commission Review required. The report identifies the Great Blue Heron (Ardea Herodias) as a species of special concern. Great Blue Herons have been observed at their rookery nearby, high in the trees on a neighboring site. These same herons may use Mill Creek Preserve for feeding, wading in the calm waters of the wetlands and wet meadow, or picking fish from Mill Creek. The master plan proposes only minor improvements and amenities, with a focus on reforestation, meadow installation and establishment of riparian buffers. These improvements should only affect herons positively, by improving water quality and creating and protecting their habitat.

Surrounding Uses

Mill Creek Preserve is an island of open space surrounded by typical suburban development. High Gate Estates (Red Coat Farm) subdivision borders

Existing Woodland Conditions

the preserve to the north, with backyards abutting the preserve boundary. the Reserve at Maple Knoll, another residential subdivision, sits across Lower State Road. The Eureka Stone Quarry still owns a site on the corner of Lower State and Pickertown Roads, an outparcel of the preserve. To the west of the preserve, the Township owns a property which holds the fire house and public works building. A private landscaping company owns property directly to the east, accessed by the driveway through the site. A few single-family residences also exist to the east.

All of the uses which surround the site have the potential to impact the preserve. Residents often tend to encroach on natural areas. The trucks coming from and going to the landscaping business are big, loud and disruptive to the peace and quiet. Even Lower State Road, and the traffic it carries can affect the ambience. The quarry also sheds dust and can be noisy at intervals when they are blasting. However, none of the surrounding uses are impacting the site severely enough to warrant major interventions. Some additional plantings and fencing can address encroachment and provide screening.

The residential subdivisions provide opportunities to connect people to nature close to home. The Reserve at Maple Knoll is connected to the preserve by a traffic light and crosswalk across Lower State Road. Residents will be able to easily access the preserve on foot. The residents of High Gate Estates are close, but don't currently have a way into the preserve. The lots that abut the preserve are private and there are no obvious places to create a pathway into the preserve. The only location that offers the possibility of a connection is very wet and involves at least 5 private properties. To create an access point, multiple landowners would need to grant an easement. Then, a boardwalk or similar raised structure would need to be designed, permitted, and implemented. This requires further study.

Bird Box at Field Edge

Circulation

Mill Creek Preserve is a major destination, connected to Warrington's township wide trail system. The trail system is being implemented, segment by segment, as funding and other opportunities allow. The trail system proposes paved, multi-use trails along the Pickertown and Lower State Roads frontages of Mill Creek Preserve. These trails will bring visitors to the preserve from the Reserve at Maple Knoll, the Reserve at Emerson Farms, Castle Hill and other subdivisions throughout the township.

Internally, the site is divided by the driveway which serves the landscaping company. The driveway doubles as a walking path, but visitors and vehicles need to yield to each other. A few social trails and wildlife trails exist through the woodlands. The existing fields feature remnant tractor paths around their edges which can become de facto walking trails. However, these existing trails and driveway are not connected well enough to provide a satisfactory trail system.

Views

Warrington Township is a suburban community with some rural character left. A number of local farms have been conserved with agricultural easements. Others have been acquired by the Township, with farming continuing through lease agreements. Mill Creek Preserve has been a part of that agricultural legacy, with corn growing along Lower State Road. Residents and visitors travelling along the road would look across the cornfields to the stream valley beyond them. While the site can no longer be farmed, the views from the road and the agricultural character can be maintained with careful plantings and the establishment of meadows.

Similarly, at the northern end of the site, some neighboring residents are used to looking out of their backyards onto cornfields. The corn is gone, but the preserve can maintain a similar look and feel with wildflower and grass meadows. Some of the meadow plants may look like weeds at first, but some education and information for the neighbors can go a long way towards appreciation of the meadows.

Woodlands at Mill Creek

Master Plan

Mill Creek Preserve has good bones and some structure which can support public access. Therefore, the master plan can focus on natural resources and just a few minor additional amenities. The changes recommended in the master plan are important, but the site may not look strikingly different to most visitors after implementation.

The existing driveway provides a readymade vehicular entrance and connection for parking. It crosses and existing bridge over the Mill Creek which pedestrians may also use. The township wide trail plan already proposes multi-use trails around the site. The fields used to grow corn and soy for so long are surrounded by remnant tractor paths which can easily become walking paths. All this existing infrastructure allows the plan to focus on planting trees and growing meadows.

Access and Parking

The driveway which connects the landscaping business to Lower State Road can be shared by preserve visitors driving into the site. There is currently no public parking on site. A small parking lot is proposed east of the driveway, tucked against the first hedgerow. This location will make the parking lot somewhat visible from the road for security reasons but will also allow it to blend into the landscape when it is empty. This lot should accommodate only a small number of vehicles, 10 to 12 at most, including universally accessible spaces which meet the requirements of the Americans with Disabilities Act (ADA). It should be landscaped with native species matching those which already exist and will be planted throughout the site. The lot should be paved for easy maintenance and accompanied by green stormwater infrastructure, such as a rain garden, to capture and infiltrate the resulting runoff.

The parking lot should also accommodate bicycles. As the preserve is connected to the township wide multi-use trail network, visitors should be encouraged to bike or walk to the preserve. Bike racks should be provided around the parking lot. One parking space could even be used to serve bicycles, demonstrating that bikes are as important as cars.

Picnic Area & Benches

A grouping of picnic tables and benches should be

established near the parking area. The picnic area should be connected to the accessible parking spaces with an accessible route, which meets the requirements of the ADA. This location is ideal for a picnic area, as visitors may have coolers or other items to unload from their cars. It also needs to be close enough to connect the accessible route. Its close proximity to the parking may also encourage some visitors to get out of their cars and into nature. Like the parking lot, the picnic area will be somewhat visible from the road but won't stand out when not in use.

The picnic area should accommodate four to six picnic tables. With many tables, the area can double as an outdoor classroom or group gathering area. It can also host medium sized groups, like scouts, who may wish to eat lunch before or after a hike in nature.

The area should be graded to a slope of approximately 2%, to encourage water to flow out of the area and into a nearby rain garden, while remaining relatively flat. The surface can primarily be mowed grass. However, the accessible route from the parking lot to universally accessible tables or benches will need to be of a surface which is considered firm and stable. Paving such as asphalt or concrete meets these requirements. However, for a more natural aesthetic, compacted stone and fines, stone chips such as decomposed granite stabilized with a binder, and engineered wood fiber also meet these requirements.

The picnic area should be landscaped with trees to provide shade over the tables. The surrounding meadow plants can be allowed to grow right up to the edge of the picnic area. Native shrubs could also be planted at the entrance and along the paths to beautify the area and make it better fit into its surroundings.

Benches should also be placed throughout the preserve, along the trails. They can be placed at intervals to serve visitors who need to sit and take a break. They can also be placed at specific location to encourage visitors to stop and enjoy a scenic view or other point of interest. Wherever possible, benches should be installed to meet the requirements of the ADA.

Trail System

Most visitors will come to the preserve to walk the trails for exercise, to connect to nature or simply to get outside. The trail system should provide enough variety, beauty, and interest to make a walk through the preserve fun, relaxing and engaging. The stream, the variety of woodland communities and the proposed meadows offer plenty to see and experience. The trail system just needs to be developed enough to bring people to these beautiful and interesting places.

The existing driveway can act as an organizing feature. Since the driveway brings visitors to the only existing bridge over the creek, it makes sense to incorporate it as a major trail, or trail corridor. Pedestrians may share the road or walking paths can be establishes alongside it.

Trails can be implemented in phases, slowly building out the trail system over time, as funding and opportunities allow. First, the trails which already exist as driveways, tractor paths and wildlife trails can be formalized through seeding and mowing, clearing or by adding signage and blazing. Second, new trails can be added where they travel through meadows and woodlands. Finally, those trails which lead to or cross bridges or boardwalks, should be implemented last, when the crossings are funded and can be implemented.

Existing Access Road

Trail Information and Wayfinding

Visitors will need some information about the trail system in order to feel safe and comfortable. When they get out of their cars, or walk into the preserve, they should be greeted by a kiosk featuring a map and other information. The Preserve is not so large that visitors will get lost for dangerous periods of time. However, trails should be named, blazed and signed for reference. In case of an emergency, a visitor should be able to identify where in the preserve they are. Visitors should also be able to easily find the parking area and other preserve entrances. Naming and blazing or signing trails can help people find their way around more easily. Trail names, and difficulty ratings, can also help residents, especially groups of students, scouts or other children, plan their visit.

The Township will also implement and encourage visitors to use a smartphone-based application, called Beacon to mark and share their locations. In case of emergency, the app will help others find them in the preserve. Information about the app, including a QR code linked to a download page, could be posted in a kiosk or on a sign at the parking area.

Habitat Restoration

The most ecologically important areas, the stream corridor, floodplains, wetlands, and wet woodlands, have been allowed to regenerate their forests over the course of the past few decades. These areas should be stewarded in accordance with the recommendations in the Resource Management Plan. The land which remained in agriculture needs to be restored to native plant communities which can contribute to the local ecosystem.

Reforestation

The smallest field in the western corner of the site, should be reforested. This area is hard to reach and is cut off from the rest of the site by a tributary and very wet soil. Tractors, seeding attachments and heavy mowers are necessary for meadow seeding and establishment. It would be difficult to bring that kind of equipment across the wet area. Additionally, this field is relatively small, at just over 4 acres. Meadows this small don't have as great an ecological impact as larger meadows.

Fallen Ash Trees at Hedgerow

Reforestation of this field would also widen the riparian buffer protecting the small tributaries which flow south into the main stem of the Mill Creek.

Two other areas also should be reforested. Along the northwestern property line, it appears that neighboring homeowners have encroached into the preserve, mowing into the preserve to extend their own backyards. This area should be fenced to create a clear boundary and then reforested to expand the woodlands. The long and narrow 3-acre field south of the Mill Creek, previously in agriculture, should also be reforested. This area is likely wet and should be planted with wet tolerant tree species. Reforestation here will expand the riparian buffer and reduce erosion.

These areas should be planted with small trees, staked and tubed, 10 feet on center. The empty rows between the trees should be mowed a few times each year for the first three to five years, until the tree branches start touching each other and create a closed canopy. Regular mowing will help to keep unwanted woody and invasive species from establishing. It will also help to protect the roots of the trees from mice and voles, which like to nest in in or under tall grass and nibble on tree roots.

Meadows

The two 7-acre fields along Lower State Road and the 10-acre field in the northernmost corner of the preserve should be transformed to meadows. The fields along Lower State Road are underlaid by Reaville soil, which is somewhat poorly drained. Therefore, a seed mix which can tolerate wet soils will perform best here. These meadows will also preserve the agricultural character along this portion of Lower State Road. The parking and picnic area will also be surrounded by these meadows. For these reasons, it is important to maintain visibility across the meadows. The seed mixes should not include large quantities of species which typically grow above 4' in height. Trails will also be created through and around these meadows, to connect to the multi-use trails, parking and picnic areas and other trails through the preserve.

The larger rear meadow is underlain by Lawrenceville soil, which is described as moderately well drained. This meadow will not be as wet as some other areas. It can be seeded with a mix heavy on wildflowers, including a variety of colors, textures, and heights. This meadow will be hidden from view of visitors, until they come over the bridge and exit the forested area. The meadow will offer a sudden feeling of openness, sun and color.

The meadows and forests will provide food and habitat for a variety of birds, mammals, insects and even reptiles. The meadow habitats can be supplemented with bird boxes, chimneys and other types of bird houses. They can also be outfitted with amenities for birders, such as bird blinds, mounted scopes and informational signage to help identify common species.

Additional Landscaping

More trees and shrubs should be planted on site to beautify the preserve and carry out functional purposes, such as providing buffering or shade. All landscaping should utilize native tree and shrub species. The landscape design should also reflect the historic agricultural character of the area and the site.

More trees and shrubs should be planted along the northeastern boundaries, where the landscaping company and private properties abut the site. This buffering should help to screen the views into these neighboring properties. The boundary shared with the landscaping company may be more heavily screened with evergreen species, to hide the day-to-day operations there. Where residential properties abut, a softening buffer, made up of evergreen and deciduous flowering trees and shrubs would provide some privacy without creating an impenetrable wall of landscaping. This should allow the residents to maintain some views into the preserve if they desire.

Shade trees should be planted along the multi-use trails, along the road frontages and along the existing driveway. These trees will shade the roads, driveways and trails, making them more comfortable for users. They can also provide some traffic calming along the roads and driveway. They would also begin to reestablish some of the farmstead look that characterized so many farms of the past in this region. Oaks and elms would frequently line the driveways leading to the farmhouse.

Trees should also be provided at locations throughout the preserve where visitors may need shade. Trail users who need to rest at a bench would also benefit from shade. The picnic area should also be shaded, for comfort and to extend the lifespan of the tables and benches. The meadows could also feature a "resting tree" or two along their edges, near the trails, or in any wet areas or sinkholes.

Conclusion

Mill Creek Preserve has already proven to be a great addition to Warrington Township's open space network. The high visibility site maintains the Township's agricultural character, as cornfields turn to meadows. The existing woodlands provide habitat for native animals of all kinds. The trees and shrubs buffer the Mill Creek, stabilize the soil, filter runoff, and help stormwater infiltrate into the ground, recharging the aquifer. Visitors already walk some of the trails and explore the fields and forests. Through master planning, Mill Creek Preserve can become an even more beautiful, accessible, and environmentally sustainable piece of Warrington's open space and trail network.

Stewardship Plan

In 2019, in advance of the Township's acquisition of the Mill Creek property, Natural Lands prepared an in-depth Resource Management Plan. The plan inventoried the existing geology, soils, hydrology, and plant communities at the site and recommended strategies for conservation and stewardship.

The plan identified two main conservation priorities: 1.) the protection of natural resources, particularly the water resources, and 2.) safe enjoyment of passive recreation and education studies. It further recommended that those goals be met through the management of existing forests and water resources, invasive species, deer and other pests, and the effects of climate change.

The Township has the *Mill Creek Preserve Resource Management Plan* on file and should refer to it for detailed stewardship recommendations.

Dead ash tree in a wooded area

Streambank erosion along Mill Creek

Existing multi-use trail

The Weisel Preserve

The Weisel Preserve is an important and well used open space. This historic farm has contributed to Warrington's agricultural character and economy for centuries. The open space can continue to produce corn, soy or other crops and still accommodate passive recreation. The site is made up of five parcels, containing nearly 94 acres. The Bradford Dam Connector Trail already crosses the site and sees heavy traffic as it connects to the Rt 202 Circuit Trail nearby. Many residentials neighborhoods also exist within walking distance to the site. The multi-use trail offers a place to walk, run or bicycle, but the site has the potential to offer residents even more.

Existing Features & Site Analysis

The site has been in agriculture for centuries and largely remains the same. Some neighborhoods have sprung up around the farm and some individual lots have been carved out from it. The trail crosses the site, some trees have been planted, a pond installed, and one field has been allowed to go fallow. A wastewater treatment plant and a materials recycling center have been established at the southern end. But the Weisel Preserve is still very much a farm. The site can continue to produce corn, soy and hay, while also inviting the public in for recreation and to connect with nature.

Neighboring Uses

The site is almost completely surrounded by residential properties. Some outparcels exist, having been cut out from the site in the past, including one that is completely surrounded by the open space. These neighboring properties need buffering for screening, privacy and reduce trespassing,which is already occurring. The irregular shape of this property results in many other neighboring uses. On the northeast side of the property, there is another private residence, a landscaping company and nursery, a farm and associated residence, and a dense residential development along Kings Court. The eastern side of the property contains commercial development and public uses along Pickertown Road, including the post office and a day care center. There is residential development on the eastern side of

Pickertown Road. Along Mill Creek Road is the Eureka Stone Quarry. There are fewer neighbors on the western side of the property. There are agricultural properties and a private residence that back up to the western side. The northwestern side of the property contains residential development on the opposite side of Stump Road. There is a small parking area for the route 202 trail across stump road as well.

Sewage Treatment & Recycling Center

A sewage treatment plant and Township operated yard waste recycling center are located on the South east side of the site. The recycling center is used by residents of the Township and public access needs to be maintained. While the two sites are necessary, they do not need to be visible from the open space. Dense, evergreen plantings can be installed to block the views of these sites from the open space.

Bridge connection to multi-use trail

Route 202 Trail

The Route 202 multi-use trail and associated parking are across Stump Road, northwest of the site. The US 202 Parkway trail is part of the Circuit, the regional trail system, and is heavily used by pedestrians and cyclists. According to DVPRC, 1,361 bicycle trips and 1,425 pedestrian trips have taken place on the US 202 Parkway Trail from January 2022 to March 2022. July had the highest number of bicycle trips, with over 5,500 trips per month in July 2021. Pedestrian counts were highest in May, with over 2,091 pedestrian counts in May of 2021.

Many of these trail users enter or exit the Rt 202 Trail through the Weisel Preserve. The trail is an important feature and should be maintained and improved to provide the best experience for trail users. This may include shade, clear sight lines, striping, signage and other trail amenities.

Agricultural and Fallow Fields

The Weisel Preserve has been divided into three distinct areas, separated by hedgerows. Two of these areas are in the northern half of the site, on either side of the central outparcel. Both of these fields have remained in agriculture. The trail traverses the eastern field. Sometimes visitors leave the trail and approach the private property in the center to see the horses. This behavior should be discouraged through fencing and plantings. The third area is in the southern section of the site. This field, clsoest to the residential subdivision, is no longer producing row crops. This field has grown hay at times and resembles a fallow field or young meadow. This field also contains a man-made pond and a small tributary or drainage channel which drains the field into the pond.

PNDI

The Pennsylvania Natural Diversity Inventory (PNDI) environmental review for the Weisel Preserve indicates that the site is potential habitat for the Great Blue Heron, which is a species of special concern. A heron rookery, a group of trees where they nest, has been observed close to the Weisel Preserve on the Eureka Quarry property. Considering the Weisel Preserve master plan aims to naturalize and conserve using a light touch, the proposed improvements shouldn't negatively affect herons. However, the Township should contact the Pennsylvania Gaming Commission prior to making major improvements.

Pollinator garden

A local eagle scout recently installed a pollinator garden off the Pickertown Road trail near the access point off King's Court. The garden features native meadow species, including milkweed, which should attract butterflies, moths, bees and other insects. After a few seasons of growth, the garden could be maintained as a small meadow, simply

mowed seasonally with spot treatment of invasive species. Once it matures, the garden will offer a beautiful view for trail users.

Streams and Tributaries

Mill Creek, an important tributary to the Neshaminy Creek, and a trout stocking stream, flows along the southeast border of the Weisel Preserve. An intermittent tributary runs along the southwest side. The intermittent stream flows past the pond. The pond drains into the tributary. Most of Mill Creek and its tributary is well buffered in the Weisel Preserve. However, the woodlands around the streams require restoration before trails can be established to bring people to the streams.

Pond

The pond is located on the southwest side of the site at the bottom of the hay / fallow field. This pond is primarily fed by a a collection system under the fields which likely includes tiles and pipes. Additionally, a swale has formed where water sheet flows off the field and has created this channel as it makes its way to the pond.

Ponds and other water features are frequently polarizing. They can be used to provide recreation, like fishing, swimming and ice skating. However, in order to safely conduct these activities, ponds need to be maintained and monitored regularly. This can be expensive and time consuming. This pond is not a good candidate for recreational uses as it is small, has not been maintained and is isolated.

This pond is surrounded by a healthy riparian buffer. However, it is filling with sediment, which is washing off the surrounding fields. The pond is slowly filling with sediment, reducing its volume and depth. This will lead to warmer water which can hold less oxygen. The pond will slowly deteriorate. However, if left as it is, the pond will likely transform itself into a wetland. A wetland here would be less hazardous to visitors and could host a more natural ecosystem, supporting birds, mammals, amphibians and insects.

Hedgerows

The primary hedgerow at Weisel Preserve runs diagonally across the site from the pond to the Kings Court subdivision and blocks the view of the horse farm on the inholding, which is useful as trail users have approached the pasture to feed or take photos. The horse farm and horses are privately owned. It is dangerous for trail users to approach the animals. This hedgerow provides a useful visual barrier.

Forest

A few different forest communities exist on the site. A ribbon of Ash forest follows a tributary of the Mill Creek along the western side of the site. Another wooded area, a maturing mixed hardwood forest exists between Mill Creek and the yard waste recycling center. Southeast of the recycling center, a higher quality, mature hickory forest buffers the Mill Creek. A fourth forest community, comprised of mature oak, hickory and ash, exists in the south westernmost area of the site. All of woodlands contais invasive plants and are in need of some restoration before trails or other uses are proposed within the forests.

Views

The Pickertown Road trail provides excellent views of the Weisel Preserve. One of the most dramatic long views is from the trail to the frog pond in the hayfield. The hayfield is framed by hedgerows. The field slopes down towards the pond and pedestrians or cyclists on the trail cannot see it unless they walk in that direction.

As visitors head from the frog pond section of the site towards the Route202 Trail, they have a pleasant view of the horse pastures. As mentioned previously, the view of the horse pastures is problematic. This view will be addressed in the master plan section.

As visitors move through the site towards Stump Road, additional agricultural fields come into view. These fields have been in corn, so the height of the crops obscures the views when the corn is mature.

Views of the outside of the site looking in are limited. There are neighboring uses that back up to the preserve on three sides. Stump road provides a limited view into the site, between two private residences.

Mill Creek Tributary

Agricultural Field

Master Plan

The Weisel Preserve is functioning well as a public open space, providing a place for active recreation on the multi-use trail and allowing people to see some nature. But the space can be improved to be more comfortable and welcoming. More trails can be developed to bring people even closer to nature. Amenities such as benches, parking and signage can make the preserve more welcoming. The preserve can be more than just a trail, it can be a real place, not just open space that people ride or run through. The Weisel Preserve is already beautiful and can become even better.

Connections to Surrounding Neighborhoods

The Weisel Preserve provides a critical connection from surrounding neighborhoods to the Route 202 Trail. The residents of the Kings Court community have direct access to the open space and the trail. They can simply walk or bike to the Pickertown Road Trail. Residents that live in the Billingsley drive residential development can cross Stump Road at the crosswalk to access the Weisel Preserve and Mill Creek Preserve. The Weisel Preserve is already well connected to the surrounding neighborhoods and no new access points are necessary.

Parking

A small informal parking area exists on the northwest side of Stump Road, on a parcel owned by PennDOT. The parking area serves PennDOT maintenance vehicles and trail users. Some visitors to the Weisel Preserve may use the parking area as well. An additional small parking parking area is proposed near the yard waste recycling center drop off point, off Pickertown Road. These two parking areas provide vehicular access on both sides of the side. Shared parking with the nearby daycare center and post office on Mill Creek Road could also be explored.

Conserved Agriculture

Three fields on the property are currently in agriculture. Two contain corn and one contains hay. The Township's agricultural history is important to the residents and during interviews

and focus groups residents indicated that they would like to see certain properties continue to be farmed as long as there is a farmer who is willing to do so. Agricultural fields are particularly appropriate where they block the view of the horse pastures and the residential properties along Stump Road. Views of these private areas should be screened or buffered and corn may be an appropriate buffer in the summer until it is harvested in the fall. Therefore, the 10 acre and 22 acre fields at the northern end of the site are proposed to remain in agriculture. The 22 acre field could also host a loop trail around its edges, following existing tractor paths and edge mowing areas.

Proposed Meadow Conversion

The lower 25 acre agricultural field has been used for growing hay recently. It can remain in hay as long as a farmer is willing to grow and harvest it. If a farmer is no longer interested in that field, it could be converted into a wildflower and grass meadow. Tall grasses would resemble hay and continue to maintain agricultural character. A mowed grass trail is also proposed through the meadow to bring visitors closer to nature. A mowed path also provides an alternative to the hard surfaced multi-use trail. A meadow will also provide habitat for birds and other animals, which is important to Township residents.

Agricultural Equipment along Multi-Use Trail

A meadow in this field will also help to manage stormwater. Currently, water is flowing from the northern end of the field down into the pond. Water is either being collected and directed through pipes, or is gathering in a natural swale on the northern side of the field. A meadow featuring native grasses and wildflowers would help to slow down flowing stormwater and allow it to infiltrate into the ground. The plants deep root systems would also drink up some of the water. Water would also be filtered as it flows through the plants. Finally, the native plants strong roots would help to hold soil in place, reducing erosion and sedimentation of the pond below.

This area is underlain by Abbottstown and Readington soils. These vary from somewhat poorly to moderately drained. Therefore, any seed mix used to convert this area to meadow should feature many plants that are well adapted to seasonally wet soils.

Forest Health and Trails

All of the forested areas at the Weisel Preserve require restoration. Like most forests in our area, deer, invasive plant species and erosion have damaged the woodland ecosystems. The master plan also includes stewardship recommendations in a separate section which describe in detail how to improve the forested areas. Once the major issues have been addressed, trails can be established throughout some of these areas as well.

Amenities

Benches

Nine benches are proposed at the Weisel Preserve. A bench is proposed near the Mill Creek banks by the pedestrian bridge off Pickertown Road. This area provides a lovely view and could serve as a meeting place. The bench would be quite near the stream bank and could be subject to flooding. The bench could be just a large boulder or a log anchored into the ground. A real bench would need to be anchored deep into the ground with concrete footers to withstand flooding.

Five benches are proposed along the meadow trail. These benches will provide resting spaces and views across the meadow. The benches at the

far end of the meadow trail near the pond will establish the trail border and protect the pond's riparian buffer area. Benches are also proposed on either side of the pollinator garden. These benches frame out the pollinator garden and provide a site very near King's Court that residents can enjoy. An additional bench is proposed along the Pickertown Road trail across from the proposed loop trail through the agricultural field. Another bench is proposed along the agricultural field loop trail.

kiosk/info signs

Three kiosks are proposed along the Pickertown Road Trail. One informational sign is proposed across from the parking lot near the yard waste dump site. This sign will orient visitors as they enter the site from Pickertown Road. Another sign is proposed near the pollinator garden where pedestrian visitors may enter from Kings Ct. Another sign is proposed across from the Route 202 Trail parking lot and will primarily inform visitors coming off that trail. This sign is particularly important, because this entrance to the Pickertown Road trail on the northwest side is between two residential developments. The sign will help ensure visitors that they have arrived in the correct location and the trail is for public use.

Landscaping

The trail through the Weisel Preserve should be lined by trees. The trees will add shade to the trail which will be especially important in the summer, when the agricultural fields and meadows are hot and feature ver little shade. Trees along the trail will visually enhance the entry points. Lines of trees will also differentiate this trail from the Route 202 Trail, giving it a different character. Portions of the site will continue to be farmed and the trees will also distinguish the boundary of the agricultural fields from the trail areas.

Buffers

The recycling center and the water treatment plant detract from the visual beauty of the Weisel

Recycling Center

Pond

Preserve and should be screened with landscaping. A mixture of different native evergreen tree species should be used. These should be planted in staggered rows approximately 10' on center. This close spacing will allow the trees grow into each other over time and form a nearly impenetrable visual screen. A mix of species will also provide a variety of food sources for native insects and birds. Mixed species will also provide some different colors and textures.

The horse farm in the inholding would also benefit from additional plantings. The master plan proposes buffering along the property lines, but a planting scheme could also add vegetation closer to the trail to block views at their origin. Additional planting in the hedgerow would also strengthen the existing screen to the southeast.

A different type of buffer should be provided along the swale in the hay field. A riparian buffer is a group of plants intended to slow, filter and capture stormwater, hold soil in place and shade surface water. The water that flows through the swale would benefit from a riparian buffer, as it would be cooler and cleaner as it flows into the pond and eventually into the tributary to Mill Creek.

Conclusion

This master plan for the Weisel Preserve focuses on making the site a little more comfortable and welcoming to visitors. The Township has already done a good job installing the multi-use trail and visitors are seeing the preserve. With a few additional improvements, the Weisel Preserve can meet its full potential as a publicly accessible open space which reflects Warrington's agricultural history, while conserving nature and offering places for recreation.

Stewardship Plan

The Weisel Preserve features a range of vegetation covers including forests, a woodland/forest, terrestrial meadow, stormwater basin, and fallow agricultural fields. Water resources include a pond, hydric soils and two streams – Mill Creek flows along the southern boundary and an unnamed tributary to Mill Creek flows along the western boundary. The property was fully cleared for agriculture prior to 1937. Between 1937-1958, patchy forest areas regenerated along the western boundary and some hedgerows were planted. Additional forest regrowth did not occur until after 1971.

Plant Communities

Ten plant communities were identified at the Weisel Preserve. These were delineated based on cover type, dominant plants, and hydrologic conditions. Map 31: *Weisel Preserve - Plant Communities and Stewardship Features* shows the location of the plant communities as well as notable stewardship features and issues. A plant list that includes all species identified during the site visit is included after the community descriptions.

Agricultural Fields/Lawn (+/-55.2 acres)

The agricultural fields/lawn areas are the dominant plant community at the Weisel Preserve. These areas currently have little ecological value. Instead, their values lies in their connection to the property's agricultural past and the potential for recreational use. If the township desires, these areas, or a portion of them, can be converted to terrestrial meadows to add scenic diversity and enhance wildlife value, particularly for pollinators. Newly converted areas can also be demonstration areas to showcase how lawn can be converted to meadows.

Ash-Mixed Hardwood Forest (+/-10.4 acres)

The ash-mixed hardwood forest is located along the western boundary. This was the first area to be released from agriculture. Shagbark hickory and ash are the dominant tree species. However, the ash trees are dead or dying from emerald ash borer. There is moderate native diversity in the canopy and understory tree layers. Invasive shrubs and the invasive Japanese stiltgrass dominate the shrub and herbaceous layers. While this forest contains mature native trees, the sustainability of this forest is threatened by deer overbrowsing native plants, competition from invasive plants, and ash die off. The first two of these issues prevent the forest from regenerating. There are already canopy gaps and this will worsen as more of the ash trees die. Controlling deer and invasive plants are a high priority for this community and could help create a healthy, self-sustaining forest. Tree planting may be needed in gaps after invasive plant control to speed up forest regeneration and establish desired plants. However, the dead ash trees create a hazard for working in the area as the compromised ash trees are susceptible to limb and trunk breakage. This should be taken into account if any work is done in the area.

These fields reflect the agricultural history of the region

The ash trees are dying due to the emerald ash borer

Mixed Hardwood Woodland/Forest (+/-7.7 acres)

The mixed hardwood woodland/forest is located south of the leaf collection building. This area is a mix of shrubs and young trees to the east and a section more heavily populated by older, larger trees to the west. In the middle of this community there are seeps with pockets of wet meadow and wetland trees and shrubs including willow and silky dogwood around them. These wetlands are important for water quality and habitat diversity. The areas outside of the wetlands are heavily colonized by invasive plants in the shrub and herbaceous layers. Callery pear, a highly invasive plant often used for landscaping, is present in the eastern section of this community.

Controlling the deer population and invasive plants will protect and improve this community. This area can be allowed to fully transition to forest over time.

Hedgerows (+/-5.9 acres)

The hedgerows were planted between 1937-1958 and now contain mature native trees. These mature trees provide food for wildlife and can be a seed source for afforestation. The rest of the plants within this community are predominantly invasive. The hedgerows can be left in place to provide shade, food for wildlife, and a connection to the agricultural legacy. The invasive plants and deer should be controlled to encourage regeneration of native plants.

Red Oak-Mixed Hardwood Forest (+/-1.8 acres)

The red oak-mixed hardwood forest is located south of Mill Creek. This area contains primarily native plants with a moderate diversity of species. Invasive plants are present but not yet widespread. This area was cleared prior to 1937 and was only reforested after 1971.

Leaf Collection Area Berm (+/-1.0 acres)

There is a vegetated berm around half of the leaf collection building. The western area contains scattered trees while the northern portion contains predominantly herbaceous plants. There is a mix of native and invasive plant species. This area can be enhanced by controlling invasive plants and adding a diversity of native species to provide a denser buffer between the leaf collection area and the rest of the property. This could also provide habitat for wildlife or pollinators and enhance the scenic views from the paved path.

Terrestrial Meadow (+/-0.7 acres)

The terrestrial meadow is located in a small pocket within the red oak-mixed hardwood forest. It is predominantly composed of herbaceous plants, with woody plants encroaching from the edges. This area can be allowed to transition to forest over time. Invasive plants should be managed.

Pond Buffer (+/-0.6 acres)

The pond is buffered primarily by native species including silver maple, willow, silky dogwood, and brambles. If the township maintains the pond in its current condition, these plants help protect the pond from stormwater runoff and provide a buffer between the pond and the public. The buffer can be expanded to better serve these functions. Alternatively, the pond can be converted to a wetland.

Planting Area (+/-0.5 acres)

Scattered native trees were planted in this area between the mixed hardwood forest/woodland and adjacent hedgerow. A majority of the trees are ash, which are dying from the emerald ash borer. Additional trees should be planted to replace these trees. Shrubs can also be added to create an understory. This would better connect adjacent forest areas. Any invasive plants that try to colonize the area should be quickly controlled to avoid degradation of this community.

Stormwater Basin (+/-0.2 acres)

A stormwater basin is located between the leaf collection area and the mixed hardwood forest/woodland. There are some native plants, including flowering dogwood and eastern white pine. However, there are also many invasive plants. The invasive plants should be removed and native species appropriate for stormwater basins should be planted to restore this basin and ensure that it functions properly. Examples of suitable plants may include:

New England aster	*Aster novae-angliae*
Swamp milkweed	*Asclepias incarnata*
Blue flag iris	*Iris versicolor*
Swamp sunflower	*Helianthus angustifolius*
Joe pye-weed	*Eupatorium purpureum*
Silky dogwood	*Cornus amomum*
Sweet pepperbush	*Clethra alnifolia*
Winterberry holly	*Ilex verticillata*

Penn State Extension offers a more complete list of possible plants: https://extension.psu.edu/raingardens-the-plants

The stormwater basin is important to control water flow, but it can also provide habitat for insects, birds, and other wildlife.

Plant Communities

Ash-Mixed Hardwood Forest

Canopy Trees	
silver maple	*Acer saccharinum*
shagbark hickory	*Carya ovata*
ash (dying)	*Fraxinus* sp.
black walnut	*Juglans nigra*
white oak	*Quercus alba*
pin oak	*Quercus palustris*
Understory Trees	
red maple	*Acer rubrum*
shagbark hickory	*Carya ovata*
crabapple	*Malus* sp.
black cherry	*Prunus serotina*
Shrub and Vines	
oriental bittersweet	***Celastrus orbiculatus***
privet	***Ligustrum* sp.**
spicebush	*Lindera benzoin*
Japanese honeysuckle	***Lonicera japonica***
shrub honeysuckle	***Lonicera* sp.**
multiflora rose	***Rosa multiflora***
brambles	*Rubus* sp.
grape	*Vitis* sp.
Herbaceous	
jointhead grass	***Arthraxon hispidus***
Japanese stiltgrass	***Microstegium vimineum***
sensitive fern	*Onoclea sensibilis*
pokeweed	*Phytolacca americana*
goldenrod	*Solidago* sp.

Mixed Hardwood Woodland/Forest

Trees	
box-elder	*Acer negundo*
red maple	*Acer rubrum*
black walnut	*Juglans nigra*
Eastern red-cedar	*Juniperus virginiana*
ash	*Fraxinus* sp.
crabtree	*Malus* sp.
Eastern white pine	*Pinus strobus*
cherry tree	*Prunus* sp.
Callery pear	***Pyrus calleryana***
pin oak	*Quercus palustris*
black locust	*Robinia pseudoacacia*
willow	*Salix* sp.
elm	*Ulmus* sp.
Shrubs and Vines	
oriental bittersweet	***Celastrus orbiculatus***
silky dogwood	*Cornus amomum*
autumn-olive	***Elaeagnus umbellata***
privet	***Ligustrum* sp.**
spicebush	*Lindera benzoin*
Japanese honeysuckle	***Lonicera japonica***
multiflora rose	***Rosa multiflora***
brambles	*Rubus* sp.
Herbaceous	
Indian-hemp	*Apocynum cannabinum*
jointhead grass	***Arthraxon hispidus***
aster	*Asteracea* sp.
field mustard	*Brassica* sp.
bittercress	*Cardamine bulbosa*
spring-beauty	*Claytonia virginica*
boneset	*Eupatorium perfoliatum*
jewelweed	*Impatiens capensis*
Japanese stiltgrass	***Microstegium vimineum***
sensitive fern	*Onoclea sensibilis*
lesser celandine	***Ranunculus ficaria***
little bluestem	*Schizachyrium scoparium*
goldenrod	*Solidago* sp.
poison-ivy	*Toxicodendron radicans*
stinging nettle	*Urtica dioica*
violets	*Viola* spp.

Plant Communities

Hedgerow

Canopy Trees	
pignut hickory	*Carya glabra*
ash	*Fraxinus* sp.
black walnut	*Juglans nigra*
white oak	*Quercus alba*
pin oak	*Quercus palustris*
red oak	*Quercus rubra*
Understory Trees	
Eastern red-cedar	*Juniperus virginiana*
mulberry	*Morus* sp.
bird cherry	*Prunus avium*
Callery pear	***Pyrus calleryana***
Shrub and Vines	
oriental bittersweet	***Celastrus orbiculatus***
privet	***Ligustrum* sp.**
multiflora rose	***Rosa multiflora***
wineberry	***Rubus phoenicolasius***
grape	*Vitis* sp.
Herbaceous	
white-snakeroot	*Ageratina altissima*
jointhead grass	***Arthraxon hispidus***
aster	*Asteracea* sp.
field mustard	*Brassica* sp.
Japanese stiltgrass	***Microstegium vimineum***
lesser celandine	***Ranunculus ficaria***
pokeweed	*Phytolacca americana*
foxtail	*Setaria* sp.
goldenrod	*Solidago* sp.
poison-ivy	*Toxicodendron radicans*

Red Oak-Mixed Hardwood Forest

Canopy Trees	
Norway maple	***Acer platanoides***
silver maple	*Acer saccharinum*
ash	*Fraxinus* sp.
black walnut	*Juglans nigra*
Eastern white pine	*Pinus strobus*
pin oak	*Quercus palustris*
red oak	*Quercus rubra*
willow	*Salix* sp.
Understory Trees	
box-elder	*Acer negundo*
Callery pear	***Pyrus calleryana***
flowering dogwood	*Cornus florida*
black walnut	*Juglans nigra*
bird cherry	*Prunus avium*
white oak	*Quercus alba*
Shrub and Vines	
barberry	***Berberis thunbergii***
oriental bittersweet	***Celastrus orbiculatus***
silky dogwood	*Cornus amomum*
spicebush	*Lindera benzoin*
Japanese honeysuckle	***Lonicera japonica***
multiflora rose	***Rosa multiflora***
brambles	*Rubus* sp.
poison-ivy	*Toxicodendron radicans*
Herbaceous	
white-snakeroot	*Ageratina altissima*
garlic-mustard	***Alliaria petiolata***
aster	*Asteracea* sp.
spring-beauty	*Claytonia virginica*
yellow trout-lily	*Erythronium americanum*
Japanese stiltgrass	***Microstegium vimineum***
lesser celandine	***Ranunculus ficaria***
goldenrod	*Solidago* sp.
violets	*Viola* spp.

Plant Communities

Leaf Collection Building Berm

Trees	
black walnut	*Juglans nigra*
Eastern red-cedar	*Juniperus virginiana*
crabapple	*Malus* sp.
Callery pear	***Pyrus calleryana***
Shrub and Vines	
oriental bittersweet	***Celastrus orbiculatus***
multiflora rose	***Rosa multiflora***
brambles	*Rubus* sp.
Herbaceous	
Indian-hemp	*Apocynum cannabinum*
common mugwort	***Artemisia vulgaris***
Japanese stiltgrass	***Microstegium vimineum***
pokeweed	*Phytolacca americana*
foxtail	*Setaria* sp.
goldenrod	*Solidago* sp.

Terrestrial Meadow

Woody Plants	
autumn-olive	***Elaeagnus umbellata***
multiflora rose	***Rosa multiflora***
brambles	*Rubus* sp.
Herbaceous	
garlic-mustard	***Alliaria petiolata***
Indian-hemp	*Apocynum cannabinum*
common milkweed	*Asclepias syriaca*
spring-beauty	*Claytonia virginica*
rushes	*Juncus* sp.
Japanese stiltgrass	***Microstegium vimineum***
lesser celandine	***Runnunculus ficaria***
goldenrod	*Solidago* sp.

Pond Buffer

Canopy Trees	
silver maple	*Acer saccharinum*
white ash	*Fraxinus americana*
crabapple	*Malus* sp.
willow	*Salix* sp.
Shrubs	
silky dogwood	*Cornus amomum*
shrub honeysuckle	***Lonicera* sp.**
Virginia creeper	*Parthenocissus quinquefolia*
multiflora rose	***Rosa multiflora***
brambles	*Rubus* sp.
Herbaceous	
jointhead grass	***Arthraxon hispidus***
field mustard	*Brassica* sp.
rushes	*Juncus* sp.
Japanese stiltgrass	***Microstegium vimineum***
sensitive fern	*Onoclea sensibilis*
lesser celandine	***Runnunculus ficaria***
goldenrod	*Solidago* sp.

Planting Area

Trees	
ash	*Fraxinus* sp.
crab apple	*Malus* sp.
pin oak	*Quercus palustris*

Stormwater Basin

Trees	
flowering dogwood	*Cornus florida*
Eastern white pine	*Pinus strobus*
Shrub and Vines	
oriental bittersweet	***Celastrus orbiculatus***
autumn-olive	***Elaeagnus umbellata***
Japanese honeysuckle	***Lonicera japonica***
multiflora rose	***Rosa multiflora***
brambles	*Rubus* sp.
Herbaceous	
Indian-hemp	*Apocynum cannabinum*
jointhead grass	***Arthraxon hispidus***
pokeweed	*Phytolacca americana*
goldenrod	*Solidago* sp.
common cat-tail	*Typha latifolia*

Recommendations

Through discussions with the township, it was determined that the conservation priorities are passive recreation, maintaining the property's agricultural legacy, and sustainable native plant communities. Each of these three priorities can support and enhance the others. Agricultural fields and healthy native plant communities will provide scenic interest and beauty for passive recreation. Additionally, there are many health benefits to spending time in nature. Agricultural fields can benefit from the pollinators present in natural plant communities. The natural plant communities will also provide a buffer between the streams and agriculture, thereby protecting water quality. Connecting people to native plant communities through passive recreation can build public support for maintenance of these resources.

The greatest threats to the preserve are deer and invasive plants, which together, can compromise the sustainability of the forests and edge out native plants from all the communities. Invasive species can frequently outcompete our native species. Deer contribute to the problem by primarily eating native plants. Once the deer decimate native plants, the invasive species can thrive with little competition. Controlling deer and invasive plants should be a high priority at the preserve. The loss of ash trees by the emerald ash borer is another key issue as it has accelerated forest decline. Loss of canopy trees combined with no regeneration can result in complete forest loss over time.

Climate change is another major threat to the sustainability of the natural systems. According to DCNR's Climate Change Mitigation and Adaptation Plan, this region of Pennsylvania is expected to experience rising temperatures, increased precipitation, and heavier storms. These changes are likely to effect plant hardiness and stormwater intensity. This can affect plant survival and regeneration, as well as what species are appropriate to plant when planning for the future. It also increases the importance of riparian buffers and natural vegetation to slow and infiltrate stormwater to reduce flooding and protect water quality. The recommendations tables on the following pages reflect the identified conservation priorities and threats while also capturing a greater scope of stewardship issues and opportunities.

Riparian buffers protect stream health from stormwater and adjacent land use.

The Weisel Preserve Stewardship Priorities

Conservation Priorities:	Passive recreation
	Sustainable native plant communities
	Maintaining agricultural legacy
Top Strategies:	Control deer
	Control invasive plants
	Remove hazard trees

Priority	Stewardship Recommendations	Season	Who could implement?*	Wole Preserve	Agricultural Field	Ash-Mixed Hardwood	Mixed Hardwood	Hedgrerows	Red Oak-Mixed Hardwood	Berm	Terrestrial Meadow	Pond Buffer	Planting Area	Stormwater Basin
Forest Communities														
1	Assess condition of ash trees before doing any work in forest; delay work around ash trees until trees have fallen due to risk	Year-round	Staff or Contractor			■								
2	Allow woodland to transition to forest	Year-round	Staff				■							
2	If natural regeneration does not occur, plant trees in canopy gaps and areas where invasive plants were cleared; protect saplings with tree tubes	Spring or Fall	Staff or Volunteers			■	■							
3	Increase understory diversity by planting shrubs; protect seedlings from deer	Spring or Fall	Staff or Volunteers										■	
Agricultural Fields/Meadows														
1	Manage agricultural areas to avoid erosion and minimize chemical use	Year-round	Staff and Farmer		■									
2	Convert identified fragmented areas to forest or meadow	Spring or Fall	Staff or Volunteers		■									
Hedgerows														
1	Retain Hedgerows	Year-round	Staff					■						
Deer Management														
1	Implement a deer management program utilizing a hunting program and/or a deer cull with professional sharpshooters	Dependent on approach chosen	Staff	■										
2	Protect new plantings and natural regeneration as needed with fencing and tree tubes	Year-round	Staff	■										
2	Monitor property for deer impact by assessing impact on plants (browsing evidence and level of regeneration)	Spring/Summer	Staff or Volunteers	■										
Invasive Plants														
1	Monitor for and prevent colonization of new species	Year-round	Staff	■										
1	Prioritize communitites that are high quality and have fewest invasive plants	Based upon the vegetation communities habitat value priority ranking, begin focused invasive removal using techniques described below.	Staff or Volunteers	■										
1	Mow wildflower meadow and pollinator garden twice annually if invasive plants are dominant - the full meadow once in Nov-March and 1/3-1/2 of the meadow once in July. Recommendations related to meadows below are for more targeted treatments and can be used in tandem with a second mowing if needed.	Nov-March and July	Staff or Contractor		■						■			
1	Control **Norway maple** through mechanical girdling, manual removal, or a cut stump treatment. A basal bark application can be used for trees with 6" dbh or smaller.	Fall	Staff or Contractor						■					

Priority	Stewardship Recommendations	Season	Who could implement?*	Wole Preserve	Agricultural Field	Ash-Mixed Hardwood	Mixed Hardwood	Hedgerows	Red Oak-Mixed Hardwood	Berm	Terrestrial Meadow	Pond Buffer	Planting Area	Stormwater Basin
Invasive Plants														
1	Control **Callery pear** through mechanical girdling, manual removal, or a cut stump treatment. A basal bark application can be used for trees with 6" dbh or smaller.	Fall	Staff or Contractor				■	■		■				
1	Control **Japanese honeysuckle** by cutting vines at ground level and at 5 feet above the ground, treat the stumps with herbicide	Anytime - cut vines at ground level and at 5 feet above the ground; Fall - cut and herbicide stumps	Staff, Contractor, or Volunteers			■	■		■					■
1	Control **oriental bittersweet** by cutting vines at ground level and at 5 feet above the ground, treat the stumps with herbicide	Anytime - cut vines at ground level and at 5 feet above the ground; Fall - cut and herbicide stumps	Staff, Contractor, or Volunteers			■	■	■	■	■				■
2	Control **autumn-olive** through a basal bark application or cut stump treatment	Fall	Staff or Contractor				■							■
2	Control **shrub honeysuckle** through a basal bark application or cut stump treatment	Fall	Staff or Contractor			■								
2	Control **privet** through a basal bark application or cut stump treatment	Fall	Staff or Contractor			■	■	■						
2	Control **barberry** through a basal bark application or cut stump treatment	Fall	Staff or Contractor						■					
2	Control **wineberry** through a basal bark application or cut stump treatment	Fall	Staff or Contractor					■						
3	Control **mugwort** by applying herbicide	Spring	Staff or Contractor							■				
3	Control **joint head grass** by applying herbicide	Late summer	Staff or Contractor			■	■	■				■		■
3	Control **Japanese stiltgrass** by applying herbicide	Late summer	Staff or Contractor			■	■	■	■	■		■		
4	Control **multiflora rose** through a basal bark application or cut stump treatment. Alternatively, multiflora rose can be killed naturally by the rose rosette disease if present.	Fall	Staff or Volunteers			■	■	■	■	■				■
2	Revegetate as needed after invasive control	Spring or Fall	Staff or Volunteers	■										
3	Educate visitors through interpretive signs about ways to prevent the spread of invasive plants.	Anytime	Staff	■										
Exotic Pests														
1	Monitor for emerald ash borer	Year-round	Staff			■		■	■					
1	Identify and remove potentially hazardous ash trees	Year-round	Staff			■		■	■					
1	Follow quarantine requirements for emerald ash borer and spotted lanternfly	Year-round	Staff	■										
2	Replant as needed to replace ash trees	Spring or Fall	Staff or Volunteers			■								
3	Utilize circle traps for spotted lanterfly	May-July	Staff or Volunteers	■										
3	Scrape spotted laternfly egg masses	Fall - Winter	Staff or Volunteers	■										

Priority	Stewardship Recommendations	Season	Who could implement?*	Wole Preserve	Agricultural Field	Ash-Mixed Hardwood	Mixed Hardwood	Hedgerows	Red Oak-Mixed Hardwood	Berm	Terrestrial Meadow	Pond Buffer	Planting Area	Stormwater Basin
Water Quality														
1	Protect seep wetlands from disturbances by creating a 300ft no-disturbance buffer; avoid trails and use of heavy equipment within buffer	Year-round	Staff				■							
1	Determine if stormwater basin is functioning properly	Spring-Summer	Staff or Contractor											■
1	Regularly maintain stormwater basin	Annually	Staff or Volunteers											■
2	Restore stormwater basin vegetation by removing invasive plants and planting native species	Spring or Fall	Staff											■
2	Expand riparian buffer around pond if pond retained	Spring or Fall	Staff or Volunteers									■		
2	Convert pond to wetland	Spring or Fall	Staff or Contractor									■		
Wildlife Enhancement														
2	Leave dead wood and snags for wildlife habitat	Year-round	Staff or Volunteers			■	■		■			■		
2	Leave brush piles for wildlife	Year-round	Staff or Volunteers			■	■		■			■		
3	Add plantings to berm to increase habitat for wildlife and pollinators	Spring or Fall	Staff or Volunteers							■				
3	Install bird (kestrel, bluebird) and bat boxes	Year-round	Volunteers	■										
Hazards and Debris														
1	Assess condition of ash trees before doing any work in forest; delay work around ash trees until trees have fallen due to risk	Year-round	Staff or Contractor			■								
1	Monitor for and remove hazard trees	Annually and after severe storms	Staff			■	■	■	■					
3	Remove debris	Anytime	Staff or Volunteers				■							
Boundary Encroachment and Illegal Use														
1	Mark open space boundaries with vinyl markers and maintain as needed	Anytime	Staff	■										
1	Monitor park regularly for encroachment	Year-round	Staff	■										
2	Recruit trail ambassadors and park monitors	Anytime	Staff	■										
Climate Change														
1	Increase plant biodiversity, choosing non-invasive species predicted to be resilient to climate change	Spring or Fall	Staff or Volunteers	■										
3	Monitor changes in precipitation and temperature, noting effects on plant or wildlife health	Year-round	Staff or Volunteers	■										
Volunteers														
2	Recruit regular volunteers to help with property management	Anytime	Staff	■										

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

Appendix A

Cost Estimates

Implementation

ITEM	DESCRIPTION	UNIT	SIZE	QTY.	UNIT PRICE	MAT'L COST	LABOR	LABOR COST	SUBTOTAL	CONTINGENCY	TOTAL
A.	**Demolition, Site Prep & Earthwork**										
1	Remove hazard trees	LS		1	$ 40,000.00	$ 40,000.00	$ -	$ -	$ 40,000.00	$ 6,000.00	**$ 46,000.00**
	SUBTOTAL					**$ 40,000.00**		**$ -**	**$ 40,000.00**	**$ 6,000.00**	**$ 46,000.00**
B.	**Site Furniture**										
1	Benches w/ concrete pad	EA	6'	9	$ 2,500.00	$ 22,500.00		$ -	$ 22,500.00	$ 3,375.00	**$ 25,875.00**
2	Kiosk	EA		1	$ 2,500.00	$ 2,500.00		$ -	$ 2,500.00	$ 375.00	**$ 2,875.00**
3	Signs (Interpretive & Wayfinding system	LS		1	$ 3,000.00	$ 3,000.00		$ -	$ 3,000.00	$ 450.00	**$ 3,450.00**
4	Fencing (Split Rail)	EA	LF	1500	$ 30.00	$ 45,000.00		$ -	$ 45,000.00	$ 6,750.00	**$ 51,750.00**
5	Bird Boxes	EA		15	$ 25.00	$ 375.00	$ 20.00	$ 300.00	$ 675.00	$ 101.25	**$ 776.25**
	SUBTOTAL					**$ 73,375.00**		**$ 300.00**	**$ 73,675.00**	**$ 11,051.25**	**$ 84,726.25**
C.	**Plant Material**										
1	Allee Shade Trees	EA	2 - 2 1/2" cal.	39	$ 150.00	$ 5,850.00	$300.00	$ 11,700.00	$ 17,550.00	$ 2,632.50	**$ 20,182.50**
2	Parking Lot Shade Trees	EA	2 - 2 1/2" cal.	10	$ 150.00	$ 1,500.00	$300.00	$ 3,000.00	$ 4,500.00	$ 675.00	**$ 5,175.00**
3	Conservation Grade Trees	EA	8' - 10' ht	1100	$ 25.00	$ 27,500.00	$ 30.00	$ 33,000.00	$ 60,500.00	$ 9,075.00	**$ 69,575.00**
	SUBTOTAL			**1149**		**$ 34,850.00**		**$ 47,700.00**	**$ 82,550.00**	**$ 12,382.50**	**$ 94,932.50**
D.	**Seed Mixes**										
1	Meadow - ERNMX-153 (20 lbs/ac)	EA	Lb.	500	$ 125.00	$ 62,500.00	$ -	$ -	$ 62,500.00	$ 9,375.00	**$ 71,875.00**
	SUBTOTAL			**500**		**$ 62,500.00**		**$ -**	**$ 62,500.00**	**$ 9,375.00**	**$ 71,875.00**
	TOTAL										**$ 297,533.75**

Operation & Maintenance (Annual)

ITEM	DESCRIPTION	UNIT	QTY.	UNIT PRICE	MAT'L COST	LABOR	LABOR COST	SUBTOTAL	CONTINGENCY	TOTAL
1	Staffing, Training, and Contracting	LS	1	$ 15,000.00	$ 15,000.00			$ 15,000.00		**$ 15,000.00**
2	Hazard Tree Work	LS	1	$ 4,500.00			$ 4,500.00	$ 4,500.00	$ 500.00	**$ 5,000.00**
3	Herbicide Application (Fields)	LS	1	$ 500.00	$ 250.00		$ 250.00	$ 500.00	$ 75.00	**$ 575.00**
4	Management Supplies	LS	1	$ 300.00	$ 300.00			$ 300.00	$ 45.00	**$ 345.00**
5	Replacement Tree Plantings	LS	1	$ 100.00	$ 100.00	$200.00	$ 200.00	$ 300.00	$ 45.00	**$ 345.00**
6	Signage Replacment/Upkeep	LS	1	$ 100.00	$ 100.00	$200.00	$ 200.00	$ 300.00	$ 45.00	**$ 345.00**
7	Tractor/Mower Fuel, Oil, Filters etc.	LS	1	$ 250.00	$ 250.00	$200.00		$ 250.00	$ 37.50	**$ 287.50**
8	Repairs (tractor, mower, small tools)	LS	1	$ 1,000.00	$ 1,000.00			$ 1,000.00	$ 150.00	**$ 1,150.00**
9	Misc. Tools	LS	1	$ 1,000.00	$ 1,000.00	$200.00	$ 200.00	$ 1,200.00	$ 180.00	**$ 1,380.00**
	TOTAL		**9**	**$ 22,750.00**	**$ 15,000.00**	**$800.00**	**$ 5,350.00**	**$ 20,350.00**	**$ 1,077.50**	**$ 22,645.00**

Implementation

ITEM	DESCRIPTION	UNIT	SIZE	QTY.	UNIT PRICE	MAT'L COST	LABOR	LABOR COST	SUBTOTAL	CONTINGENCY	TOTAL
A.	**Demolition, Site Prep & Earthwork**										
1	Remove hazard trees	LS		1	$ 50,000.00	$ 50,000.00	$ -	$ -	$ 50,000.00	$ 7,500.00	**$ 57,500.00**
	SUBTOTAL					**$ 50,000.00**		**$ -**	**$ 50,000.00**	**$ 7,500.00**	**$ 57,500.00**
B.	**Infrastructure**										
1	Parking - 10 spaces	EA	SF	5525	$ 1.00	$ 5,525.00	$ 2.00	$ 11,050.00	$ 16,575.00	$ 2,486.25	**$ 19,061.25**
2	Grass trails - clear and level	EA	AC	0.25	$ 8,000.00	$ 2,000.00	$ -	$ -	$ 2,000.00	$ 300.00	**$ 2,300.00**
	SUBTOTAL					**$ 7,525.00**		**$ 11,050.00**	**$ 18,575.00**	**$ 2,786.25**	**$ 21,361.25**
C.	**Furniture & Amenities**										
1	Fencing (Split Rail)	EA	LF	1000	$ 30.00	$ 30,000.00		$ -	$ 30,000.00	$ 4,500.00	**$ 34,500.00**
2	Benches w/ concrete pad	EA	6'	10	$ 1,200.00	$ 12,000.00		$ 1,200.00	$ 13,200.00	$ 1,980.00	**$ 15,180.00**
3	Kiosk	EA		1	$ 2,500.00	$ 2,500.00		$ -	$ 2,500.00	$ 375.00	**$ 2,875.00**
4	Signs (Interpretive & Wayfinding system	LS		1	$ 3,000.00	$ 3,000.00		$ -	$ 3,000.00	$ 450.00	**$ 3,450.00**
5	Picnic Tables	EA		5	$ 1,200.00	$ 6,000.00		$ 1,200.00	$ 7,200.00	$ 1,080.00	**$ 8,280.00**
6	Bridges and Boardwalks	EA		2	$ 500,000.00	$ 1,000,000.00			$ 1,000,000.00	$ 150,000.00	**$ 1,150,000.00**
7	Footbridges	EA		2	$ 2,500.00	$ 5,000.00		$ -	$ 5,000.00	$ 750.00	**$ 5,750.00**
	SUBTOTAL					**$ -**		**$ 2,400.00**	**$ 60,900.00**	**$ 9,135.00**	**$ 1,220,035.00**
D.	**Plant Material**										
1	Shade Trees	EA	2 - 2 1/2" cal.	67	$ 150.00	$ 10,050.00	$300.00	$ 20,100.00	$ 30,150.00	$ 4,522.50	**$ 34,672.50**
2	Evergreen Trees	EA	7-8' ht	160	$ 100.00	$ 16,000.00	$200.00	$ 32,000.00	$ 48,000.00	$ 7,200.00	**$ 55,200.00**
3	Deciduous Shrubs	EA	24-36" ht	50	$ 30.00	$ 1,500.00	$ 60.00	$ 3,000.00	$ 4,500.00	$ 675.00	**$ 5,175.00**
4	Conservation Grade Trees	EA	8' - 10' ht	1400	$ 25.00	$ 35,000.00	$ 30.00	$ 42,000.00	$ 77,000.00	$ 11,550.00	**$ 88,550.00**
	SUBTOTAL			**1677**		**$ 62,550.00**		**$ 97,100.00**	**$ 159,650.00**	**$ 23,947.50**	**$ 183,597.50**
E.	**Seed Mixes**										
1	Meadow - ERNMX-153 (20 lbs/ac)	EA	Lb.	500	$ 125.00	$ 62,500.00	$ -	$ -	$ 62,500.00	$ 9,375.00	**$ 71,875.00**
	SUBTOTAL			**500**		**$ 62,500.00**		**$ -**	**$ 62,500.00**	**$ 9,375.00**	**$ 71,875.00**
	TOTAL										**$ 1,554,368.75**

Operation & Maintenance (Annual)

ITEM	DESCRIPTION	UNIT	QTY.	UNIT PRICE	MAT'L COST	LABOR	LABOR COST	SUBTOTAL	CONTINGENCY	TOTAL
1	Staffing, Training, and Contracting	LS	1	$ 15,000.00	$ 15,000.00			$ 15,000.00		**$ 15,000.00**
2	Hazard Tree Work	LS	1	$ 4,500.00			$ 4,500.00	$ 4,500.00	$ 500.00	**$ 5,000.00**
3	Herbicide Application (Fields)	LS	1	$ 500.00	$ 250.00		$ 250.00	$ 500.00	$ 75.00	**$ 575.00**
4	Management Supplies	LS	1	$ 300.00	$ 300.00			$ 300.00	$ 45.00	**$ 345.00**
5	Replacement Tree Plantings	LS	1	$ 100.00	$ 100.00	$200.00	$ 200.00	$ 300.00	$ 45.00	**$ 345.00**
6	Signage Replacment/Upkeep	LS	1	$ 100.00	$ 100.00	$200.00	$ 200.00	$ 300.00	$ 45.00	**$ 345.00**
7	Tractor/Mower Fuel, Oil, Filters etc.	LS	1	$ 250.00	$ 250.00	$200.00		$ 250.00	$ 37.50	**$ 287.50**
8	Repairs (tractor, mower, small tools)	LS	1	$ 1,000.00	$ 1,000.00			$ 1,000.00	$ 150.00	**$ 1,150.00**
9	Misc. Tools	LS	1	$ 1,000.00	$ 1,000.00	$200.00	$ 200.00	$ 1,200.00	$ 180.00	**$ 1,380.00**
	TOTAL		**9**	**$ 22,750.00**	**$ 15,000.00**	**$800.00**	**$ 5,350.00**	**$ 20,350.00**	**$ 1,077.50**	**$ 22,645.00**

Implementation

ITEM	DESCRIPTION	UNIT	SIZE	QTY.	UNIT PRICE	MAT'L COST	LABOR	LABOR COST	SUBTOTAL	CONTINGENCY	TOTAL
A.	**Demolition, Site Prep & Earthwork**										
1	Assess & remove hazard trees	LS		1			$ -	$ 45,000.00	$ 45,000.00	$ 6,750.00	**$ 51,750.00**
	SUBTOTAL					**$ -**		**$ 45,000.00**	**$ 45,000.00**	**$ 6,750.00**	**$ 51,750.00**
B.	**Infrastructure**										
1	Parking Lot	EA	SF	5000	$ 1.00	$ 5,000.00	$ 2.00	$ 10,000.00	$ 15,000.00	$ 2,250.00	**$ 17,250.00**
	SUBTOTAL					**$ 5,000.00**		**$ 10,000.00**	**$ 15,000.00**	**$ 2,250.00**	**$ 17,250.00**
C.	**Site Furniture**										
1	Fencing (Split Rail)	EA	LF	500	$ 30.00	$ 15,000.00		$ -	$ 15,000.00	$ 2,250.00	**$ 17,250.00**
2	Benches w/ concrete pad	EA	6'	9	$ 1,200.00	$ 10,800.00		$ 1,200.00	$ 12,000.00	$ 1,800.00	**$ 13,800.00**
3	Kiosk	EA		1	$ 2,500.00	$ 2,500.00		$ -	$ 2,500.00	$ 375.00	**$ 2,875.00**
4	Signs (Interpretive & Wayfinding system	LS		1	$ 3,000.00	$ 3,000.00		$ -	$ 3,000.00	$ 450.00	**$ 3,450.00**
	SUBTOTAL					**$ 31,300.00**		**$ 1,200.00**	**$ 32,500.00**	**$ 4,875.00**	**$ 37,375.00**
D.	**Plant Material**										
1	Shade Trees	EA	2 - 2 1/2" cal.	229	$ 150.00	$ 34,350.00	$300.00	$ 68,700.00	$ 103,050.00	$ 15,457.50	**$ 118,507.50**
2	Evergreen Trees	EA	7-8' ht	200	$ 100.00	$ 20,000.00	$200.00	$ 40,000.00	$ 60,000.00	$ 9,000.00	**$ 69,000.00**
3	Deciduous Shrubs	EA	24-36" ht	200	$ 30.00	$ 6,000.00	$ 60.00	$ 12,000.00	$ 18,000.00	$ 2,700.00	**$ 20,700.00**
4	Conservation Grade Trees	EA	8' - 10' ht	500	$ 25.00	$ 12,500.00	$ 30.00	$ 15,000.00	$ 27,500.00	$ 4,125.00	**$ 31,625.00**
	SUBTOTAL			**1129**		**$ 72,850.00**		**$ 135,700.00**	**$ 208,550.00**	**$ 31,282.50**	**$ 239,832.50**
E.	**Seed Mixes**										
1	Meadow - ERNMX-153 (20 lbs/ac)	EA	Lb.	500	$ 125.00	$ 62,500.00	$ -	$ 5,000.00	$ 67,500.00	$ 10,125.00	**$ 77,625.00**
	SUBTOTAL			**500**		**$ 62,500.00**		**$ 5,000.00**	**$ 67,500.00**	**$ 10,125.00**	**$ 77,625.00**
	TOTAL										**$ 423,832.50**

Operation & Maintenance (Annual)

ITEM	DESCRIPTION	UNIT	QTY.	UNIT PRICE	MAT'L COST	LABOR	LABOR COST	SUBTOTAL	CONTINGENCY	TOTAL
1	Staffing, Training, and Contracting	LS	1	$ 15,000.00	$ 15,000.00			$ 15,000.00		**$ 15,000.00**
2	Hazard Tree Work	LS	1	$ 4,500.00			$ 4,500.00	$ 4,500.00	$ 500.00	**$ 5,000.00**
3	Herbicide Application (Fields)	LS	1	$ 500.00	$ 250.00		$ 250.00	$ 500.00	$ 75.00	**$ 575.00**
4	Management Supplies	LS	1	$ 300.00	$ 300.00			$ 300.00	$ 45.00	**$ 345.00**
5	Replacement Tree Plantings	LS	1	$ 100.00	$ 100.00	$200.00	$ 200.00	$ 300.00	$ 45.00	**$ 345.00**
6	Signage Replacment/Upkeep	LS	1	$ 100.00	$ 100.00	$200.00	$ 200.00	$ 300.00	$ 45.00	**$ 345.00**
7	Tractor/Mower Fuel, Oil, Filters etc.	LS	1	$ 250.00	$ 250.00	$200.00		$ 250.00	$ 37.50	**$ 287.50**
8	Repairs (tractor, mower, small tools)	LS	1	$ 1,000.00	$ 1,000.00			$ 1,000.00	$ 150.00	**$ 1,150.00**
9	Misc. Tools	LS	1	$ 1,000.00	$ 1,000.00	$200.00	$ 200.00	$ 1,200.00	$ 180.00	**$ 1,380.00**
	TOTAL		**9**	**$ 22,750.00**	**$ 15,000.00**	**$800.00**	**$ 5,350.00**	**$ 20,350.00**	**$ 1,077.50**	**$ 22,645.00**

Appendix B

Summaries of Public Meetings, Focus Group and Key Person Interviews

Warrington Township – First Open Space Committee Meeting

Summary of Open Space Master Plans Presentation, Discussion and Questionnaire Responses

January 6th, 2021

One January 6th, 2021, Natural Lands virtually attended Warrington Township's Open Space Committee meeting to present our progress on the open space master plans for the Weisel Preserve, Emerson Farm Preserve, and Mill Creek Preserve. Rick Tralies, Kate Raman, and Hannah Thomas attended on behalf of Natural Lands in addition to members of the Open Space Committee, Township staff, and Warrington residents. Attendees were given opportunities to ask questions at specified times during the presentation.

This document provides a summary of the presentation, the questions asked by the attendees and the answers given by Natural Lands staff members. The summary should be considered as representative of the conversation, but not as minutes or a word for word account.

Following the presentation, Natural Lands staff members provided a web link to an online questionnaire and asked the meeting participants to respond to it by Monday, January 11th, 2021. A summary of responses is included at the end of this document. These responses will be used to inform Natural Lands staff of the opinions and attitudes of the respondents and will be considered much like public comment at a meeting. The responses will not be treated as votes. No decisions will be made based purely on the results of the questionnaire.

Summary of Presentation

Rick Tralies and Kate Raman led Natural Lands' presentation to the Committee. After Kate conducted introductions s, Rick opened the presentation with background on Natural Lands as well as the context of the three sites. The project's scope of work and goals of the presentation were also described by Rick. Kate then updated the Committee on the process of Natural Lands' Key Person Interviews (KPI's) with select members of the public, providing an overview of the key takeaways of each conversation.

The majority of the presentation focused on what our team has learned about the three sites so far. The information was shared through diagrams, photography, and notes about each. These described the natural features, views, habitats, built features, opportunities and issues at each site.

After the three sites were presented, Natural Lands' next steps were explained. These include continuing to conduct Key Person Interviews (KPI's), conducting a focus group of potential user group representatives, continuing to visit the sites, and beginning to draft narrative report sections. Additionally, it was noted that Natural Lands hopes to present the first draft of the master plans at a second meeting in the Spring. To conclude the presentation, Rick explained the online questionnaire and opened time for any attendees to provide additional suggestions or ask more questions.

Natural Lands

Summary of Discussions, Comments and Questions

After each site was introduced, attendees were able to make comments or suggestions and ask questions.

Emerson Farm Preserve –

- Dumping - Ivy Ross mentioned that recently the Township has been in discussion with Toll Brothers about the removal of waste which has been dumped on the property. She mentioned that it will be important to designate the open space areas so that people do not continue to dump on the site.

- Tree removal - Ivy has requested that Toll Brothers remove hazardous trees leaving the bottom six feet of the trunk to remain for habitat.

- Trails - Scott Vogin inquired about trail materials. Rick suggested that the open spaces will likely end up containing both paved multi-use trails as well as natural surface trails.

- Agriculture - Fred Gains asked whether agriculture would be considered as a permanent use. Rick suggested that agriculture will be discussed throughout the length of the project, as Natural Lands is aware of its importance to the community.

- Property Boundaries - Mike Diorka then brought up the issue of a survey to show the adjacent property owners where the boundaries of Emerson Farm Preserve lay. Kate explained that once the protected areas are finalized a site survey will be completed, but a visual barrier or clear signage is a good idea to let people know where the property lines are. Bill Connelly mentioned that the developer is required to make the boundary legible.

Mill Creek Preserve –

- Streams - Scott Vogin inquired about the depth of Mill Creek Preserve's streams and their suitability to be stocked with fish. Rick mentioned that in certain areas the streams seem to be several feet deep, but the Township would need to work with the PA Fish and Boat Commission to organize fish stocking.

- Leni-Lenape History - Fred Gaines asked if this property was once occupied by the Leni-Lenape tribe. Rick mentioned that he was unsure, but it was a topic which could be further investigated, particularly with Natural Lands' IDEA initiative. Ivy Ross said that Mill Creek Preserve is a site which potentially has a high quality of archeological resources. Mike Diorka suggested that these resources provide an opportunity for education.

- Parking - As people already park along the driveway at Mill Creek Preserve, Fred asked about the potential of establishing a formal parking area. Rick said that a designated parking area would be appropriate at Mill Creek Preserve and Natural Lands will explore options as part of the master planning process.

- Birding - Barbara Brown suggested looking into a natural bird blind, and wanted feedback on the most appropriate location.

- Agriculture - Ivy stated that the grant agreement for the funding used to acquire the site stipulated that all farming at Mill Creek Preserve needs to end by 2022.

Weisel Preserve –

- Solar Panels - Fred Gaines asked if Natural Lands had any experience with solar panels, and if it was a possibility for any of the sites. Rick answered that other than implementing solar panels sparingly on some buildings, Natural Lands usually doesn't recommend them as the nonprofit's main concern is promoting public access and habitat which solar panels tend to limit.

- Ice Skating - Scott Vogin gave the input that from the Township's perspective, the potential of ice skating on the pond is concerning due to liability.

- Leaf/Yard Waste Dump - Scott said that the Leaf Dump is necessary for the Township to have, or else they would need to vacuum each resident's leaves. Ivy said that it was critical for the area to be cleaned up and have an aesthetically appealing presence.

- Bird habitat - It was mentioned that the property is ideal for wood ducks, blue birds, and screech owls.

- The Pond - Kathy suggested that the pond is most likely not a natural feature, and may have been built by farmers for irrigation. This, would mean that there are potentially pipes located at its base. Fred suggested that it could have been built by firefighting services as a water source. As it serves as a habitat resource, and could pose a liability issue if publically accessible, the general consensus of the group was to leave the pond as is.

Final Comments –

- Deer management - Mike Diorka, Rick Weiss, and Andy Oles mentioned their concerns about deer impact to the sites. It was concluded that deer need to be controlled at a Township wide scale for impacts to be mitigated at a site level.

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Post Meeting Questionnaire Results

After the meeting, Natural Lands sent an email to attendees which reiterated the project's next steps and included a link to take the online questionnaire. The questionnaire was twelve questions with multiple choice and open ended response options. Natural Lands received fifteen responses which offered insight to attendee's perspectives, opinions and concerns.

1. **Where is agriculture appropriate?** (Select all that apply.)
    a. Mill Creek Preserve **(4, 26.7%)**
    b. Open Space at the Emerson Farm Preserve **(8, 53.3%)**
    c. Weisel Preserve **(10, 66.7%)**
    d. All open space should contain agriculture. **(3, 20%)**
    e. Agriculture should not be a permitted use in the Township's open spaces. **(1, 6.7%)**

Written in responses –

- Can't continue on Mill Creek Preserve after 2022.
- Not sure until we solidify all plans.
- I have no expertise nor prior knowledge of any of these projects, but I think there needs to be an underlying 'credo' and when/where/how to support or allow is on a case by case basis.

2. **Where are meadows appropriate?** (Select all that apply.)
    a. Mill Creek Preserve **(5, 33.3%)**
    b. Open Space at the Emerson Farm Preserve **(7, 46.7%)**
    c. Weisel Preserve **(6, 40%)**
    d. Meadows are appropriate at all sites. **(12, 80%)**
    e. Meadows are not appropriate in the Township's open spaces. **(0, 0%)**

Written in responses –

- I have no expertise nor prior knowledge of any of these projects but I think there needs to be an underlying 'credo' and when/where/how to support or allow is on a case by case basis.

3. **Where are natural surface hiking trails appropriate?** (Select all that apply.)
    a. Mill Creek Preserve **(7, 46.7%)**
    b. Open Space at the Emerson Farm Preserve **(6, 40%)**
    c. Weisel Preserve **(5, 33.3%)**

d. All open space should contain natural surface hiking trails. **(9, 60%)**

e. None of the Township's open spaces should contain natural surface hiking trails. **(0, 0%)**

Written in responses –

- Along with paved trails connecting main routes and future uses.
- I have no expertise nor prior knowledge of any of these projects but I think there needs to be an underlying 'credo' and when/where/how to support or allow is on a case by case basis.

4. Where is water access appropriate? (Select all that apply.)

a. Mill Creek Preserve **(5, 33.3%)**

b. Open Space at the Emerson Farm Preserve **(2, 13.3%)**

c. Weisel Preserve **(1, 6.7%)**

d. If there is water on a site, people should have access to it. **(5, 33.3%)**

e. People should not have access to water features on Township open space. **(3, 20%)**

Written in responses –

- Need limitations for safety of wildlife and keep out dogs off lead.
- Along with paved trails connecting main routes and future uses and hopefully connecting in ways to avoid crossing roads at grade. Under grade provides separation for safety.
- I can see this impacting wildlife in the area.
- I am not on board for access to water at all our sites especially where water is limited. In my experience especially in areas where habitat is crucial the public is not always respectful for its use. Example Bradford Dam where people come to fish leave behind fishing lines hooks etc. Mill Creek Preserve where we plan to put up Wood duck boxes and hopefully plant along the riparian area to stabilize the bank would be at risk.
- I have no expertise nor prior knowledge of any of these projects but I think there needs to be an underlying 'credo' and when/where/how to support or allow is on a case by case basis.

5. Where should habitat be the priority? (Select all that apply.)

a. Mill Creek Preserve **(8, 53.3%)**

b. Open Space at the Emerson Farm Preserve **(4, 26.7%)**

c. Weisel Preserve **(5, 33.3%)**

d. Habitat should always be a priority. **(10, 66.7%)**

e. Habitat should never be a priority. **(0, 0%)**

Written in responses –

- I have no expertise nor prior knowledge of any of these projects but I think there needs to be an underlying 'credo' and when/where/how to support or allow is on a case by case basis.
- Along with paved trails connecting main routes and future uses and hopefully connecting in ways to avoid crossing roads at grade. Under grade provides separation for safety.

6. Where would paved multi-use trails be appropriate? (Select all that apply.)

a. Mill Creek Preserve **(2, 13.3%)**

b. Open Space at the Emerson Farm Preserve **(7, 46.7%)**

c. Weisel Preserve **(5, 33.3%)**

d. Paved multi-use trails should be incorporated at all sites. **(4, 26.7%)**

e. Paved multi-use trails should not be incorporated in Township open space. **(1, 6.7%)**

Written in responses –

- I see a combination of paved and natural trails.
- Along with paved trails connecting main routes and future uses and hopefully connecting in ways to avoid crossing roads at grade. Under grade provides separation for safety.
- I think paved areas should be carefully considered at each site and limited where possible. A natural pathway should always be considered first.
- Each site is case by case.
- I have no expertise nor prior knowledge of any of these projects but I think there needs to be an underlying 'credo' and when/where/how to support or allow is on a case by case basis.

7. Where would afforestation be appropriate? (Select all that apply.)

a. Mill Creek Preserve **(5, 33.3%)**

b. Open Space at the Emerson Farm Preserve **(3, 20%)**

c. Weisel Preserve **(3, 20%)**

d. New Trees should be incorporated into all open spaces. **(14, 93.3%)**

e. Additional trees should not be incorporated in open spaces. **(0, 0%)**

Written in responses –

- I have no expertise nor prior knowledge of any of these projects but I think there needs to be an underlying 'credo' and when/where/how to support or allow is on a case by case basis.

8. What amenities are most important to you? (Select the three most important please.)

a. Bathrooms **(4, 26.7%)**

b. Wayfinding signage **(4, 26.7%)**

c. Trail and Park information signage **(12, 80%)**

d. Educational signage **(7, 46.7%)**

e. Dog related amenities **(1, 6.7%)**

f. Benches **(8, 53.3%)**

g. Water fountains **(2, 13.3%)**

h. Picnic areas **(3, 20%)**

i. Cycling amenities (pumps, racks, etc.) **(2, 13.3%)**

j. Lighting **(0, 0%)**

Written in responses –

- Along with paved trails connecting main routes and future uses and hopefully connecting in ways to avoid crossing roads at grade. Under grade provides separation for safety.
- Trash cans

9. What activities would YOU do at preserves? (Select the three most important please.)

a. Walking **(13, 86.7%)**

b. Dog walking **(1, 6.7%)**

c. Connecting with nature **(12, 80%)**

d. Running **(1, 6.7%)**

e. Cycling **(4, 26.7%)**

f. Birding **(5, 33.3%)**

g. Socializing **(1, 6.7%)**

h. Plant and wildlife study **(6, 40%)**

i. Equestrian trail riding **(1, 6.7%)**

Written in responses –

- Fishing

10. What activities do you expect OTHERS to do at the preserves? (Select the three most important please.)

a. Walking **(10, 66.7%)**

b. Dog walking **(8, 53.3%)**

c. Connecting with nature **(6, 40%)**

d. Running **(6, 40%)**

e. Cycling **(4, 26.7%)**

f. Birding **(3, 20%)**

g. Socializing **(4, 26.7%)**

h. Plant and wildlife study **(4, 26.7%)**

i. Equestrian trail riding **(0, 0%)**

11. Should access be limited anywhere? (Select all that apply.)

a. Mill Creek Preserve **(7, 46.7%)**

b. Open Space at the Emerson Farm Preserve **(0, 0%)**

c. Weisel Preserve **(3, 20%)**

d. Access should not be limited. **(3, 20%)**

Written in responses –

- Any sensitive areas no matter where they are should be limited, very limited.
- Unless critical habitat with specific breeding or other sensitive issues. IE mowing should be alternately restricted as was planned for Bradford dam, but it should be enforced for bird nesting times.
- Depends on conditions variety of factors.
- Should be limited as appropriate for habitat/wildlife preservation.
- Depends on situation and season.
- Access limited on seasonal basis.
- I have no expertise nor prior knowledge of any of these projects but I think there needs to be an underlying 'credo' and when/where/how to support or allow is on a case by case basis.

12. Are we missing anything? Please feel free to share any other considerations or concerns that you may have.

A. Signage that educates public.

B. How much is this going to cost on annual basis including NLT supervision, operations of facilities including trash removal, maintenance and insurance?

C. Like to encourage plantings that provide berries for people and animals. i.e. edible forest

D. In the Mill Creek Preserve Resource Management Plan, January 2019- a number of recommendations were made which should have more specific detail and recommendations as part of the Master Plan. As in any feasibility study, recommendations are made along with project cost estimates that need to be clearly defined and eventual operational costs over time. It would also be most helpful to know any phasing strategy for the three parcels and timelines associated with proposed Master Plan completion. Your recommendations should be clear regarding any deer management program, plan to control invasive plants, lantern fly infestation, best practice for stewardship. As Natural Lands has provided development and implementation for a number of preserves, it might be a good idea, if Covid restrictions lessen to have a select representative group from open space, EAC, Park and Recreation, and Bike and Hike to have a site visit to see results of what the parcel can become for Warrington. As Warrington's recreation inventory expands, the enjoyment of what can be comes with a cost- which truly needs to be explained to all and the management it will take. Thank you for your time and efforts in providing a path forward to improve the quality of life for our community. Please let me know if you need any clarification of my response. Take care.

E. In my line of work, you always have to worry about downstream affects. Given the location of my property, I am concerned with 'down creek' affects - as I have Mill Creek running through my property for an acre or two, ending at the bridge on Bristol Rd!

F. Better mowing management and maintenance for bird nesting and wildlife. Crossings from one parcel to another along with paved trails connecting main routes and future uses and hopefully connecting in ways to avoid crossing roads at grade. Possible under grade provides separation for safety. Future crossings under rt 611 and rt 132 and connectors under county line road when upgraded should also be planned. Long term invasive maintenance and native plant educational signs are helpful.

G. Since we have been blessed with being able to protect these few remaining natural areas in Warrington I want to see habitat restoration, reforestation, minimal human intervention, ok to walk and bike the trails etc. As I suggested in our Zoom meeting the other night, I would like to see things like the establishment of a naturalized area for birds through planting of plants for food, shelter, etc. There were comments on how to hide the area of the Warrington tradesville recycling from the trail at Wiesel, how about the planting of many Eastern Red Cedar. Relativity inexpensive, great habitat, a natural screen. Let’s not go White Pine overused but better than nothing.

H. There has been ATV and dirt bike activity on some open space. Perhaps there should be signage restricting that.

I. I am concerned about the long term maintenance of all three areas. I also think the frog pond should be converted to a marsh d/t the probable pollution from the years of being a farm run off area. The marsh could help renew this area.

J. Adequate and ongoing maintenance of the spaces is critical and should be a township priority. Trails that are linked together enhance the experience.

Natural Lands

Warrington Township – Second Open Space Committee Meeting

Summary of Open Space Master Plans Presentation, Discussion, Focus Group Results and Questionnaire Responses

March 9, 2022

Rick Tralies, Kate Raman, and Nick Upmeyer lead the virtual meeting. Rick gave a presentation which presented the results of the questionnaires completed by the Open Space Committee and the results of the focus group. Then the draft master plans were presented to the group. The remainder of the meeting was dedicated to discussion and critique of the plans. The following notes are organized by site, rather than chronologically.

Mill Creek Preserve

- Confirmation that agriculture will be removed at Mill Creek Preserve site, in accordance with terms of purchase, as well as the prevailing opinion of focus group respondents.
- Mill Creek presents a particular opportunity for preservation of wildlife habitat; focus group respondents accordingly express concern that we limit access via trails in areas where there may be unwanted impacts. Additionally noted that access should be limited due to wetness of site and potential for unwanted impacts from public use, and that the existing multiuse trails skirting the site are already providing circulation access for the site and surroundings.
- Much of the interior of the site is designated as a High Protection Area (HPA), further indicating that development of the open space needs to be minimal.
- NL states that Ernst Conservation Seeds willing to provide a custom meadow mix that would specifically exclude big blue stem and other species that grow too tall, to avoid creating safety/visibility issues in meadow areas.
- The design should be sure to include informational/interpretive signage, as well as sufficient appropriately sited benches.
- Site will require stewardship and maintenance, which will involve education for the township. NL's final narrative to include stewardship recommendations.
- Committee desires to install native plantings that promote biodiversity, balanced with considerations about capacity for maintenance during establishment period.
- Committee notes erosion and the degrading condition of gabion baskets at the existing channel crossing. A natural channel design will be needed in the future.
- Proposed boardwalks are desired but given that their installation across Mill Creek may be complicated by both cost and permitting issues, it is particularly important to be mindful of the condition of the existing crossing in order to maintain connection between the two halves of the property.
- Discussion regarding the proposed inclusion of an area of picnic tables close to the proposed parking lot. Some discussion about problems of trash and vandalism associated

with picnic areas, as well as an abundance of picnic areas in the active recreation areas nearby.

- Finally, arguments made for the importance of putting trust in the public, of providing them with amenities like picnic tables, given the scale of public investment in these open space properties, and of the provision of access to natural areas for the differently abled (via seating directly adjacent to parking). Consensus seems to be that a minimal (3-5 tables) picnic area at the site would be desirable.
- Brief mentions of proposed outdoor education areas and larger bird blinds, but no specific conclusions reached beyond limiting size/extent.
- Along the northwest edge of the site, may want to consider fencing in order to accurately define limits of the site and prevent incursion by the neighbors in terms of unwanted mowing, damage to proposed reforestation etc.

Weisel Preserve

- There is an existing multi-use trail leading through the site. Plan will propose tree plantings for an allee effect along the trail, while taking care to not impact visibility and thereby cause safety concerns for users.
- Existing plan indicated a narrow trail extension to the northeast, but it should be removed from the final – the area is too wet to encourage pedestrian circulation.
- An interpretive sign has been installed at the existing pollinator garden – condition of the plantings to be checked during site visit.
- NL has coordinated with horse farm owner on appropriate location for screening planting to prevent unwanted public interaction with horses at the inholding.
- Committee members note that Beacon app being deployed (via grant funding) along trail to provide guidance/interpretation. Also useful for orienting non-sighted and hearing-impaired trail users. Have physical signs been installed to prompt user interface?
- Trails are open dawn to dusk, typical to Township Open Space. No desire to add lighting to trails (conclusion for all three sites)
- Committee notes that the outlet structure at the pond is failing/has breached, creating erosion. Our site visits have not addressed hydrology specifically, but condition should be noted in final plan.
- Discussion of whether pedestrian access to Mill Creek at southern boundary of site is possible. May be issues with the condition of the woodland around the creek i.e. ash trees impacted by borer becoming hazardous. There is existing sidewalk along Mill Creek Road, but doesn't provide particularly appealing experience of the creek area.
- Township has access to funding for three benches – proposed locations make sense in terms of spacing. Should be confirmed and noted on the plan as they would impact any additional proposed seating.
- Parking near the dump is open to the public, and there is also parking by the (former?) public works building with a day care.

Natural Lands

Emerson Farm Preserve

- Current design shows about half of agricultural land being converted to meadow. Committee indicates that there is a farmer interested in continuing to farm the land. Would it be feasible to phase conversion of the 12 ac. plot to meadow at some future date, leaving more contiguous farmland for the time being? Some concern that it may be difficult to find/retain a farmer for such a relatively small plot.
- Also need to confirm access for the farmer – most likely there is an access point through the hedge row via an existing trail.
- Finalized master plan (for all sites, but particularly at EF) needs to show acreages - committee would like to confirm that the correct percentage of land at the site is being kept in open space vis a vis the new development.
- There is an existing multiuse trail along the SW border of the site associated with the new development.
- The trail is being utilized by kids to get to and from school and there will be a guarded crossing installed at the intersection with Pickertown Road in the future.
- Design for township open space relative to the multiuse trail should be mindful of use/traffic (e.g. kids walking to/from school, riding bikes) and take care not to invite access to natural areas in ways that may have a negative impact. May include “no biking” signs in appropriate locations.
- There are several dedicated parking spots located within the development, intended to provide access to open space as part of the initial site design. Participants also note that streets within the development are public, so parking is allowed. Suggestion that there may be an additional option for a few parking spots in the northeast corner of the site where the guarded crossing is to be installed – would be tight to the creek, however.
- Note that parcel in NW corner is owned by quarry, would not allow for a trail as proposed on plan.
- Committee members suggest visit to Lion’s Pride Park, an active recreation facility nearby – serves as contrast to the intended passive recreation opportunities being developed at the three sites.

Natural Lands

Warrington Township – Third Open Space Committee Meeting

Summary of Open Space Master Plan Revisions, Precedents & Examples, Rough Cost Estimates and Narrative Report

May 11, 2022

Rick Tralies and Nick Upmeyer lead the virtual meeting. Rick gave a presentation which presented the revised master plans, presented precedents and examples of potential improvements, rough cost estimates and introduced the narrative plan. The notes that follow have been organized by preserve, rather than chronologically.

Weisel Preserve

- No major changes to the plan
  - Existing trail locations updated
  - Trail to pond move back
  - Benches and signage added
- Estimate for improvements $400,500
- Ivy reports that she has won two grants
  - 75 shade trees
  - 30 shrubs
- Three benches and three interpretive signs have been ordered
- Should confirm species selection and location against any landscape plan proposals; confirm bench and signage locations
- Discussion of issues related to failing ash tree populations – hazard trees vs. Long term removals
- Bluebird and kestrel houses were installed

Mill Creek Preserve

- Plan adjusted to move outdoor education area and reduce size of picnic area
- Estimate for improvements $911,250 – particularly large number for amount of bridges/boardwalks proposed
- Discussion of substantial wet areas and need for bridges/boardwalks
- Note that access required to reach SPA in northwest corner of site to do restoration work
- Bridges cost approx. $1000 per linear foot
- Option for kit bridges or simple bog planks
- Township advised that any construction near water will require permitting
- Questions of whether federal grant-funded improvements would require ADA-accessible trails - Natural/Recreational trails do not need to follow same requirements as sidewalks
- Possible location for proposed bird blinds to be referred to local birders

- Note that furnishings/signage/kiosks should be consistent throughout open space properties
- Note that parking areas will need to include stormwater management
    - $50,000 estimated for 10 space parking lot at Mill Creek

The Reserve at Emerson Farm

- No major changes to plan
- Estimate for improvements is $233,500
- Discussion of priorities – Natural Lands recommends prioritizing site navigation – signs, kiosks etc.
- Discussion of whether to retain agriculture rather than convert to meadow – may make sense to approach that part of plan further down the line
    - Note that meadow seed mixes becoming more expensive
    - Note that farmer should be alerting township when spraying
    - Even if agriculture is retained, trails can be mowed around perimeter
- Discussion of large ash forest to the northeast of the ball field – can be dealt with later assuming that hazard trees are addressed in the short term
- Discussion of reforestation areas – planting red maples along the creek or behind the development
- Note that Township won a grant for a crosswalk and flashers across Street Road
- Note that Township is expanding connection from site to Bradford Dam Connector Trail/Recreation Area

Next Steps

- Rick to share narrative draft, will add other maps
- Update cost estimates
- Priorities/phasing plan
- O&M cost estimates
- Landscape Plan

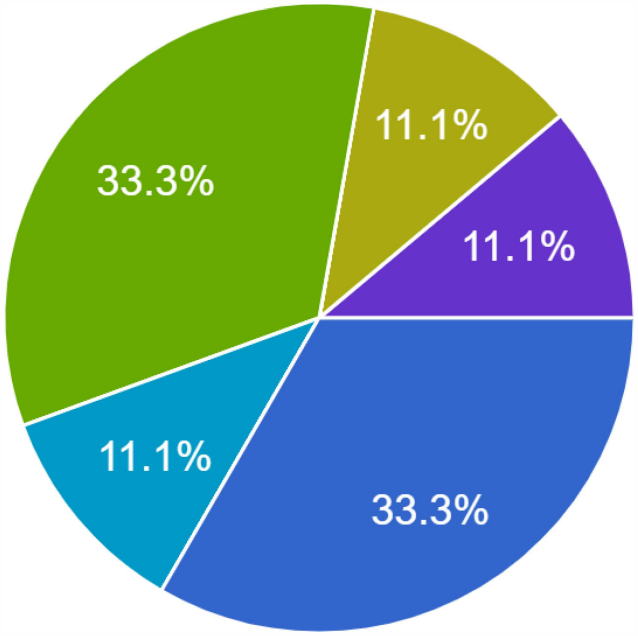
Warrington Township Open Space Master Plans

Focus Group Questionnaire Results

November 10, 2021

How would YOU PRIMARILY use these open spaces? (Please choose 1)

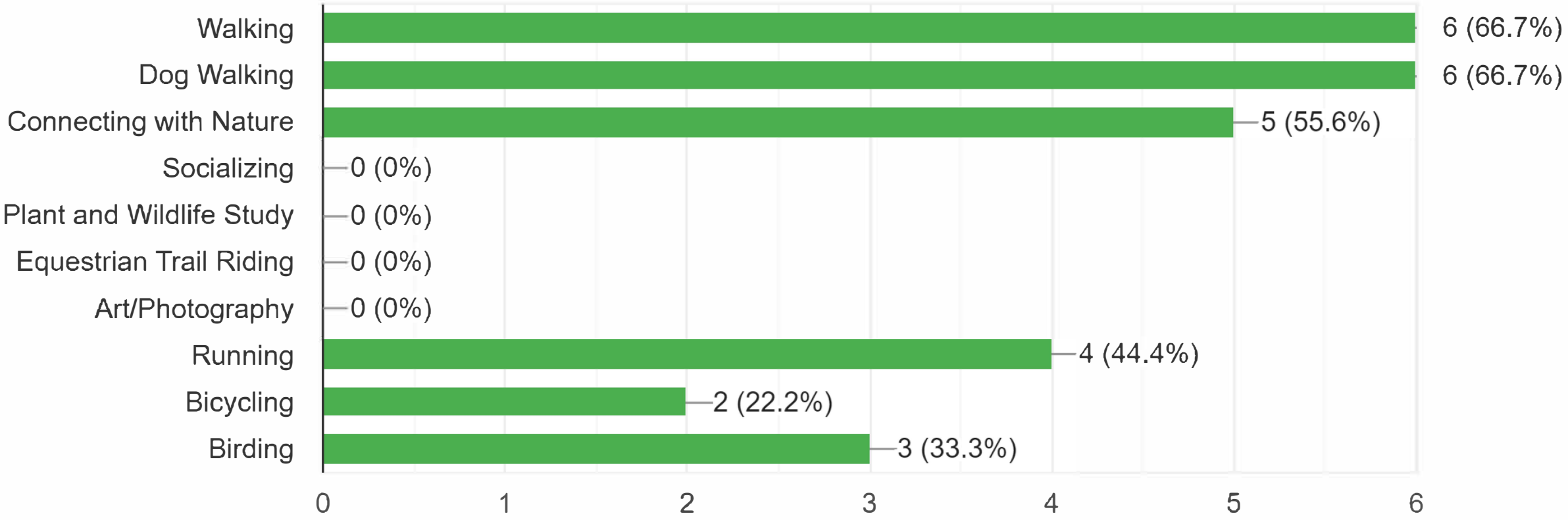
9 responses



- Walking
- Dog Walking
- Connecting with Nature
- Running
- Bicycling
- Birding
- Socializing
- Plant and Wildlife Study
- Equestrian Trail Riding
- Art/ Photography
- Scout or other Youth Group Leadership
- Yoga or Similar Group Leadership
- wildlife and bird photography
- observing wildlife and native bird release areas

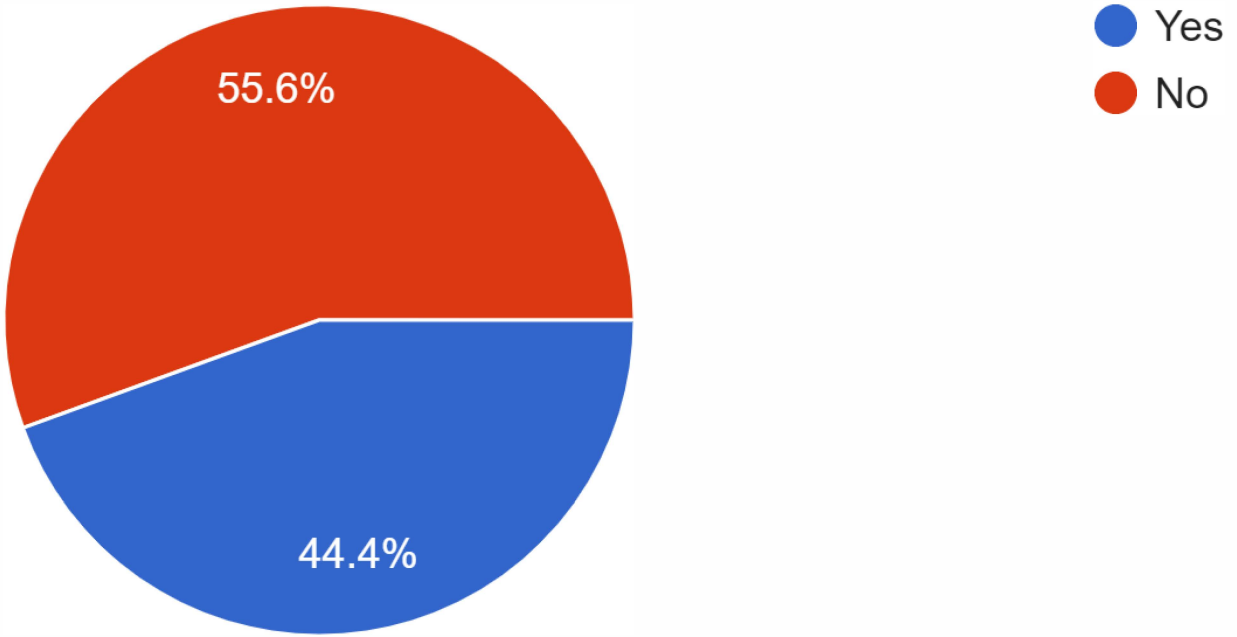
How do you think others will primarily use these open spaces? (Choose 3 max)

9 responses



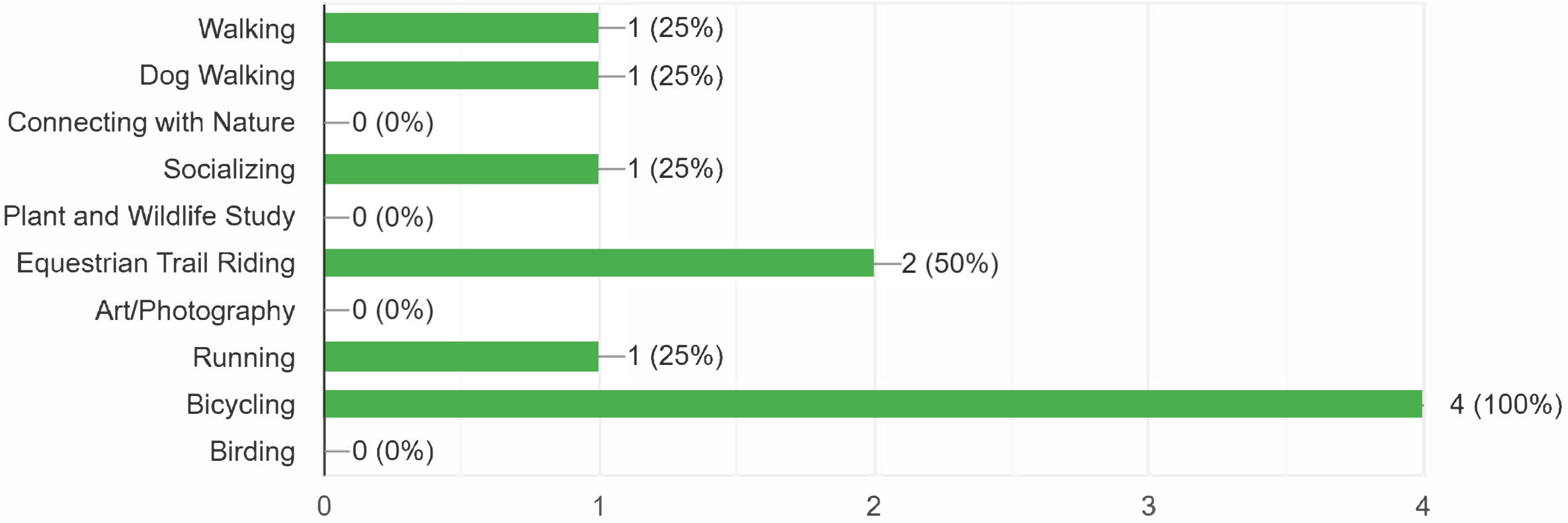
Do any of the suggested uses pose a major conflict with YOUR primary use?

9 responses



Which uses pose a conflict with YOUR primary use?

4 responses



Is there specific programming or events that could be hosted at the preserves related to your primary use?

7 responses

NA

Educational Bird walk or nature walk

nature study and habitat walks for kids

Education on native plant species

Bioblitz

Night walks with full moons.

birding and nature walks

Is there specific programming or events that you would prefer NOT to see held at the preserves?

6 responses

Hunting as they are already doing this at the sites

Active sports and hunting

huge events

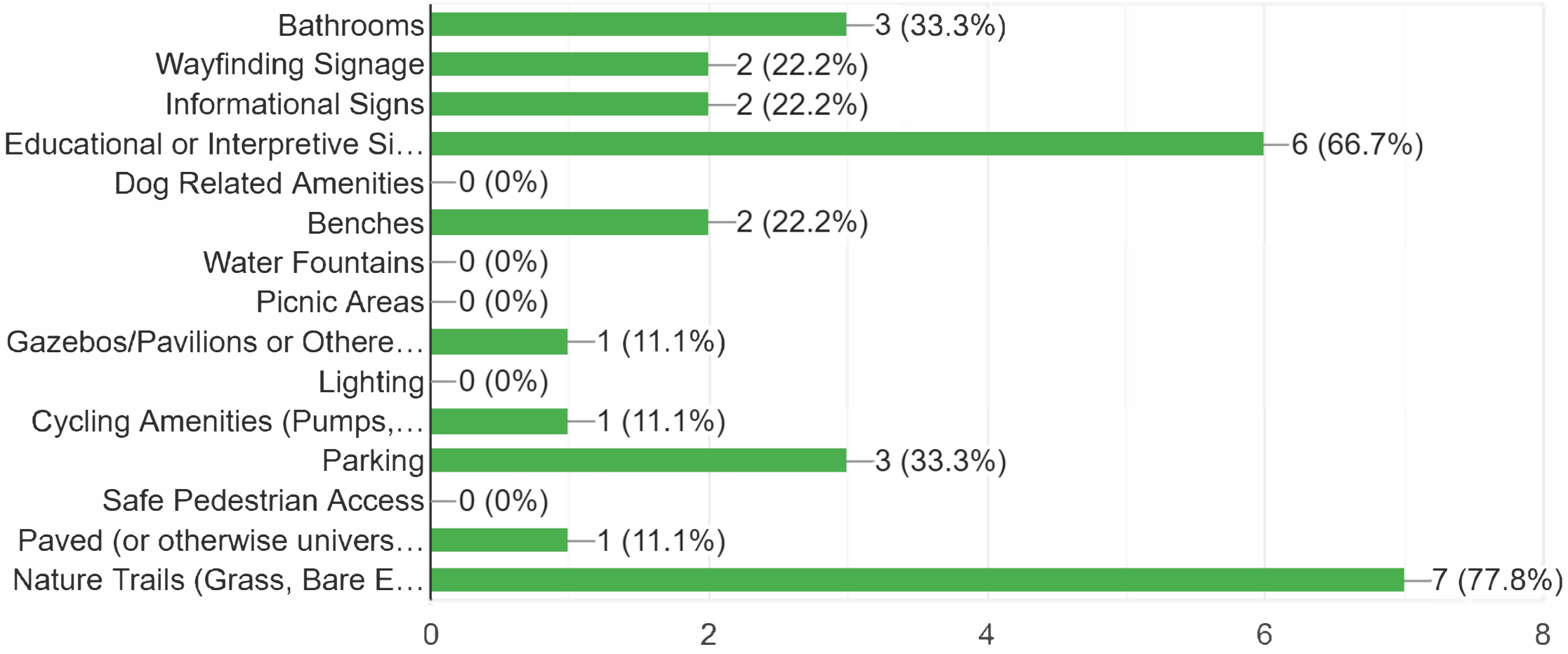
Group sport teams

Any events that would be very loud and frighten wildlife; concerts, fire works, etc.

active recreation activities

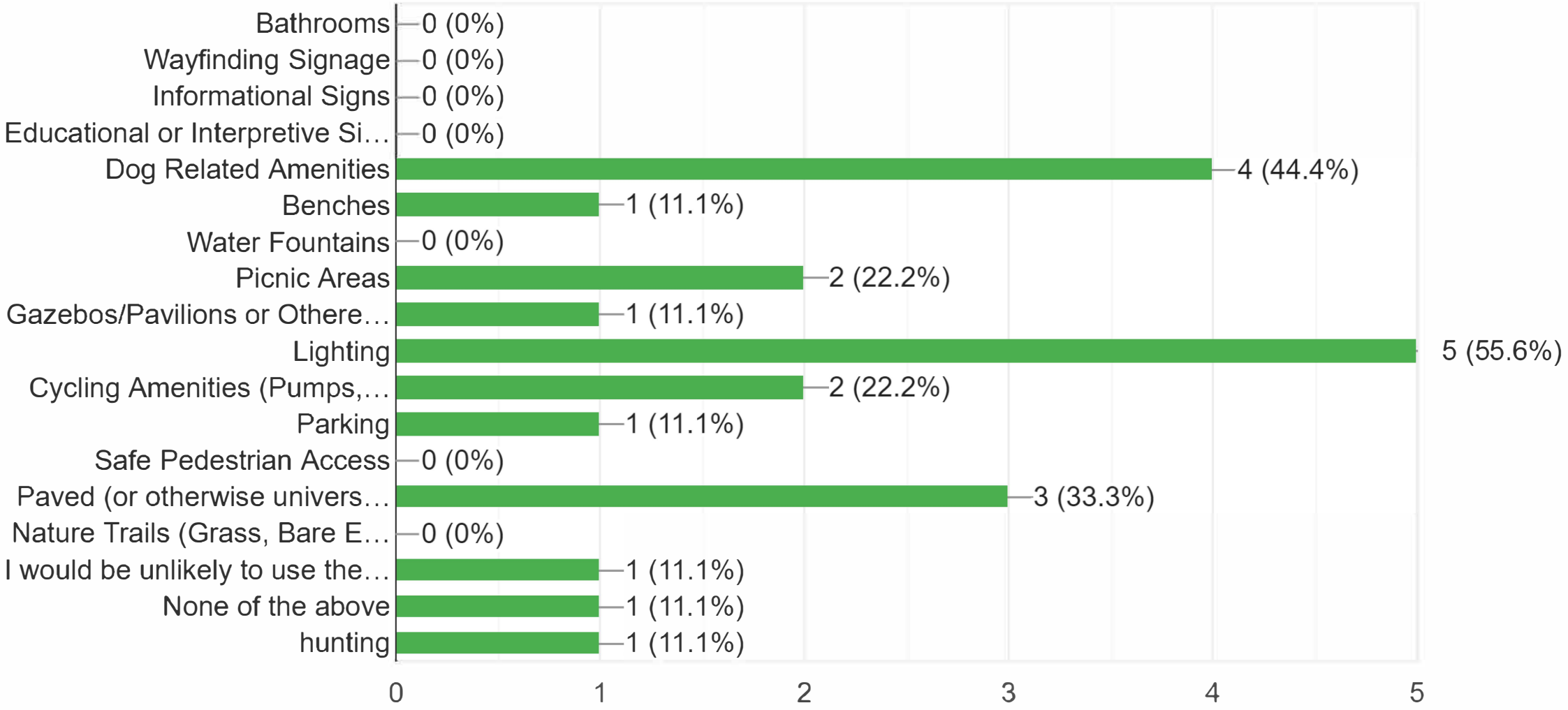
What amenities are most important to how you would primarily use the site (your selection in Q1)? (Choose 3 Max)

9 responses



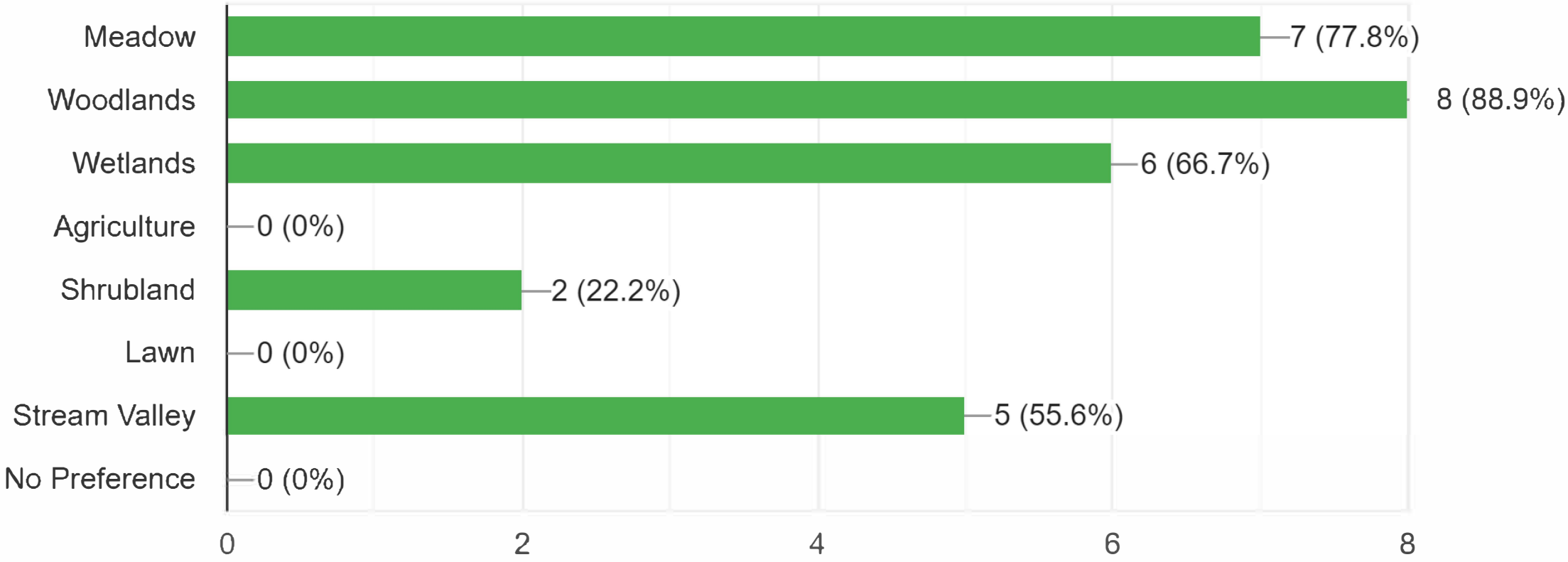
What amenities would negatively affect your use of the site?

9 responses



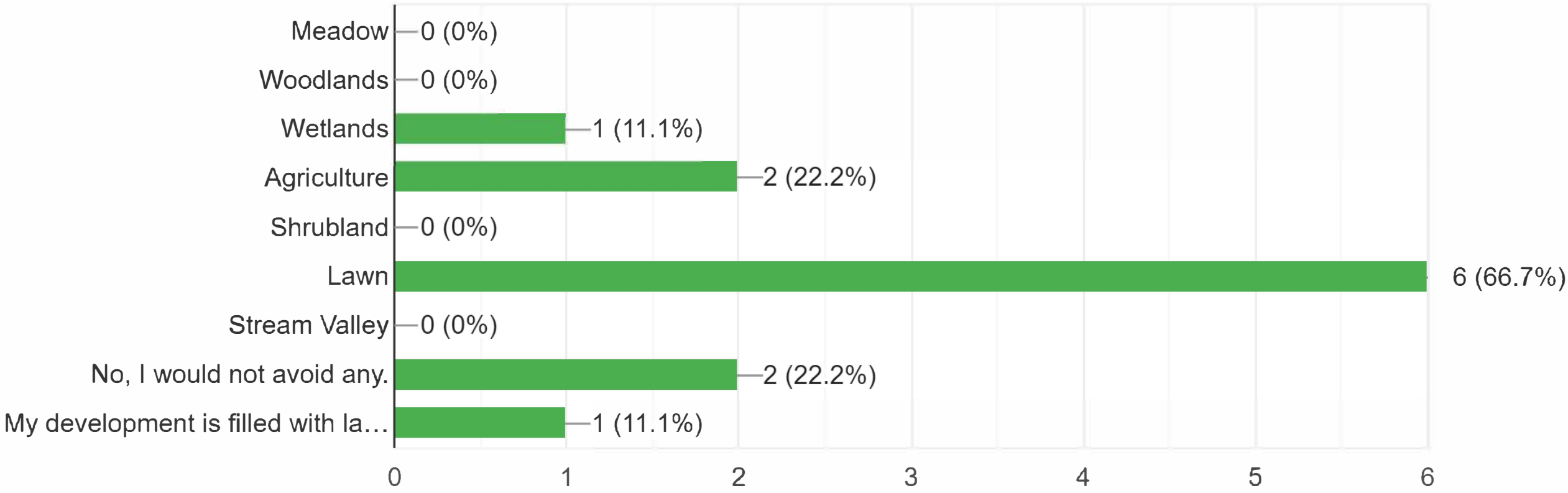
What is the preferred type of surroundings for your primary use?

9 responses



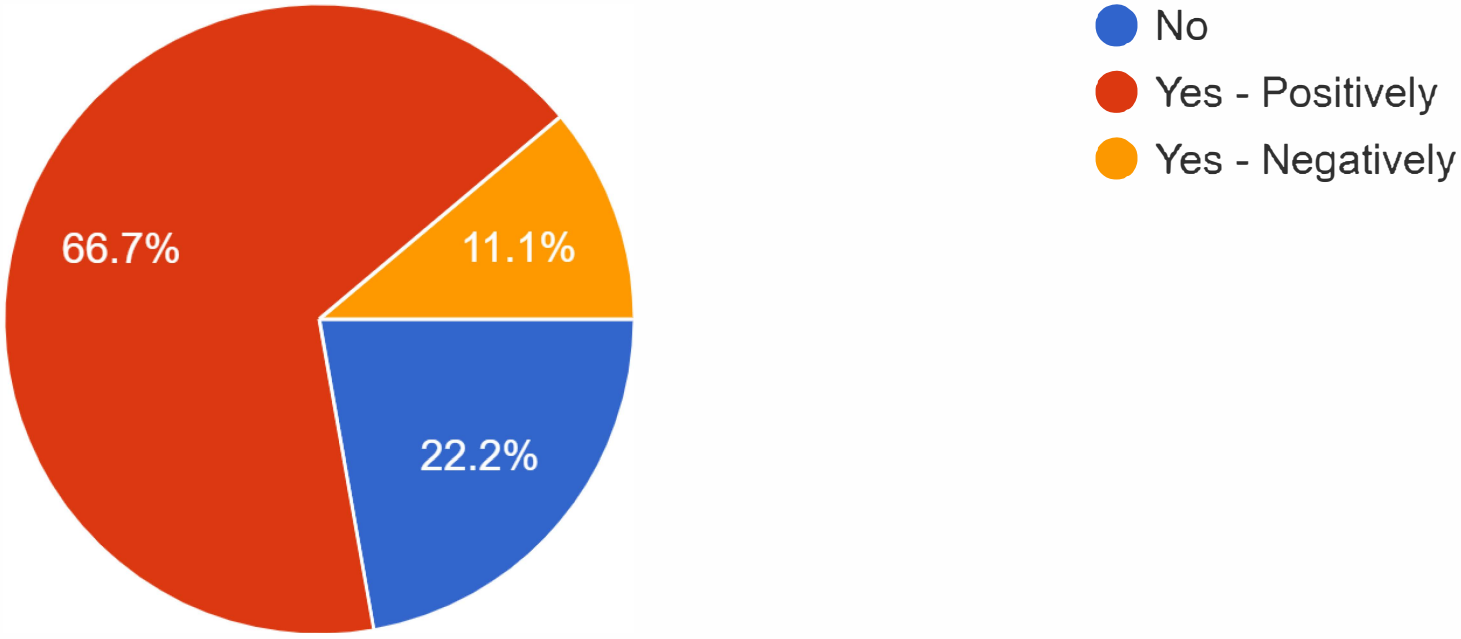
Are there any land cover types that you would AVOID for your primary use?

9 responses



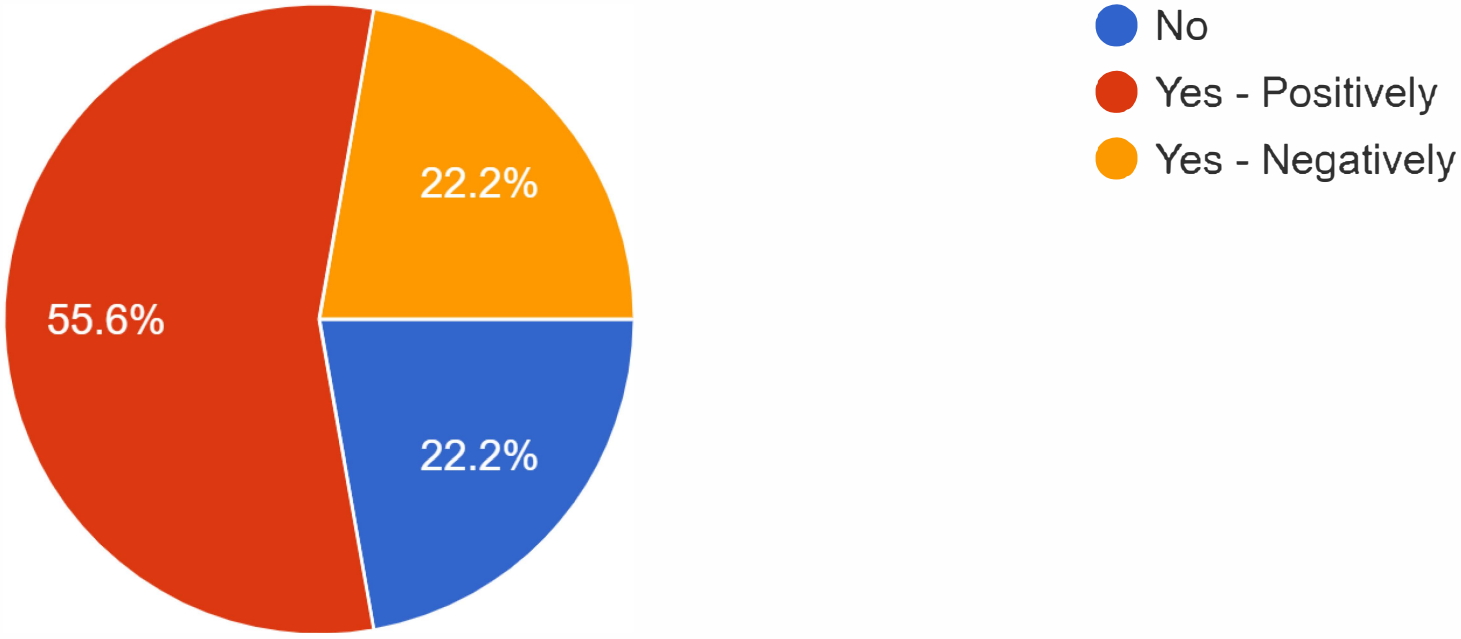
If the land stewardship and trails were designed to permit access to the pond, would that affect your primary use?

9 responses



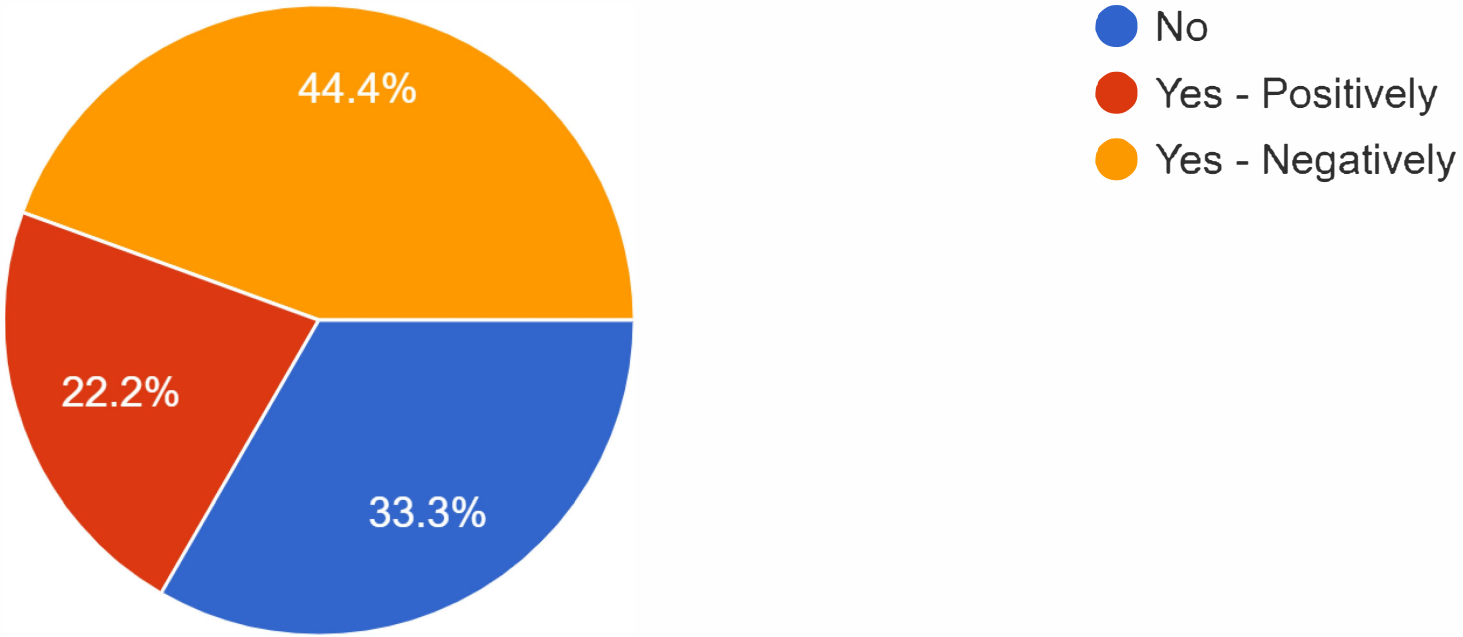
If the land stewardship and trails were designed to permit access to the pond, would that affect events or programs related to your primary use?

9 responses



If the pond were to be converted to a wetland, would it affect your primary use?

9 responses



One Big Idea

If you were the ruler of the Township, what big idea would you implement? It could be a use, an improvement, a program, an event or anything else. It could be at a specific preserve, or across all three of these preserves, or across the whole township. THINK BIG!!!

7 responses

Make these wildlife heavy themed parks

Keep all the farmed land as meadow habitat like Gwynedd or Dixon meadows.

I think public restrooms in natural spaces, regularly spaced to maximize use, are essential to allow members of the public to take best advantage of this spaces. If this were my township I would do two things: I would ensure access to public restrooms throughout the township and I would take absolutely every opportunity to reforest every space possible to reduce pollution and beautify the township.

Most important is to keep a land ethic in mind and to take a long-term, intentional view. Protect, preserve, and restore this public land. Public land is so precious - it must be considered an untouchable resource. Restoration will be a long, involved process: decades and money and hard work. Trees and meadows and grasslands and wetlands - oh my! Protect it now, restore it carefully, and preserve it for our great-great-grandchildren.

I would focus on beautifying the main paved pathways with native plantings and strive to have limited access off the main paved pathways to preserve the natural habitats.

One Big Idea

If you were the ruler of the Township, what big idea would you implement? It could be a use, an improvement, a program, an event or anything else. It could be at a specific preserve, or across all three of these preserves, or across the whole township. THINK BIG!!!

I would focus on beautifying the main paved pathways with native plantings and strive to have limited access off the main paved pathways to preserve the natural habitats.

I would focus heavily on securing and protecting some of the more sensitive habitats such as the vernal pools as well as excluding dog walkers from some areas in order to give wildlife areas away from what they perceive as predators.

Bike trails in the woods for off road cycling like at nockamixon

What did we miss? What else do you think we should know?

8 responses

not much really. Hunting is my biggest concern.

Keep the lighting to bare minimum. Hope it is day use only.

I thought this was really informative and well conceived. Thank you for helping to steward our communities and planet.

Deer management will be critical for any restoration of these preserves or any other public lands that we hold dear. The overpopulation of native white-tailed deer needs our immediate attention. A regional deer management committee is being formed by members of EACs in Bucks and Montgomery Counties. Please consider being actively involved in this effort.

I would say I would be concerned about converting the pond and destroying habitat of native reptiles and amphibians. Many of our native reptiles and amphibians use these ponds as annual breeding sites and a general home territory. These animals typically cannot be relocated due to issues with them honing to such a small designated area of land, and disease spread. We also often look for ponds when selecting a release site for wildlife and we do utilize sites like the ones mentioned for releasing rehabbed native wildlife.

What did we miss? What else do you think we should know?

8 responses

Warrington Township is a wonderful group to work with and cares about the environmental impact these open spaces will have in the future.

My biggest concerns would be any possible destruction to the surrounding habitat during construction, as well as altering any existing habitat such as the pond and vernal pools. Existing amphibian and turtle populations there would be extremely sensitive to these alterations. Impacts on these species is often not considered in the same way that more obvious animals to the casual observer are, such as birds or mammals.

Access to the parks by trail or bicycle. Not having to drive to get to one of these destinations but being able to have bike/hike trails or lanes on the roads to get to the parks safely.

Natural Lands

Warrington Township Key Person Interviews

Connie Ace

Date – *12/14/2020*
Project – *Warrington Township Open Space (5196)*
Interview conducted by Kate Raman
Notes by Hannah Thomas

Connie Ace is currently, and has been for the past five years, Chair to the Township Historic Commission which is responsible for advising the Board of Supervisors on issues related to historic preservation. She has lived in the township full-time since moving to the area in 2011, but has been a property owner in the area since 1984, when she and her husband purchased he in-laws poultry farm. Professionally, she is a biophysicist and works as a genealogist, assisting people with their research in local historic records.

With her work on the Historic Commission, Connie was one of the members responsible for naming the Emerson Farm Preserve after the Emerson family. She described that this was an important farming family who owned the property in the nineteenth century. Other work on the Commission has involved saving centuries old structures from being torn down from developers, and instead focal points of new developments.

Connie feels that the preservation of agriculture is an urgent issue as it is disappearing quickly. She mentioned that she always hears from residents that what brings them to Warrington, or what they like about it is the agricultural history and rural atmosphere.

1. Do you currently visit Mill Creek Preserve or the Weisel Preserve?
Connie said that she has only recently been to the Mill Creek Preserve. But, in the past has been to the Weisel Preserve property to photograph the horse farm which it surrounds, for the historic commission.

2. If yes, what do you like best about these spaces? (If not, why not?)
She thinks that their best attributes are the lack of development. This, to Connie includes lack of park land, lack of parking, as well as lack of anything unnatural.

3. How important is it to have paved trails for cyclists? Are you in favor of paved trails?
Connie felt very strongly against paved trails, answering “absolutely not”. She felt that because of the sensitive natural lands and habitat, the trails should be as natural as possible as paved trails only opens up the land to more traffic. However, at Weisel Preservewhere the trail is already paved, she said that that should remain, and not be torn up.

4. How would you access each site (on foot, via bicycle or in a car that would be parked in a lot)?
Connie stated that because Emerson Farm Preserve is closer to where she lives, she would walk. From where she lives she would be unable to walk to Mill Creek Preserve.

5. What uses should be located at each location? Nature trails, agriculture, bike paths, access to water?

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Connie was most excited about the wildlife habitat remaining on the Mill Creek Preserve, especially as the eagle nests there have been recently occupied. She mentioned that during her time in Warrington she has only seen the habitat get smaller, and it should be retained as it is an important aspect of the area. Therefore, she said Mill Creek Preserve should remain an open space, and non-agricultural.

At Weisel, she thinks that farming should have a continued presence. She would support the pond being cut off to public access with agriculture as at the Bradford Dam Park there have been issues with fisherman leaving litter (hooks, lines, etc.) and it negatively affecting the wildlife.

For the Emerson Farm Preserve, she is strongly in favor of retaining its agriculture as there has been agriculture on that property parcel for the past two-hundred years. She said that this property has been corn and soy beans for as long as she could remember. She mentioned a challenge with corn is that people tend to steal stalks for Halloween decorations. These crops would only require two days out of year for farmers, one day of planting, and one day of harvesting. She explained that due to the area's precipitation, no irrigation is needed.

At the Emerson Farm Preserve, Connie recalls that efforts were made in the development plan to conserve the best soil for agriculture. She is nervous about the berms along Pickertown Road, an effort to buffer for the neighbors, taking up too much space, as you cannot farm on berms.

Connie mentioned her concern for the quarry which is surrounded by the three open space sites. She says that it is a State operation which the Board of Supervisors has no say on. The trees and hedgerows help block the sound. She has noticed a drastic increase in sound as a result of the trees taken down at Emerson Farm Preserve. She is against developers stripping the land, and thinks that the hedgerows need to be retained, or if a new one is planted, they need to utilize a variety of species.

Connie mentioned that on her property she is hoping to do a CSA (community supported agriculture) and also suggested it for the Emerson Farm Preserve. She said that it has not been done in Warrington, and that it is "begging to happen". Connie also mentioned that the one farm which had a vegetable stand and available produce for purchase from local residents, has been turned into a development. Additionally, she suggested working in partnership with Delaware Valley University's Agriculture school as they have lost a lot of agriculture property and could provide assistant in management and maintenance. Connie said that about ten acres would be the appropriate size.

6. Who else should we talk to?

Connie suggested we also talk to Mary Doyle Roth, who is Chair of the Historical Society, and a long-time advocate of the Weisel family. She also suggested we talk to the people who are currently farming the Emerson Farm Preserve property to understand their intentions when the property is altered.

Natural Lands

Warrington Township Key Person Interviews

Frank Ace

Date – *12/10/2020*
Project – *Warrington Township Open Space (5196)*
Interview conducted by Kate Raman
Notes by Hannah Thomas

Husband of Connie Ace, Frank comes from one of the original farming families in the Township. He grew up on his family owned poultry farm on Folly Road, known locally as Yankee Farm. Here, his father had thousands of chickens, selling their eggs to hatcheries. Frank and his wife lived in New Jersey for thirty years, and after retiring, moved back to Yankee Farm where they lived with his mother who has recently passed away. Today, Yankee Farm is no longer a poultry farm. Frank and his wife lease the agriculture land to the owners of the farm adjacent, who use its field to grow corn, soy beans, hay, etc.

Through our conversation, Frank expressed a great passion for conservation and sustainability of agricultural land in the township for the future. He was disappointed that the township hasn't offered more incentive initiatives to preserve land, such as tax breaks, legacy arrangements, and buy-outs to avoid parcels being developed once a land owner dies. Additionally, he thinks that the township needs to be clear and upfront with developers that they cannot and should not tear down the historic stone farm buildings which are integral to the rural, Bucks County character.

He mentioned in our conversation that he wrote a letter in 2015/16 to board of supervisors expressing his stance on open space which he will send to Kate.

1. Do you currently visit Mill Creek Preserve or the Weisel Preserve?
He knows where they are as he drives by them frequently. Currently he uses the leaf/yard waste recycling plant on Weisel Preserve which is open to Warrington Township residents for the first seven days of each month. This facilities is not for commercial use.

2. How important is it to have paved trails for cyclists?
Frank seemed cautious about too many paved trails through the township, he doesn't think they all need to be paved. Instead, he felt that this was really only important for the main connector trails, and there should always be an option to use non-paved trails. Additionally, he mentioned that it felt that there were a lot of paved trials for cyclists in the area. He finished his thoughts saying that anything which can be avoid being paved, should.

3. How important is it to connect existing subdivisions? How would you access each site (on foot, via bicycle, or in a car that would be parked in a lot)?
Frank thinks that connecting to existing subdivisions, and local neighborhoods is a good thing. Currently he doesn't feel very safe walking along edge of Picktertown Road. Therefore, he mentioned that having parking lots available is a good thing, so you can park and get out to walk.

4. Should agriculture remain at these sites?
Frank believes that agriculture absolutely needs to have a presence, but he is also okay with some trails. He thinks that the township shouldn't push agriculture out of land-uses since the mission statement of the planning commission is to preserve the rural character of Warrington Township. He mentioned that in the 2016 Comprehensive Plan Update, polling showed that residents strongly agreed in favor of maintaining the township's rural character and farmland.

In regards to the possibility of agriculture at Emerson Farm, he thought that because of the proximity to housing people may not want it due to equipment noise. In reality though, he said that really they are only out there for two days out of the year with the mower and bailor, every other day of the year the crops "grow quietly".

5. What uses should be located at each location? Nature trails, agriculture, bike paths, access to water?
Frank believes that Mill Creek Preserve should be kept more like a 'nature park' as it is a beautiful natural landscape and used as owl and hawk habitat. He would prefer the agriculture to happen at Weisel, because he thinks Mill Creek should be left for habitat and is unsure how viable agriculture would be at Emerson Farm. At Weisel, a man named Mr. Crooke may be interested in the land as he currently farms on the land next to, and owned by the quarry.

He seemed to support the idea of meadows and a loop trail at Emerson Farm Preserve. In regards to Emerson's development, he mentioned that he really hates to see contractors clearing away the hedgerows, brush and understory of a natural woodland. He thinks this is important to preserve not only to keep things natural, but also it is very important to buffer the noise of the quarry. He mentioned that in recent years with increased development and removal of hedgerows the noise of the quarry in the area has drastically increased.

Natural Lands

Warrington Township Key Person Interviews

Jim Furlong & Janice DeVito

Date – *01/27/2020*
Project – *Warrington Township Open Space (5196)*
Interview conducted by Kate Raman
Notes by Hannah Thomas

Jim and Janice are both long-time residents of Warrington Township, and very involved with the Warrington Lion's Club. Janice is on the Township Zoning and Hearing Board, and Jim is the director of the Lion's Club. Their involvement has made them both incredibly knowledgeable about local history and culture, as well as the Township needs.

Both Jim and Janice felt that the more land that was kept preserved, and accessible for nature walks, the better. They mentioned that there were already plenty of active recreational areas around Warrington. Additionally, they were both very enthusiastic about local wildlife and environmental education for children.

1. Do you currently visit Mill Creek Preserve or the Weisel Preserve?
Jim and Janice mentioned that they know where the properties are and have been to them.

2. How important is it to have paved trails for cyclists?
Jim mentioned that the trails should be for walking and biking.

3. How would you access each site (on foot, via bicycle or in a car that would be parked in a lot)?
At the moment, Jim and Janice visit the properties by car, park, then walk around. Additionally, Jim mentioned that there could be connecting trails to Lion's Pride Park and John Paul Park, where there are already parking and bathroom facilities.

4. How important is it to connect existing subdivisions to these sites so that people can walk to or bike to open space?
They felt that it is very important to connect the properties to surrounding subdivisions, as it is important for people to connect to passive and active recreational areas.

5. What uses should be located at each location? Nature trails, agriculture, bike paths, access to water?
It was mentioned that recreational fishing may be a good idea, as people use the pond at Lion's Pride Park which will soon be converted to wetlands, so there will be a need for fishing. In regards to water access, Jim and Janice were enthusiastic about a dock and access points for kayaks as a possibility at one of the properties. They felt that any kid of use which would aid the promotion of outdoor activities would be great. Janice mentioned that having agriculture at a property could be good for educating school children about their food sources. Another suggestion was to have a 'flower park' where children could learn about the many types of flowers, and how to care for them. They were also both enthusiastic about using plants which support birds.

6. Which of these three sites are you most excited about? Least excited about?
Jim and Janice mentioned that while they don't live near the properties, their grandchildren live near Mill Creek Preserve.

7. Do you (or the public) have any major concerns about using any of these sites?
There were no general concerns. Jim mentioned that there will always be some kind of littering and vandalism, but with cameras you can handle the problem via technology. They felt any issues can be mitigated in a cost effective way.

8. Do you know of any events or organizations that would be interested in using the sites?
Jim and Janice mentioned both the Girl and Boy Scouts, any environmental clubs, school groups, and hiking/biking clubs. They felt that all the properties could be tied into community use, giving people an opportunity for these activities closer to home and school. Additionally, Jim mentioned at John Paul Park there is an artificial duck race held each year to raise money for the Lion's Pride Park which attracts hundreds of people.

Natural Lands

Warrington Township Key Person Interviews

Jim Molinari

Date – *12/09/2020*
Project – *Warrington Township Open Space (5196)*
Interview conducted by Kate Raman
Notes by Hannah Thomas

Jim served on the Warrington Township Board of Supervisors in the 1980's. He was one of the original elected officials to discuss open space when there was over 10,000 acres of undeveloped land in Warrington Township. He also was one of the first to develop a trail plan during his tenure. Jim prepared a 20-page typed document with photos to his successor on the Board of Supervisors. This document was of his recommendations and findings after conducting fieldwork following Mill Creek from Valley Road to the 202 Parkway in attempts to find where a trail could stretch across the township. None of the land parcels which Natural Lands is currently studying affected his decision making at that time. He said that the township decided to go a different direction than what he had recommended. Unfortunately, this was before computers and cannot be located.

1. Do you currently visit Mill Creek Preserve or the Weisel Preserve?
Jim knows where they are, but as they are all on the other end of the township from where he lives and is currently immobile, he has not recently visited any of them.

2. How important is it to have paved trails for cyclists?
Jim felt that the trails should provide access with a bike. His preference is that it would be a combination of paved and unpaved, similar to the 202 bypass.

3. How would you access each site (on foot, via bicycle or in a car that would be parked in a lot)?
He likes the way the Nikesite Park was planned and has seen people walking around that park. He thinks that a park should have amenities similar to the Nikesite. These include features such as pavilions, ball fields, and a parking lot.

4. How important is it to connect existing subdivisions to these sites so that people can walk to or bike to open space?
Jim thinks that it is important, and that that each new development should have a park in it "for kids to play".

5. What uses should be located at each location? Nature trails, agriculture, bike paths, access to water?
He mentioned liking the trail by Bradford Dam, specifically that it was a mix of land types, you could walk along the water, as well as through the woods and habitat areas. Additionally, Jim believes that the farming is important, and that the Weisel preserve would be a good place for that.

6. Do you (or the public) have any major concerns about using any of these sites?
Jim mentioned when he was on the Board of Supervisors, residents were concerned that "busloads of kids" would be showing up to the open space which was happening at Central Park in Downingtown.

7. Do you know of any events or organizations that would be interested in using the sites?
He thinks that some groups are using them already, especially a shooting/rifle club. Jim believes that once these plans are developed, some organizations would be very interested in using the sites.

Appendix C

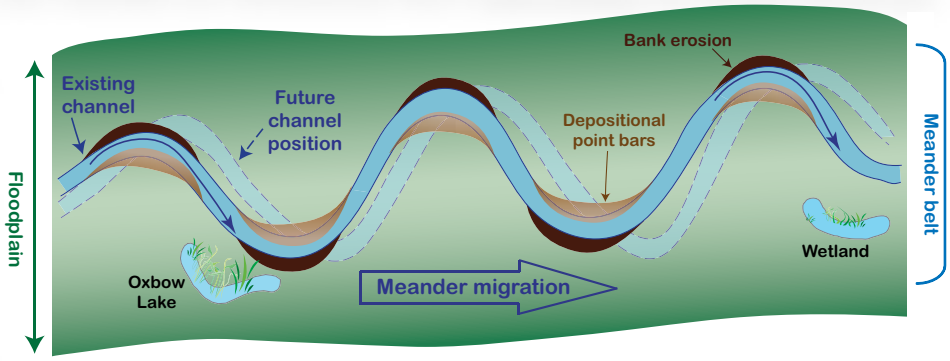
Streambank Restoration and Riparian Buffers

Resource Sheet 1: Streambank Erosion and Restoration

Why is my streambank eroding?

In order to determine why a streambank is eroding and to develop a restoration approach, it is necessary to understand stream behavior. All streams are dynamic, gradually changing shape as they erode, transport, and deposit sediment. A natural stream will have slowly eroding banks, developing sandbars, migrating meanders, and channels reshaped by flood flows. They are in a state of *dynamic equilibrium*, where the stream is able to maintain a stable shape (dimension, pattern, and profile) over time without excessive erosion or sedimentation even as natural changes or artificial changes occur in the watershed (see informational sheet Understanding Our Streams and Rivers).

A stream system maintains this dynamic equilibrium when its natural flexibility and a functional connection to the floodplain are preserved (see figure).



A natural, healthy stream channel meanders from bend to bend within a *meander belt*. This meandering (seen here from above) is known as the stream's *pattern*.

Many streams are artificially confined; consequently, they cannot adjust or regain their equilibrium within their meander belt or floodplain after a disturbance. Streams are increasingly confined by agriculture, infrastructure, and development in the floodplain. When ditches and levees, roads, bridges and culverts, rock revetments, and other structures are placed in the floodplain, the state of dynamic equilibrium is interrupted. Confined streams can no longer self-mend, which results in instability where bed and bank erosion is a common consequence.

Common causes of stream instability

Land use changes

Land use activities throughout the watershed lead to stream instability by changing the watershed's *hydrology*. Land use changes force a stream to adjust to changes in *discharge*, water *velocities*, or *sediment load*. For example, both urban storm drains and agricultural tile funnel rainfall quickly and directly into streams. These practices dramatically increase the peak discharge and water velocity of a stream. Additionally, this direct flow is low-sediment or "sediment-hungry" runoff and is very erosive. Another land use change that impacts hydrology is draining wetlands. By removing natural water storage, streams are further burdened with water that is no longer retained on the landscape. Consequently, affected streams are unstable, usually degraded and incised, and must eventually adjust their shape to accommodate the flashy discharge events with un-naturally high peak flows.

Land use change and channelization: The floodplain and stream corridor are impinged by agricultural fields. The meanders are disconnected after straightening by channelization.

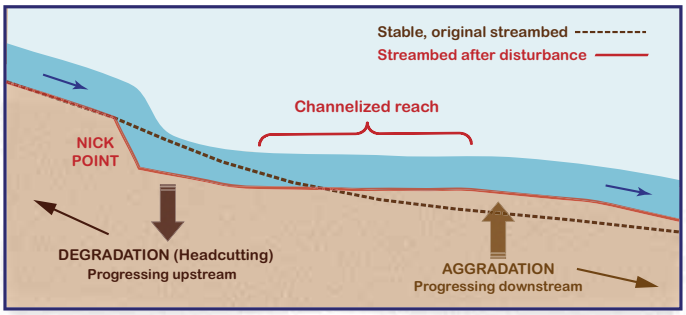
Vegetation changes

Streambank instability, erosion, and bank failure also result from a lack or loss of natural vegetation along streambanks. Deep, dense-rooting, and flood-tolerant native plants strengthen and stabilize the banks and slow floodwaters. (See additional benefits explained in Resource Sheet #2.) The loss or degradation of natural riparian vegetation can be caused by livestock overgrazing, row crops without vegetative buffers, herbicide applications, deforestation, or development. Once streambanks are degraded the potential for accelerated erosion is greatly increased because the banks are weak and unstable. Common practices of repairing banks with riprap are expensive, less stable, and lack the biological benefits of a vegetated bank.

Definitions:
aggradation: *rising streambed, sedimentation*
degradation: *lowering streambed, erosion*
discharge: *volume of water carried by a stream per unit time*
headcut: *downcutting of streambed in upstream direction*
hydrology: *movement of water through the hydrologic cycle*
nickpoint: *sudden change in the slope of the streambed*
sediment load: *amount of sediment carried by a stream*
slumping: *block(s) of bank slips down*
velocity: *speed of flow*

In-channel changes

In-channel alterations of stream shape directly disrupt stream balance resulting in *aggradation* and *degradation*. For instance, ditching or channelizing a stream replaces a long, sinuous stream reach with a short, straight, smooth channel. Such a change steepens the slope and removes roughness from the streambed. The sudden increase in speed and erosive energy of the streamflow will degrade the streambed within the straightened reach. Upstream the channel will begin to incise at the *nickpoint*. This forms an active *headcut* that migrates upstream (referred to as headcutting). Over time, the streambed continues to deepen and the entire stream reach becomes incised and disconnected from its floodplain.



In-channel changes: As shown in this side view, channelizing a stream may cause headcutting upstream and aggradation downstream.

The effects of channelization are widespread and impact the entire stream network. A headcut can initiate headcuts in the tributaries. This leads to excessive erosion and instability upstream into the basin. As excessive sediment is released into the stream system, the instability will extend downstream as the newly eroded sediment aggrades in flatter valley reaches.

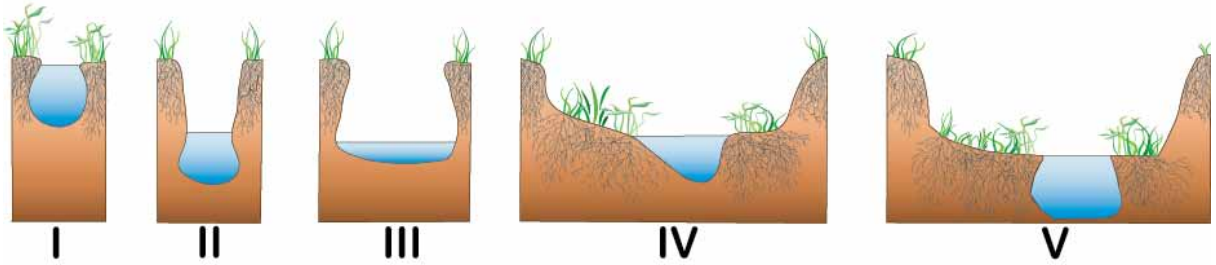
In-channel structures such as dams, bridges, and culverts interrupt the natural stream shape by creating unnatural reservoirs or passageways. For instance, culverts are commonly too small, set improperly, and do not emulate the natural channel pattern. Stream instability is the result as demonstrated by flooding upstream and erosion downstream of these structures.

Headcut & nickpoint: An active headcut degrades the bed of an Illinois stream.

Stream responses to disturbances

A disturbance such as ditching, development, or deforestation that changes the hydrology, stream shape, or riparian vegetation causes a stream to lose its equilibrium. When a stream is in disequilibrium, the stream channel actively adjusts toward a more stable form by going through transitional phases. Channel evolution can progress through many phases, where each phase could persist for years to centuries depending on stream and valley slope, geology, and hydrology. One of the more common channel degradation progressions is illustrated below.

Channel evolution



I. A properly shaped stream in **equilibrium** and connected to its floodplain prior to disturbance.
II. Channel incision from ditching or by a headcut originating in a channelized reach due to increased slope and flow.
III. Channel widening as the channel begins to meander again.
IV. A more properly shaped stream as it evolves to re-establish equilibrium and rebuild a new floodplain.
V. A new, properly shaped channel in equilibrium with a lowered floodplain.

The first section below describes an undisturbed stream in equilibrium. The next three sections describe common responses to stream instability after a disturbance. These responses vary greatly in extent and duration depending on the disturbance and the channel's recovery potential.

Equilibrium

A stream in equilibrium (Stage I in Channel evolution figure above) can transport water and sediment and dissipate the water's energy while maintaining its shape over time without excessive degradation or aggradation. A stream channel in equilibrium has these shape features:

- Pattern: a sinuous pattern that increases the stream's length, thereby decreasing its gradient and stream flows
- Profile: an alternation between riffles that help control stream gradient and pools that absorb the water's energy
- Dimension: the proper width and depth to effectively transport water and sediment supplied by the watershed

Furthermore, the channel is connected to the floodplain during high flows, the riparian zone is well vegetated, and the channel is not confined throughout the meander belt. As a result, channel movement (meander migration) and streambed and streambank erosion are minimal.

Channel incision

When a channel is incising (Stage II in Channel evolution figure), the streambed is actively eroding, downcutting, or degrading in response to disturbances such as:

- changes in the watershed (urban stormwater drains, ditching, tiling, draining wetlands) that introduce higher volumes of water or low-sediment ("sediment hungry") runoff,
- erosion by low-sediment water flowing over a dam or out of a reservoir,
- improperly sized or placed bridges or culverts that constrict flow and effectively act as dams,
- increased streamflow velocities because of disturbances such as channelization or urbanization, or
- a headcut that originated downstream.

An incised channel is disconnected from its floodplain. During high flows, the channel must transport the total volume of water because it cannot access the floodplain that, under natural conditions, could store and slow down the floodwaters. The banks of an incised channel are actively eroding (see Channel widening, below). Consequently, excessive erosion of the streambed and streambanks occurs and often results in long-term instability. As degradation continues, streambank heights and angles increase, which further reduces bank stability resulting in weak banks prone to failure and *slumping*.

Channel widening

Channel widening is lateral erosion of the streambanks (Stage III in Channel evolution figure). It can be caused by one or more of the following: channel incision; scour below culverts, bridges, or dams; flood flows in incised channels; weakened banks; increased streamflows due to watershed changes; aggradation; or construction of over-wide channels.

Channel widening occurs in an incised or scoured stream reach that attempts to find a new equilibrium by reforming and amplifying meanders to decrease the slope of the streambed and stream velocities. Also during this process, developing point bars establish a new floodplain that corresponds to the channel's new, lower streambed elevation. (For more detail, refer to the MN DNR website for the brochure, "The Shape of Healthy Rivers.")

Restoration philosophy

Incision is a common stream channel condition in Minnesota due to the prevalence of activities such as ditching and draining wetlands. It is also a systemic problem that results in stream instabilities throughout the watershed. During this response stage the channel will continue to unwind (degrade) until a new equilibrium is established. To reach equilibrium, the channel will go through successional stages that erode the banks to develop meanders, rebuild a new floodplain, and develop a properly sized channel that can effectively transport water and sediment. This process can be advanced artificially by constructing a properly shaped channel with a new lowered floodplain. Another method involves installing riffles and rock weirs that incrementally elevate the streambed to reconnect the channel to the original floodplain. These structures, unlike check dams, maintain sediment transport and are submerged during a bankfull event.

Widening is a successional stage following incision or aggradation when the channel is in disequilibrium. Restoration approaches depend on the cause, the extent of incision or aggradation, and future impacts. A restoration design could include the following:

- address upstream impacts by restoring upstream reaches (e.g. replace improperly placed culverts),
- restoring riparian vegetation,
- installing woody material and structures to add roughness, narrow the channel, and protect the banks,
- reshaping cutbanks with a bankfull bench,
- installing tree or rootwad revetments,
- excavating a properly shaped channel, or
- excavating a new floodplain.

Aggradation in Minnesota most commonly occurs downstream of channelized reaches. To re-establish equilibrium, an aggraded stream reach must develop a properly shaped channel (sinuous, deep, and narrow) through the aggraded sediment, which becomes the new floodplain. A restoration approach would be similar to that described above for an over-wide channel and similarly would depend on the cause, the extent of aggradation, recovery potential, and future circumstances.

(left) *Incision*: Extreme field erosion and an active headcut resulting from unbuffered runoff. (right) *Aggradation*: Downstream of the headcut, the flow of water slowed where the terrain flattened and deposited sediment, forming a delta.

Channel aggradation

Channel aggradation is the raising of the streambed elevation as sediment is deposited from upstream erosion along the flatter valley reaches, making the channel too shallow or over-wide. An aggraded stream reach will continue to fill and widen because the channel dimensions are out of balance with the amount of sediment that needs to be transported by the stream. More sediment settles out, further aggrading the stream bed. The channel becomes increasingly shallow, water extends laterally and erodes the banks, and stream flows more readily cause flooding.

Resource Sheet 1: Streambank Erosion and Restoration

What are the steps to address streambank erosion?

Extreme streambank erosion indicates an unstable, unhealthy stream. The instability stems from a change in the stream's shape, flow, or connectivity (see info sheet Understanding Our Streams and Rivers). These changes can be direct (ditching, dredging, straightening, dams) or the results of land use changes within the watershed (degradation of natural riparian vegetation, urbanization, logging, agriculture). Explained below are the recommended steps for restoring an eroding streambank with naturally designed approaches.

Identify the underlying cause

The first step is to determine the cause of stream instability. Are there disturbances in or along the stream; or are there destabilizing activities in the watershed? Individual landowners may not be able to control activities in a watershed that affect a stream, but landowners and citizens can have a voice in promoting and advocating natural channel design. In any situation, restoration and protection of natural riparian zones is a positive step for landowners to take to prevent or reduce streambank erosion and promote good stewardship of the watershed.

Adopt a natural design approach

Below is a list of recommended designs and approaches that can be used in combination to stabilize the soils in a streambank, protect the banks and floodplain, accelerate recovery, and ultimately restore stream stability. The keys to a successful bank stabilization project are:

- Allow the stream to maintain its dynamic equilibrium by not confining the channel.
- Design streambank structures to temporarily protect the banks while they stabilize.
- Consider future watershed conditions in a project design to assess how the stream will need to adjust with time.

The structures and materials listed in the box below are explained in more detail in following resource sheets.

Additional adverse impacts to stream health

Channel incision, widening, and aggradation not only affect stream **shape** and **flow** but also degrade the other components of stream health:

- **Biology.** Loss and degradation of aquatic and riparian habitat (e.g. sedimentation in riffles and pools, degraded riparian vegetation).
- **Water quality.** Higher turbidity and nutrient concentrations from erosion and land inputs. Warmer water temperatures in aggraded reaches and in reservoirs.
- **Connectivity.** Disconnection from floodplain habitat (lateral) in incised streams. Disconnection from upstream and downstream reaches (longitudinal) due to dams and culverts. Increased flood risk in aggraded streams.

Natural design approaches

Landscape scale
- Preserve and re-establish natural riparian and floodplain vegetation buffers
- Re-establish and protect the floodplain with compatible land use practices

Streambank stabilization and protection *(Resouce Sheet #2)*
- Vegetation: seed or plant native, deep-rooting vegetation on banks
- Biodegradable erosion-control blankets or hydroseeding
- Brush mattresses
- Biologs, wattles, or fiber rolls
- Tree revetments
- Toe wood-sod mat

In-stream bank protection
- Root wad revetments
- Bankfull bench
- J-hooks and rock vanes

Grade control (to decrease slope and reconnect channel to floodplain)
- Riffles and rock weirs

Large-scale restoration
- Re-meander straightened reach
- Remove or modify dams or improperly place culverts
- Excavate properly shaped channel
- Excavate new floodplain
- Reestablish and protect a functional floodplain with compatible land use practices
- Promote best management practices for runoff including: wetland restoration; minimum tillage; grassed waterways on agricultural land; and rain gardens and pervious pavement in urban areas

*These approaches are described in following resource sheets in this **Understanding Our Streams** series (in development).*

Consult with a professional and determine what permits you need

Contact a representative of the Stream Habitat Program from DNR Ecological Resources, your Area Hydrologist from DNR Waters, or your local soil and water conservation district to discuss what you can do on your streambank and within the watershed to minimize or correct streambank erosion. Before attempting any stabilization project, obtain the applicable permits from the DNR or other agencies. The permits you need can be identified when you contact your DNR Area Hydrologist and representatives from other agencies.

Contact Information

DNR Ecological Resources in St. Paul: 500 Lafayette Road, Box 25, St. Paul, MN 55155, (651) 259-5900
Stream Habitat Program website: http://mndnr.gov/eco/streamhab
DNR Waters in St. Paul: 500 Lafayette Road, Box 32, St. Paul, MN 55155, (651) 259-5700
DNR Waters website: http://mndnr.gov/waters

Riparian Buffers for Wildlife

Riparian buffers protect water quality by intercepting sediment and pollution from agricultural fields, residential lawns, roadways, and other sources. This improves habitat for aquatic wildlife while providing food, cover, water, and breeding areas for many other kinds of wildlife.

Riparian forests have been severely damaged or removed for many human uses, including agriculture, timber harvesting, development, and recreation. Losing these buffers has negatively affected wildlife habitat and water quality throughout the state.

If you own agricultural fields that border a wide river, a cabin near a large lake, or even a small stream in your backyard, you can improve water quality and wildlife habitat by creating a riparian buffer. Restoring and maintaining riparian buffers may take time, money, and effort, but plenty of assistance is available to help you through the process. This fact sheet provides the information you will need to create an effective riparian buffer for wildlife while protecting water quality for everyone.

Benefits of Riparian Buffers

Riparian buffers offer many benefits for wildlife, but they also improve water quality for humans. In general, the wider and more diversely planted the buffer, the more likely it is to yield positive benefits. A riparian buffer:

■ Traps sediment.
Runoff from agricultural fields, lawns, and roads is deposited in the buffer rather than being allowed to enter the water. Trees and shrubs along a stream bank help to keep moving water from eroding the bank, further reducing sedimentation rates.

■ Traps nutrients and pollutants.
Excessive amounts of pesticides, fertilizers, and animal wastes from farms, lawns, and roadways can seriously disrupt an aquatic system. Fertilizers that make a lawn green and lush and make corn grow also encourage high levels of plants and algae in a stream, which depletes oxygen levels. A good riparian buffer can remove up to 80 percent of excessive nutrient inputs.

■ Recharges groundwater.
A riparian buffer prevents surface runoff from moving too quickly over the land before it can filter into the soil and recharge groundwater supplies. This also helps to control flooding as well as maintain adequate flow during dry times.

■ Provides better habitat for fish.
Fish depend on a good aquatic habitat, and a stream without a riparian buffer is not likely to support good fish populations. Resident fish such as trout, as well as migratory fish like the American shad, depend on the quality of each "link" in the stream system. A poor or nonexistent riparian buffer can affect fish both directly and indirectly. Too much fine sediment caused by erosion and runoff can be especially damaging to fish by clogging their gills and smothering spawning sites for both fish and aquatic insects. A lack of trees along the riparian zone can cause higher water temperatures, which may ultimately deplete oxygen levels in the water.

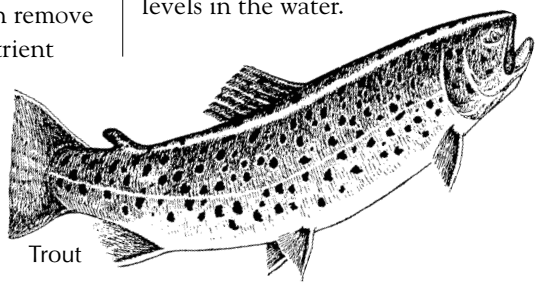
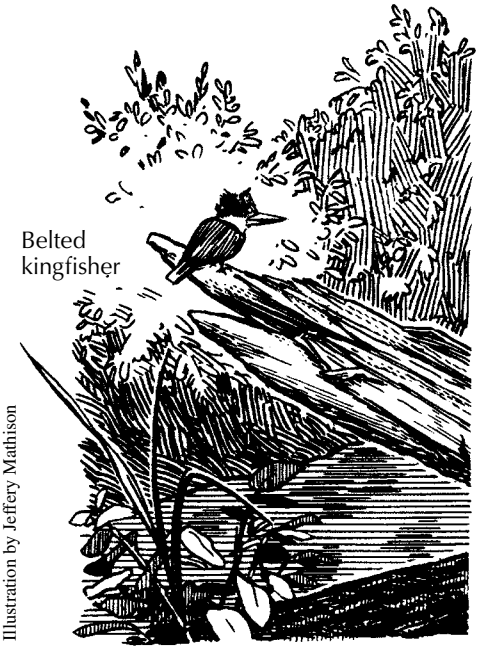

Trout

Illustration by John Sidelinger

PennState Extension

A riparian buffer helps to supply organic materials (leaves and woody debris), which provide food for aquatic invertebrates (and these, in turn, provide food for wildlife). A buffer serves as the basis for a more diverse structural habitat for all aquatic life. As a stream system's quality declines, fish like catfish and carp, more tolerant of poor conditions, begin increasing, and those less tolerant, such as trout, begin to decline.

■ Improves habitat for other wildlife.
A good riparian buffer provides food, shelter, water, and breeding sites for birds, mammals, amphibians, and reptiles. Which species will be found in riparian habitats largely depends on the type and size of the water source (wetland, river, stream, lake, or pond), as well as the habitat within the riparian buffer (diversity of tree species, availability of nest and perch sites, frequency of flooding, etc.). For example, some smaller mammals such as the eastern cottontail, white-footed mouse, and meadow vole may be found in any riparian buffer as long as some cover is available. Other mammals, like the mink, look for expanses of riparian forest with scattered down trees, which provide shelter near streams and ponds.



Belted kingfisher

Illustration by Jeffery Mathison

Birds like the alder flycatcher are likely to be found only near streams with a thick understory of shrubs, whereas the pileated woodpecker can be found in nearly any type of mature riparian forest, as long as large trees are available for nest cavities. Amphibians like the eastern hellbender and mudpuppy, which require water throughout their life cycles, need clear, fast-moving streams with snags and an abundance of aquatic insects for food.

Along ponds and lakes, bullfrogs, green frogs, cricket frogs, and American toads lay their eggs in the shallow waters and then use upland riparian areas for foraging and shelter. The wood turtle overwinters in smaller headwater streams but uses adjacent riparian areas to forage and breed, and the northern watersnake forages for food along stream edges.

Planning Your Riparian Buffer

When planning your buffer, it is best to work with someone who is familiar with riparian restoration. This person can help you consider all that is necessary to make the best decisions given your land, time, and money constraints.

A riparian buffer is usually conceptualized as consisting of three zones. Each zone's basic design and function, along with its possible wildlife benefits, are shown in the diagram on the opposite page. Zone 1 begins at the water's edge, and Zones 2 and 3 move inland. Each zone has a different mixture of trees, shrubs, or grasses; the composition and the width of each depends on the size of the water body, the intensity of upstream land use, the wildlife benefits desired, and other factors.

In addition to wildlife needs, many other factors influence buffer design. Some of the more practical considerations in deciding how to create a riparian buffer are as follows:

■ Buffer width
While wildlife use may be your primary consideration, hydrology, prior land use, slope of the land, and desired water quality benefits are a few of the many considerations in determining zone and total buffer width. For example, a small stream with minimal inputs from adjacent land use may require only a small Zone 1 to improve aquatic habitat, while a larger water body with intense adjacent land use might require larger areas of each of Zones 1–3 to provide water protection and wildlife habitat. If you live near a lake or pond, you may simply be able to leave the area adjacent to the water unmowed or planted with wildflowers, especially if fertilizers or pesticides are not used. In areas with excess sedimentation problems, you may want to consider planting more of your total buffer in grasses (Zone 3), which help to hold the soil.

A total width of 25–50 feet from the stream's edge is usually the minimum suggested as an effective buffer for bank stabilization and water quality control, but most wildlife require wider buffer widths. As the size of the buffer increases, the benefits for both wildlife and water quality increase. Providing a very small buffer (less than 25 feet) may not be very useful for wildlife, but it would still have some water quality benefits. Small mammals generally require 20–30 feet of buffer, while amphibians can require anywhere from 10 feet to 300 feet. Birds that prefer edge habitat use almost any size of buffer, but many more area-sensitive species need at least a 100- to 300-foot riparian buffer. If you have only a small area of land to put into a riparian buffer, consider planting species such as fruit-bearing shrubs or trees that will afford the most benefits for wildlife.

■ Current adjacent land uses
The recommended minimum buffer width depends on the adjacent land use. For example, is the land adjacent to the water agricultural, a residence, or in commercial use? If it is agricultural, does the farmer use best management practices, or are

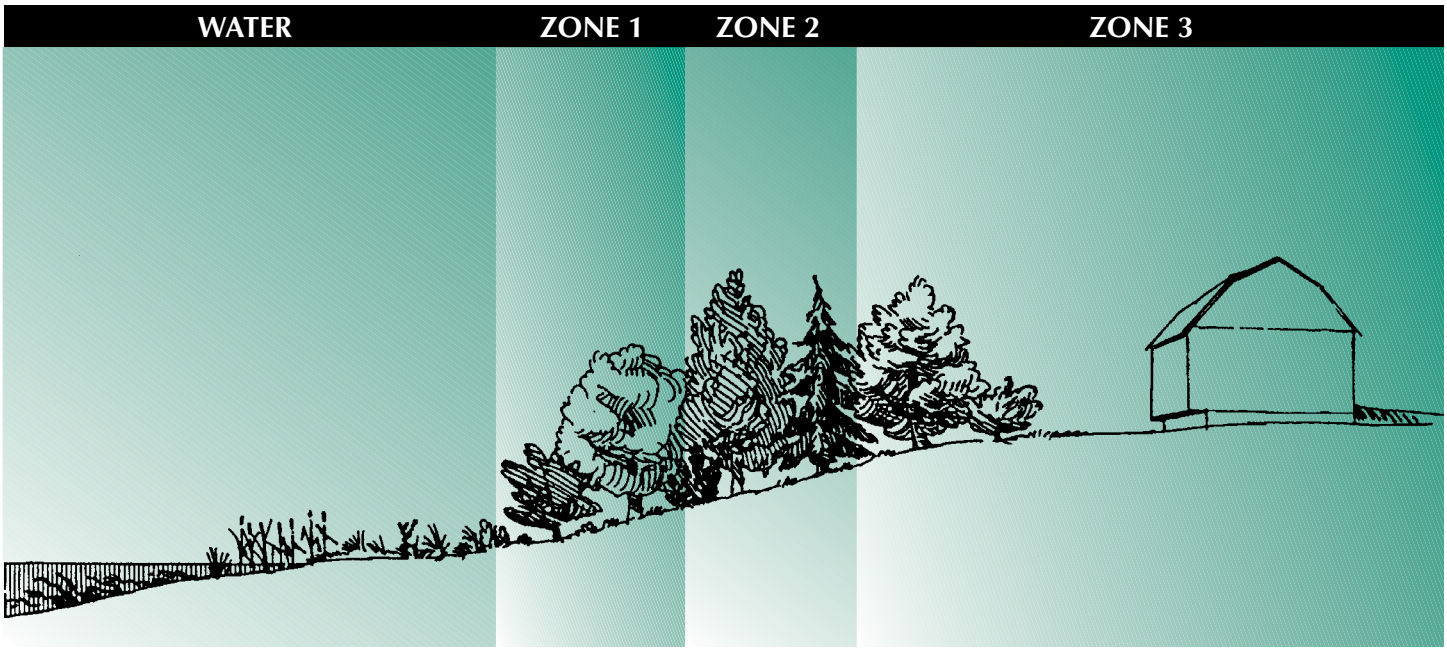


Illustration by Jeffery Mathison

ZONE 1

Purpose

- To provide bank stabilization as well as shade and organic inputs for the stream system.

What to plant

- Larger trees and shrubs are typically planted in this zone to increase stability; they should be species that tolerate wet conditions.

Potential wildlife benefits

- Shades water to keep temperatures cooler for fish.
- Organic inputs from trees provide food for aquatic insects, which in turn provide food for fish, amphibians, and birds.
- Branches falling into the stream can provide structure as well as hiding places for small fish and insects.
- Bats forage for insects near water.
- The belted kingfisher uses overhanging branches to forage for fish.
- Wood ducks use cavities or nest boxes along larger streams for nesting.
- Trees like the river birch are hosts for butterflies like the tiger swallowtail.

ZONE 2

Purpose

- This zone is usually a managed forest or mixed forest shrubland. The vegetation here helps to absorb excess nutrients such as nitrogen and phosphorus, preventing them from entering the water. This zone also helps slow runoff and allows it to recharge the groundwater supply.

What to plant

- A diverse array of native trees and shrubs.
- Can also be used for economic benefit (limited timber harvest, nuts, mushrooms, etc.).

Potential wildlife benefits

- Travel corridor for wildlife.
- Migrating birds find insects and fruits on shrubs and trees during stopovers.
- Deer, birds, and other wildlife use evergreen shrubs and trees as winter cover.
- Native shrubs and small trees like American holly, inkberry, persimmon, and gray dogwood provide fruit for many wildlife species throughout the year. Larger trees like red oak supply acorns for mammals and waterfowl during the fall.
- Amphibians use seasonal pools of water within low spots for breeding. Some salamander species place their eggs on wet logs or rocks.
- Fallen trees can provide dens or shelter for some mammals.
- Bats roost in large standing cavities.

ZONE 3

Purpose

- Planted as grassland or a mix of grasses and wildflowers. In residential areas, gardens or compost piles can be established here. In agricultural areas, this zone can be important for slowing runoff and trapping sediment.

What to plant

- Native grasses, wildflowers, or gardens if being used near agricultural or residential areas.
- Can also be planted in shrubs or trees where there is not high sediment runoff.

Potential wildlife benefits

- Hummingbirds use certain wildflower species for nectar.
- Butterflies and moths use certain wildflower species for nectar and as host breeding plants.
- Large areas of grassy habitat can attract breeding grassland birds.
- Nest boxes can be used to attract bluebirds and tree swallows.

there heavy inflows of excess fertilizer, animal waste, or pesticides into the water? Agricultural land that contributes heavy loads of sediment and other pollutants requires a larger buffer than a single residence where no chemical pesticides or fertilizers are used.

■ Creating corridors

A riparian buffer is more valuable to wildlife if it is connected to similar habitat areas. A small patch of riparian forest will not attract the same diversity of wildlife as one made larger by being connected to additional habitat of the same type. Connectivity is especially important for some amphibians, which move to upland habitats after the breeding season and avoid crossing dry, open areas.

■ Slope of the land

Where the riparian area has a very steep slope leading to the water, a wider buffer is necessary to slow runoff traveling over the land to the water. Planting more of the total buffer in grasses rather than trees or shrubs can help to spread and slow runoff, allowing it greater infiltration into soil.

■ Current condition of the stream and stream bank

A Stream Visual Assessment (see "Sources of Assistance and Additional Information") can help you determine the overall condition of your stream. If the stream bank is very eroded or the stream has been channelized, additional work may be needed before the riparian areas can be replanted. This will likely incur additional costs, and professional assistance may be necessary.

■ Existing soil conditions

The pH of the soil in your riparian buffer and its composition will determine what types of plants to use. In addition, well-drained soils absorb runoff more quickly, requiring a smaller buffer width, while poorly drained soils require a wider buffer.

■ Need for other economic benefits

Some landowners use riparian buffers for supplemental economic benefits as well. Limited timber harvesting can be allowed in Zone 2, as long as some standing snags are left for nesting and perching sites. Other crops you can grow and harvest include black cherry (specialty wood), exotic mushrooms (e.g., shiitake), or herbal plants (e.g., ginseng).

■ Technical and financial assistance

Many programs for both farmers and residential landowners can provide monetary assistance, technical advice, and labor for a riparian buffer project. In addition, many local organizations can furnish volunteers to help replant riparian areas. Before starting any project, check with these sources and your county extension office and county conservation district office to make sure the project is appropriate for existing zoning regulations.

Enhancing Wildlife Habitat and Water Quality

Once you have assessed current conditions on your land, it is time to figure out your goals for the wildlife that may be using your buffer. You might only be interested in improving stream quality for better fishing, to provide habitat for frogs and toads, or just to provide habitat for as many wildlife species as you can. While it would be hard to create a buffer with a particular species in mind, there are many things you can do to improve the overall quality of your riparian buffer.

Illustration by Jeffery Mathison

There are only general guidelines as to which species will use a buffer of a certain width, and much variation can exist within a particular group of animals. For example, the pileated woodpecker and the scarlet tanager are likely to be found only in large expanses of forested riparian habitat (greater than 500 feet total width), whereas the hairy woodpecker and red-eyed vireo may be found in somewhat smaller forested buffers (150 feet total width). The northern cardinal, brown thrasher, and northern mockingbird will use even the smallest areas of shrubby riparian habitat since they prefer transitional zones. As a general rule, the wider the buffer, the more species it supports. The same holds true for mammals, amphibians, and reptiles.

No matter how large a riparian buffer you can provide, keep in mind the following to improve the design of your buffer so that you attract the greatest diversity of wildlife:

■ Control excess sediment in water.
An increase in fine sediment owing to a poor or nonexistent buffer can be extremely detrimental for fish and aquatic insect populations. As you increase the size of your riparian buffer, the more opportunities there are for runoff to be intercepted by trees, grasses, and shrubs, and the benefits generally increase as the total size of the buffer increases (up to around 100 feet). Where sedimentation is a problem, a greater portion of the total buffer may need to be planted in grass, which will more effectively slow and trap sediment.

■ Keep water temperatures cool.
Large, flood-tolerant trees like willow or black birch if planted along your stream bank help to shade the water, keeping water temperatures cool. Cooler water temperatures also help to discourage filamentous algae growth, which can deplete oxygen levels and encourage the growth of parasitic bacteria. The stream will likely need to be completely shaded to be effective in providing habitat for fish like trout that prefer cooler waters.

American robin

Illustration by Jeffery Mathison

■ Provide food for aquatic insects.
As leaves and branches from a riparian buffer fall into a stream, they eventually become food for aquatic invertebrates (insects). These are, in turn, an important food source for fish and other wildlife. Some evidence suggests that providing such insects with native vegetation rather than exotic plants helps to create a more abundant and diverse aquatic community.

■ Add structure to water.
The branches and other woody debris that fall into a stream from a riparian zone afford structure as well as refuge and hunting spots for fish. Some aquatic turtles use logs and other woody debris as "sunning" spots.

■ Increase structural diversity on land.
A riparian buffer that has a mix of native vegetation is more likely to attract a greater diversity of wildlife. Therefore, a buffer planted only with pine trees will benefit a few species, but one that combines native tree and shrub species with a border of native grasses or wildflowers will attract a greater assortment of wildlife. See "Planting Your Riparian Buffer" (below) for more details.

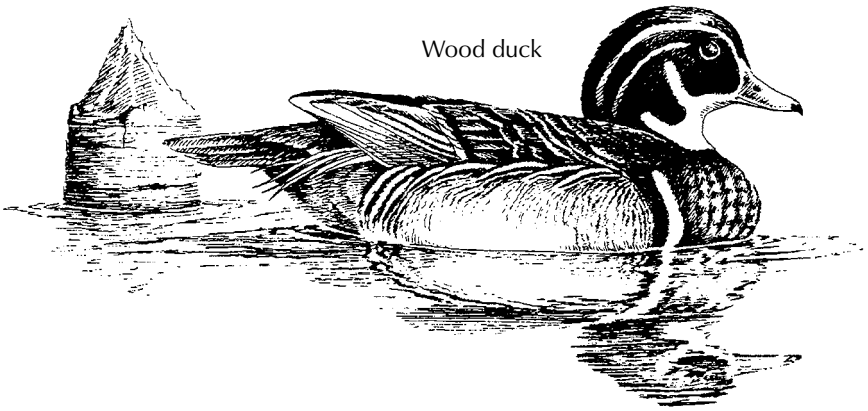
■ Retain large, standing, dead trees (snags).
Primary cavity-nesting birds (those making their own cavities), such as the downy, hairy, and red-bellied woodpeckers, use snags as nesting sites. Secondary cavity-nesting birds (those using cavities already created), like the bluebird, tufted titmouse, and great-crested flycatcher, may eventually use these sites. Also, many bats prefer to feed on insects in riparian areas on or near rivers, ponds, and lakes and roost underneath the peeling bark of larger, dying trees.

■ Provide food for wildlife.
Providing a natural food source is one of the best ways to attract wildlife to your riparian buffer. Squirrels, turkeys, ducks, and deer take advantage of the acorns from oak trees. Both birds and mammals find shrubs that produce berries, such as holly, dogwood, and viburnum (there are many varieties). A good riparian buffer also serves as a stopover site for migratory birds, which use even small patches of riparian habitat to find food (insects on trees and fruit produced by shrubs) and water during migration.

■ Provide winter cover.
Resident mammals and birds use small areas of dense, coniferous trees such as eastern hemlock or white pine for shelter from winds and harsh weather in winter.

■ Install nesting or roost boxes.
Many species use artificial nest boxes because they mimic natural cavities. Boxes placed near grassy areas and open fields (they can be near a forested edge) attract both bluebirds and tree swallows. If placed within or near a forested setting, boxes are more likely to attract birds such as the tufted titmouse. Larger nest boxes situated within more mature wooded areas can attract the great-crested flycatcher. Wood ducks, typically found along rivers at least 600 feet wide, nest in large cavities along the river's edge. Installing appropriate cavity boxes in large trees along a river or lake encourages use by this waterfowl species.

Bats are one of the best wildlife species to have near your farm or home because they help control insect pests. To attract roosting bats to your riparian buffer, place bat boxes in sunny locations near the water. There are fairly specific requirements for the construction and placement of bat houses, and organizations such as Bat Conservation International Inc. (see below) have more information on this and other topics related to bats.


Wood duck

Illustrations by John Sidelinger

■ **Use native plant species.**
Native wildlife and native plants belong together. In particular, many butterflies and moths use certain native tree species as host plants. Other insects use wildflowers planted in a riparian buffer as a nectar source. Beneficial insects such as dragonflies are also attracted to buffers.

■ **Leave hollow logs or brush piles.**
Many small mammals use downed hollow logs or brush piles for cover or nesting sites. Amphibians also use these structures as cover. Snakes use large rocks as den sites and take cover under large brush piles or logs.

■ **Maintain stream bank integrity.**
Weasels, otters, and muskrats use burrows within a stream bank as den sites, and rough-winged swallows and belted kingfishers excavate nest tunnels within stream banks. Trampling by livestock and lack of vegetation along a stream bank increase erosion and limit the availability of this type of habitat.

Planting Your Riparian Buffer

While you can leave your riparian buffer alone and allow it to regrow naturally, without additional preparation or plantings a good buffer is likely to take much longer to establish. In addition, many people find that without assistance their riparian habitat gets overtaken with exotic species such as multiflora rose or honeysuckle. Although a buffer with only minimal vegetation is still much better than bare soil, some extra effort can create a much more effective buffer in a shorter time. Many organizations are willing to donate time, money, seedlings, and expertise toward your project. If you decide to add vegetation to your buffer, you can plant trees, shrubs, grasses, and other herbaceous perennials to enhance diversity and add benefits for wildlife. The amount of preparation your site will need depends on prior land use, the stream bank's condition, and other factors. Below are some things you will want to consider as you prepare and plant your buffer zone:

■ **Soil type**
Although many plants thrive in a wide variety of soil types, some species do not do well in soils of a certain pH, moisture, or texture. Test the soil at various locations within your buffer to get the most accurate assessment of which plants you will need throughout your buffer.

■ **Hardiness zones**
Pennsylvania has three hardiness zones (5–7), so make sure that the plants you choose will tolerate your particular location.

■ **Choice of plantings**
Consider native plants that are available from local growers and nurseries, and avoid invasive species. Think about plants that offer the most benefit as food, cover, and nesting sites, and include a mix of deciduous and evergreen species (see table on page 7). If possible, plant species that are tolerant of full sun first and save understory or shade plants until after the first plantings have become established. For areas near the stream bank, choose species that will completely shade the stream when they reach full height. Where deer browsing or beaver activity is a problem, use plants known to be less palatable to deer and beaver, or fencing may be needed.

■ **Reducing effects on soil**
Avoid using heavy equipment to plant trees or shrubs, especially near the stream bank; this causes soil compaction and erosion.

■ **Fencing**
On agricultural lands, livestock entering a stream area can seriously disrupt water quality as well as harm the stream bank. Stream bank fencing can be used along a riparian buffer to help keep livestock from walking near and through a stream, thus preventing water pollution, bank erosion, and excess sedimentation. Fencing also allows vegetation to regrow in the protected areas, further helping to trap sediment and pollutants and minimize erosion. It is recommended that fencing be placed a minimum of 25 feet from the edge of the stream bank. Fencing around newly planted saplings or seedlings can help to lessen damage caused by deer or beaver.

Maintaining Your Buffer

Your riparian buffer should be monitored and maintained regularly at first, and then periodically as the buffer becomes established. Routine maintenance may be necessary, depending on weather conditions and other factors. Some things to consider are the following:

■ **Water**
During the first growing season, newly planted trees and shrubs need water at least once a week until they become established. Newly planted vegetation should also be inspected after heavy rains to make sure that they are not damaged.

■ **Weed control**
Weed control may be necessary for the first few years as trees and shrubs become established. Organic mulches such as

leaf humus, wood chips (avoid redwood or cedar; they can be toxic to some types of plant seedlings), pine mulch, or shredded bark help to retain moisture and limit weeds in a newly planted buffer. Mechanical methods of weed control are preferable to using herbicides, which are likely to enter the water.

Mowing

Zone 3 may need to be mowed periodically to keep it as a grassy-herbaceous patch and prevent it from becoming overgrown with shrubs. Avoid mowing from April to July when birds may be nesting there.

Looking Ahead

While many different species will "find" your riparian buffer immediately after it has been planted, others will not use your buffer until it has a chance to mature, which may take several years to several decades. As your riparian buffer ages, the plant communities and habitat within it also change and become attractive to different wildlife. Whatever type of riparian buffer you create, you have contributed a valuable resource for both people and wildlife.

Sources of Assistance and Additional Information

Books

Verry, E. S., J. W. Hornbeck, and C. A. Dolloff. *Riparian Management in Forests of the Continental Eastern United States*. 2001. Gives detailed information on the specific habitat needs and uses of wildlife along riparian zones in the eastern United States. Although geared toward forest managers, it still provides useful information for all landowners.

Websites

Connecticut River Watershed

Provides a useful 10-part fact sheet series, "Riparian Buffers for the Connecticut

Some native trees, shrubs, and perennial herbaceous plants that you can plant in a riparian buffer. See "Sources of Assistance" for more information. A plant guide or nursery can provide information on hardiness zones, mature height, and other considerations.

Species	Site moisture preferences*	Light preferences	Wildlife benefits
Trees			
American holly	W	S to SH	Fruit
Black cherry	M to D	S to PS	Fruit
Black willow	W	S	Host plant for butterflies
Common hackberry	W to D	S	Fruit
Eastern hemlock	W	SH	Winter shelter
Eastern white pine	M to D	S to SH	Seeds, winter cover
Green ash and white ash	W to M	S to SH	Seeds
Persimmon	W to D	S to PS	Fruit
Red maple	W to M	S to SH	Flowers, buds, leaves, and seeds
Red oak	M to D	S to PS	Acorns
River birch	W	S to SH	Catkins, foliage, host plant for butterflies
White oak	M to D	S to SH	Acorns
Willow oak	W to M	S to PS	Acorns
Shrubs			
American cranberrybush	W	S to SH	Fruit
American holly	W	S to PS	Fruit, winter cover
Black chokeberry	W to D	S to S	Fruit
Flowering dogwood	M to D	S to PS	Fruit
Grey (swamp or red-panicle) dogwood	W to D	S to PS	Fruit, twigs, leaves
Highbush blueberry	W	S to PS	Fruit
Inkberry	W to M	S to SH	Fruit
Mapleleaf viburnum	W to D	M to S	Foliage, twigs, fruit
Mountain laurel	W	S to S	Foliage, twigs, winter shelter
Nannyberry	W to D	S to PS	Fruit
Northern bayberry	M to D	S to PS	Fruit
Silky dogwood	W to M	S to PS	Fruit
Spicebush	W to M	PS to SH	Fruit, nectar, host plant for butterflies
Winterberry	W to M	S to S	Fruit
Herbaceous perennials			
Bee-balm	M to D	S to PS	Nectar
Black-eyed susan	M	S to SH	Nectar, host plant
Blue lobelia	W to M	S to SH	Nectar
Cardinal flower	W to M	S to SH	Nectar
Christmas fern	M	PS to SH	Shade
Joe-pye weed	W to M	S to PS	Attracts butterflies, beneficial insects
New England aster	M	S to PS	Nectar, seeds
Partridgeberry	M to D	PS to SH	Berries
Solomon's seal	M	S to S	Berries
Swamp milkweed	W to M	S to PS	Nectar, host plant

Species to avoid: multiflora rose, mile-a-minute, purple loosestrife, autumn olive, Japanese barberry, Norway maple, Japanese knotweed

*W=wet, M=moderate, D=dry, S=sun, PS=partial sun, SH=shade

River," and details many aspects of riparian buffers for residential and agricultural landowners. Call 603-826-4800 for reprints.
www.crjc.org/riparianbuffers.htm

Pennsylvania Department of Environmental Protection

Pennsylvania's Stream Releaf Program
As part of the Chesapeake Bay Program, the state has committed to help restore riparian buffers on Pennsylvania waterways. The program publishes a handbook containing lists of resources that can help you in planning your buffer and places to look for money and technical advice. **www.dep.state.pa.us/dep/deputate/watermgt/wc/subjects/streamreleaf/default.htm**

Natural Resources Conservation Service

Stream Visual Assessment Protocol
This protocol helps landowners to assess visually the condition of their streams. **www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044776.pdf**

Bat Conservation International, Inc.

Provides help on constructing bat houses and information on how to attract bats to your property. **www.batcon.org**

Financial Assistance, Technical Advice, and Volunteer Help

U.S. Fish and Wildlife Service

Partners for Fish and Wildlife Program
Provides financial and technical assistance for habitat restoration on private lands. Eligible land must be set aside for at least 10 years. **partners.fws.gov**

U.S. Department of Agriculture/ NRCS/Farm Service Agency

Website has information on all the programs listed below. Or contact your county USDA service center office for more information. **www.fsa.usda.gov/programs-and-services/conservation-programs/index**

Conservation Reserve Program (CRP)

Offers annual rental, incentive, and maintenance payments for certain activities, including establishing riparian buffers on croplands or marginal pasturelands.

Conservation Reserve Enhancement Program (CREP)

An offspring of the CRP, the CREP is a voluntary program for agricultural landowners. The program involves state-federal partnerships that focus on high priority environmental concerns.

Sources of Native Plant Information, Seeds, and Seedlings

Natural Lands Trust

This organization has a useful guide to native Pennsylvania trees and shrubs as well as their site preferences and wildlife value. **www.natlands.org**

Wildlife Habitat Council

Provides on-demand webinars on topics including implementing a riparian buffer zone. **www.wildlifehc.org/knowledge-center/conservation-academy**

Pennsylvania Department of Conservation and Natural Resources

Publishes a brochure, "Landscaping with Native Plants," which lists some plants native to Pennsylvania and their site preferences. Also available on website. **www.dcnr.state.pa.us/foresty/plants/index.htm**

Pennsylvania Native Plant Society

Website lists native plant sources in the state. **www.panativeplantsociety.org**

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Acknowledgment

Partial funding for this fact sheet was provided by Pennsylvania's Wild Resource Conservation Fund.

extension.psu.edu

Penn State College of Agricultural Sciences research and extension programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

Produced by Ag Communications and Marketing

Code UH165 2/17pod

FORESTED RIPARIAN BUFFER PLANTING GUIDE FOR LANDOWNERS AND DEVELOPERS

BRANDYWINE CONSERVANCY

Preserving Our Land & Water

www.brandywine.org/conservancy

ASSISTANCE AND FUNDING INFORMATION

BRANDYWINE CONSERVANCY:

brandywine@brandywine.org

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Senior Land Use Planner
Phone: 610-388-8124
rdaniels@brandywine.org

Meredith Mayer Braine
Associate Planner
Phone: 610-388-8351
mbraine@brandywine.org

PA EXTENSION:

Penn State Agricultural Analytical Services Lab
Phone: 814-863-0841
Fax: 814-863-4540
aaslab@psu.edu

Chester County Penn State Extension
Government Services Center
601 Westtown Road, Suite 370
West Chester, PA 19380-0990
Phone: 610-696-3500
Ask to be connected to the master gardener hotline.

SOIL SURVEY CONTACTS:

USDA - Natural Resource Conservation Service
One Credit Union Place, Suite 340
Harrisburg, PA 17110-2993
Phone: (717) 237-2100 (General office)
(717) 237-2207 (Soil)
(717) 237-2236 (GIS)
Fax: (855) 813-2861

Local USDA Contacts List

FUNDING

Grant funding from organizations like Treevitalize is sometimes available for the purchase of trees. Additionally, funding can be available for tree protection and site maintenance. Call or email the **Brandywine Conservancy** contacts at left for information.

ACKNOWLEDGEMENTS

This work follows upon prestigious work focused on the optimal function, form, and composition of riparian buffers completed by Stroud Water Research Center, USDA, PA Conservation Districts, Penn State Extension, and many, many more. Brandywine Conservancy and PALTA are proud to be cooperative partners with so many leaders in the field with a focus on the health of our precious water systems.

FORESTED RIPARIAN BUFFER PLANTING GUIDE FOR LANDOWNERS AND DEVELOPERS

The protection of forested riparian buffers often depends on local land use regulations. An increasing number of Pennsylvania townships, boroughs, and cities are enacting regulations to require buffer protection and restoration.

This document is a how-to guide for the planting and maintenance of forested riparian buffers, the most effective and cost-efficient way to protect water quality.

This guide was created to inform each step of the planting project, whether undertaken voluntarily, or in accordance with a municipal riparian buffer ordinance. It can also be used in the creation of a planting and maintenance plan for revegetating an impacted riparian buffer, voluntarily or when required by your municipality.

WHY FORESTED RIPARIAN BUFFERS?

USDA FS http://nac.unl.edu/documents/workingtrees/brochures/wta.pdf

RIPARIAN BUFFERS ARE IDEALLY FORESTED LANDS THAT BORDER STREAMS, RIVERS, RESERVOIRS, PONDS, LAKES, WETLANDS, & OTHER WATER BODIES.

https://allianceforthebay.org/2014/05/chesapeake-riparian-forest-buffer-leadership-summit/

FORESTED RIPARIAN BUFFERS are essential for healthy streams that are sources of drinking water. They are the most *cost-effective* way to:

filter excess nutrients, sediment, and pesticides from runoff,

improve the safety and reliability of the water supply,

reduce water treatment costs,

stabilize stream banks,

reduce flooding,

maintain ideal water temperature for aquatic animals,

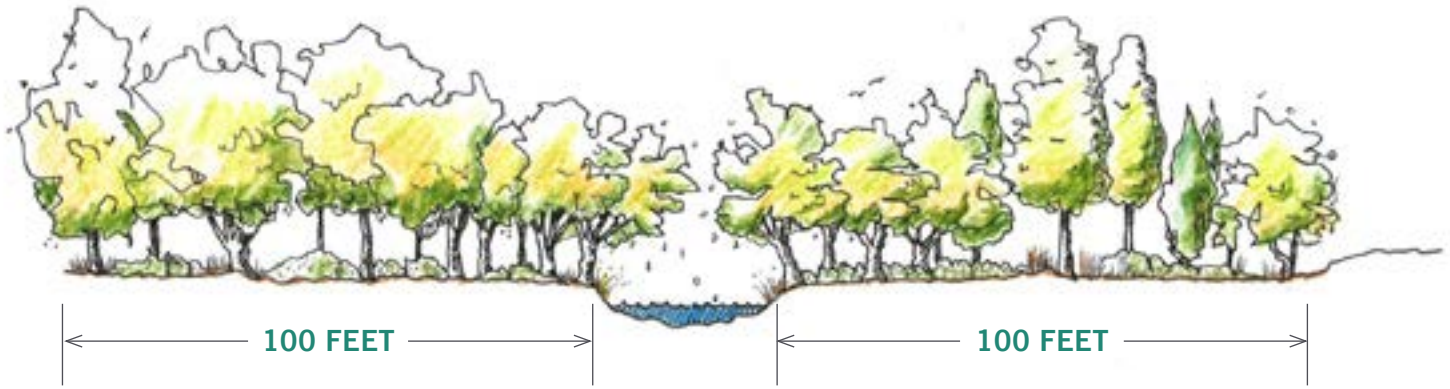
protect native plant species and provide habitat for wildlife,

absorb and store carbon from the air,

feed streams with organic matter essential for bottom dwelling organisms,

and help conserve scenic and recreation areas.

WHAT DOES A FORESTED RIPARIAN BUFFER PROTECTED BY A LOCAL ORDINANCE LOOK LIKE?



A cross-section illustration of a forested riparian buffer from PALTA's model overlay district.

The publication, Riparian Buffer Protection via Local Government Regulation, A Guide and Model Ordinance for Pennsylvania Municipalities, authored by the Brandywine Conservancy on behalf of the Pennsylvania Land Trust Association (PALTA), includes a model riparian buffer protection overlay district suitable for municipal zoning ordinances. A forested riparian buffer that is required by this model overlay district is defined as (see illustration above):

"An area that begins at each edge of a water body and extends landward a minimum width of one hundred (100) feet. This area is to be measured horizontally on a line perpendicular to the nearest edge of the water body. Where a floodplain extends greater than one hundred (100) feet from the water body, the riparian buffer area extends to the outer edge of this defined 100-year floodplain."

According to the model overlay district, the regulated riparian buffer is to be continually maintained with a diverse mix of locally adapted native species of canopy trees, understory trees, shrubs, and herbaceous plants that provide a minimum of sixty (60) percent uniform canopy coverage. Uses of land within this forested buffer are limited, and include stream restoration projects, stream crossings for farm vehicles, natural trails, and docks, and other "low-impact" uses (see model ordinance for complete listing). Also permitted within the outer fifty (50) feet of the buffer, but subject to special municipal approval, are paved trails, stormwater outfalls and conveyance structures, and up to twenty (20) percent land clearing or disturbance for uses permitted by the zoning.

Where existing buffers do not yield the sixty (60) percent canopy coverage, the model overlay district requires their restoration to be the full one hundred (100) feet. The model overlay district includes planting standards for restoration purposes. A planting and maintenance plan is a required submittal of applicants seeking municipal approvals (building or zoning permits, conditional use, special exception, variance applications, subdivision or land development approvals).

The actual width of a forested riparian buffer when required by a municipal ordinance may be wider or narrower than that of the PALTA model. Additionally, streams designated by Pennsylvania's Department of Environmental Protection as Special Protection Waters, may require wider buffers. Consult your municipality for any established forested riparian buffer requirements.

For landowners voluntarily reforesting buffers, a forested buffer of at least 100 feet in width is the best practice determined by research[1] to maintain or improve water quality.

1 http://www.stroudcenter.org/about/pdfs/Sweeney2014-JAWRA-StreamsideBufferWidth_LiteratureReview.pdf

HOW TO PREPARE THE SITE

SITE PREPARATION

The first step in riparian buffer establishment is site preparation. Preparation of a site requires removal of all invasive vegetation (list on page 7) to reduce competition for new native trees and shrubs. Site preparation includes mowing, cutting, and herbicide application. Always use aquatic-safe herbicides and heed instructions and warnings on herbicide labels. For large projects, hire a licensed professional to apply herbicide (see Appendix 2 contractor list and Appendix 3 herbicide resource list). As bare ground and soil disturbance[2] lead to erosion and invasive seed germination, mow invasive ground cover down to a low or lawn height, but *do not remove it entirely* from the site. For sites with large invasive populations, allow sufficient time for site preparation (i.e., a growing season). Site preparation techniques vary, as follows, depending on prior land use and current site conditions.

Grassy fields with few woody plants:

Mow site. Cut and remove any large woody invasives (page 7) and apply concentrated glyphosate herbicide to the cut stems.

Sites with many invasive shrubs & vines but only a few seedlings/saplings:

Eradicate invasive shrubs and vines (page 7) which will compete with the future sapling plantings. First, use a brush hog to cut out as much invasive vegetation as possible. Then apply glyphosate herbicide with either a backpack sprayer or a boom sprayer. Cut and remove any large woody invasives and apply concentrated glyphosate to the cut stems. Retain any native species (Appendix 1).

Brush hogs quickly and effectively mow invasive grasses, small shrubs, and small vines.

http://i.ytimg.com/vi/QHnzBHlFh-So/maxresdefault.jpg

Cut stem method of herbicide application.

https://greenshootsnews. files. wordpress.com/2012/09/cut-stumpapplication.jpg

Sites with very young saplings and fewer invasive shrubs & vines:

You may find a few pioneer species *(see box at right for definition)* at your site prior to buffer establishment. Native pioneer species *(list at right)* should be retained during reforestation. Here, the goal is to preserve pioneer species and fill in around them with new plantings. Retain saplings of any species listed in Appendix 1 (Species to Plant) or the list at right. Retained saplings begin desired canopy closure at crown heights of 12-20ft. Remove invasive and noxious saplings (page 7) by cutting trunks with a chainsaw, then coating the cut stumps with concentrated glyphosate. Remove all invasive shrubs and vines from your site in the manner previously described.

2 Earth disturbance of an area greater than one acre requires an National Pollutant Discharge Elimination System (NPDES) Permit. Contact your local Conservation District with questions.

WHAT ARE PIONEER SPECIES:

Pioneer species are the plants which take hold first in a riparian area. They are generally sun-loving and short-lived, so pioneer species will not generally persist as dominant riparian buffer species. However, many should be retained because they do act as a "quick fix" in a riparian area—providing shade, bank stability, filtration, habitat, and food while slower-growing climax vegetation (the species which will ultimately compose your riparian buffer) have a chance to take hold.

NATIVE PIONEER SPECIES THAT SHOULD BE RETAINED

Smooth/Hazel Alder (*Alnus serrulata***)**

Fringetree (*Chionanthus virginicus***)**

Fothergilla (*Fothergilla major***)**

Black Ash (*Fraxinus nigra***)**

Carolina Silverbell (*Halesia carolinia***)**

Snowbell (*Styrax americanus***)**

American Elm (Ulmus Americana)

Slippery Elm (*Ulmus rubra***)**

INVASIVE PLANT ERADICATION

When preparing and maintaining your forested riparian buffer site, eradicate the species listed below and never introduce them while planting. For additional photos to help identify these noxious and invasive plants, see the **Pennsylvania Field Guide Common Invasive Plants in Riparian Areas**.

TREES

Norway Maple (*Acer platanoides*)
Tree of Heaven (*Ailanthus altissima*)
Sawtooth Oak (*Quercus acutissima*)
Princess Tree (*Paulownia tomentosa*)
Mimosa (*Albizia julibrissin*)
Siberian Elm (*Ulmus pumila*)
Ornamental Flowering Pear (Pyrus calleryana)
White Mulberry (*Morus alba*)

SHRUBS

Goatsrue (*Galega officinalis*)
Bush Honeysuckles (*genus Diervilla*)
Japanese Spirea (*Spiraea japonica*)
Privet (*genus Ligustrum*)
Giant Hogweed (*Heracleum mantegazzianum*)
Burning Bush (*Euonymus alatus*)
Barberry (*Berberis vulgaris*)
Autumn Olive (*Elaeagnus umbellata*)
Russian Olive (*Elaeagnus angustifolia*)
Multiflora Rose (*Rosa multiflora*)

GROUND COVERS

Crown Vetch (*Securigera varia*)
Ajuga (*genus Ajuga*)
Bamboo (*tribe Bambusoideae*)

REMOVE INVASIVE PLANTS AND STATE LISTED NOXIOUS WEEDS IN PENNSYLVANIA

Ornamental Flowering Pear
https://en.wikipedia.org/wiki/Pyrus_calleryana

Tree-of-Heaven (*Ailanthus*)
Bargeron, University of Georgia, Bugwood.org

Mile-a-Minute
Mehrhoff, University of Connecticut, Bugwood.org

Winged Euonymus (Burning Bush)
Miller, USDA Forest Service, Bugwood.org

Japanese Hop
https://gobotany.newenglandwild. org/species/humulus/japonicus/

Common Reed (Phragmites)

Multiflora Rose
Miller, USDA Forest Service, Bugwood.org

Oriental Bittersweet
Evans, Illinois Wildlife Action Plan, Bugwood.org

FLOWERS

Purple Loosestrife (*Lythrum salicaria*)
Japanese Knotweed (*Fallopia japonica*)
Lesser Celandine (Ranunculus ficaria)
Canada Thistle (Cirsium arvense)
Bull or Spear Thistle (Cirsium vulgare)
Musk or Nodding Thistle (Carduus nutans)
Jimsonweed (Datura stramonium)

VINES

Japanese/Chinese Wisteria (*genus Wisteria)*
Oriental Bittersweet (*Celastrus orbiculatus*)
Porcelain Berry (*Ampelopsis brevi-pedunculata*)
English Ivy (*Hedera helix*)
Wintercreeper (*Euonymus fortunei*)
Vinca Periwinkle (*Vinca major & minor*)
Mile-a-Minute (*genus Polygonum*)
Trumpet Creeper (*Campsis radicans*)
Kudzu (*Pueraria lobata*)
Japanese Hops (*Humulus japonicas*)
Japanese Honeysuckle (*Lonicera japonica*)

GRASSES

Japanese Silver Grass (*Miscanthus sinensis*)
Pampas Grass (*Saccharum ravennae*)
Reed Canary Grass (*Phalaris australis*)
Common Reed (*Phragmites*)
Shattercane (*Sorghum bicolor*)

HOW TO SELECT AND SOURCE MATERIALS

River Birch is suitable for wet soil conditions, located within the inner 50 feet of a 100-foot riparian buffer—nearest the water body.

www.eyota.govoffice.com

White Pine is suitable for dryer soil conditions, located within the outer 50 feet of a 100-foot riparian buffer.

Dr. Green Thumb Identification (http://www.treeplantflowerid.com/Pinus-parviflora.php)

LOCATION	TREE CHARACTERISTICS	EXAMPLES
Inner 50 Feet of Buffer Nearest Water Body:	Must provide shade and organic matter to stream Must be flood tolerant Should be deciduous	Red maple River birch Sycamore
Outer 50 Feet of Buffer:	Must be moderately flood tolerant Can be deciduous or coniferous	White oak White pine Black cherry Sugar maple

The next step in riparian buffer establishment is the selection of plants—appropriate to your objectives and site conditions—and plant protection to ensure high survival rates.

PLANT SELECTION

Plant selection relies on a combination of many factors and objectives. The main objective of your planting is water quality improvement. Secondary objectives may include improved wildlife habitat, privacy screening, fall color diversity, or special features such as nut or fruit production. Consider these additional objectives when selecting plants.

The vegetation in the outer 50 feet should slow and disperse any concentrated flow as it approaches the inner 50 feet of the buffer and ultimately the body of water. The 100-foot model riparian buffer may consist of different tree and shrub species. The plants closest to the water body must be flood tolerant and ideally, deciduous. See the chart at left for a small selection of suggested species per location.

Evaluate site conditions, as these will dictate which plants are most appropriate. An initial way to identify species that will flourish on your property is to observe the native species that already grow there and on similar sites nearby. Then get to know your soil, as soil drainage is an important factor in plant selection. Consult an online soil survey, such as the Web Soil Survey for a basic understanding of your area's soil type (contact the PA Natural Resources Conservation Service for interpretation help).

Developers and those establishing very large forested riparian buffers should hire a soil consultant and conduct a soil test to better understand pH and fertility (available at county offices of Penn State Extension and online). Project managers and landowners can conduct simple tests to evaluate soil.

Determine your soil texture by squeezing a damp handful of soil into a ball. Balls of sandy soil break when even slight pressure is applied. Balls of loam change shape easily and may crumble a bit under pressure. Clayey soils feel sticky, resist breaking, and can be molded easily. Learn an advanced version of this test at soil-quality.org.

http://gastromomica.net/2012/05/12/seed-balls/

Test your soil's drainage by digging a hole with a volume of one cubic foot. Fill it with water, then refill it once it drains. If the water takes more than 24 hours to drain from the hole the second time, your soil likely has poor drainage. If this is the case, select flood tolerant or very flood tolerant species.

http://www.walterreeves.com/landscaping/soil-percolation-rate/

HOW TO SELECT AND SOURCE MATERIALS

SELECTING NATIVE PLANTS

Why plant native species? Native tree species support natural ecosystems by providing habitat and food for birds, mammals, and insects. Dr. Douglas Tallamy, wildlife ecologist and researcher on the impact of alien plants on native ecosystems, found that Pennsylvania native plant species support over four times the insect biomass commonly found on non-native species. This is because both terrestrial and aquatic insects coevolved with native plants, developing mouthparts that are only able to feed on specific native leaves and flowers. For more information about native plantings, see *Landscaping with Native Plants in the Middle Atlantic Region* by Elizabeth N. du Pont in collaboration with the Brandywine Conservancy, Native Plants for Wildlife Habitat and Conservation Landscaping: Chesapeake Bay Watershed by the U.S. Fish & Wildlife Service, and Bringing Nature Home by Dr. Douglas Tallamy.

For a list of native tree species to plant, including preferred site conditions, see Appendix 1, page 15. For a list of shrubs, forbs, ferns, grasses, groundcovers, and additional trees to plant in your riparian buffer, see Table 7-1 of the Chesapeake Bay Riparian Handbook.

CHOOSING STOCK TYPE

Stock refers to the specific age and packaging of young trees for purchase. For riparian reforestation projects, year-old seedlings are generally the best choice, followed by 2- or 3-year-old seedlings for smaller-scale projects. There are pros and cons associated with each stock choice.

STOCK TYPE	PROS	CONS
Bare Root 	Cheapest option Easy to transport to stream	Often needs staking Roots can dry out
Container 	Comes in a range of sizes Leaves root system in tact	Roots hard to inspect Can be expensive Discontinuity between potting mix and site soil
Balled & Burlapped 	Can be large and generate instant impact Roots have best chance of survival	Heavy Expensive Requires lots of moisture maintenance

TREE PROTECTION OPTIONS

Some form of tree protection is essential to sapling survival, as unprotected plantings in Pennsylvania succumb to the intense deer browse and buck rub. According to Sweeney and Czapka (2004), on average, tree shelters increase tree survival by 39% and increase growth by 300%. Alternatives to the plastic tube-style shelters pictured throughout this guide include 5-foot-high mesh tubes, most often selected in areas prone to flooding, and 8-foot-high perimeter fencing, which can be a cost-effective option for large reforestation projects. Visit this Penn State Extension webpage for more about tree protection.

ESTIMATING COSTS

The following figures may be helpful when estimating the cost of your project. For budgeting purposes, a 100-foot buffer on a 100-foot linear stream length would require approximately 121 trees (calculated using 10-foot center spacing of trees within the 10,000-square-foot area). A probable cost for 121 plants, stakes, and tree tubes—using 2015 pricing—would be approximately $1,200. For labor estimates, a healthy person can plant 8 to 10 trees per hour by themselves (not including the time to lay out the site in a 10-foot grid). The aforementioned 10,000-square-foot buffer would take a single person 12 hours to plant—not including project layout (for more on laying out the site see page 10).

See page 2 for information about funding resources for reforestation projects.

PLANNING THE PLANTING

There are many contractors that can help with your reforestation project; see Appendix 2 for a list of local planting contractors. Whether you will be planting the riparian buffer yourself or using a contractor, the steps are the same.

WHEN TO PLANT

Determine the best time to plant based on your goals, site conditions, and plant selection.

	SPRING	FALL
PROS:	long growing season and usually plenty of precipitation	moderate to cool temperatures are gentle on plantings and encourage root growth
CONS:	excessive rain fall or a shortened season can damage plantings	shorter growing season

	SPRING	FALL
EVERGREEN TIMING SUGGESTION:	plant later (before full extension of new growth)	plant earlier (after summer heat has fallen)
DECIDUOUS TIMING SUGGESTION:	plant earlier (before bud break)	plant later (after leaf drop)

Trees planted in rows for accessibility by mower.

BEGIN BY LAYING OUT THE SITE

Determine the plant spacing and density goals for your reforestation project. Recommended planting density is more than 350 trees per acre. Your municipality's riparian buffer ordinance may require a different minimum planting density.

SPACING (FEET)	TREES PER ACRE
9 x 9:	538
10 x 10:	435
11 x 11:	360
12 x 12	302
13 x 13:	258

Mowing is recommended to minimize competition for water and light, control invasives, and prevent rodent damage. If you plan to mow your site (page 13), plant trees in rows far enough apart for the mower to fit between. Use the chart below to find your maximum planting density based on the width of your mower. Otherwise, random spacing of trees and shrubs can create a natural forest effect but will require hand work to maintain.

HOW TO PLANT (USING 1-YEAR OLD TREE SEEDLINGS)

1 Using a sharp shovel, dig a hole about 8-10 inches wide and as deep as the tree's root mass.

2 Save the soil (and sod) that you remove from the hole. This will be used to backfill around the tree. Use shovel to cut and loosen the soil from the sod.

3 Gently free the tree from its pot. Squeezing the pot helps to separate the root mass from the pot.

4 Place the tree in the hole, making sure it is planted at the correct depth (the soil from the pot should be level with or slightly above the ground level). A tree planted too low will die, and a tree planted too high will dry out.

5 Now backfill around the tree while holding it upright. You can include some grass placed upside down at the bottom of your hole– it will provide the tree with extra nutrients.

6 Gently firm the soil around the tree with your foot, being careful not to damage the tree.

7 When using tree shelters, as is highly recommended, place a 5-foot-tall shelter over the tree, making sure to try to preserve the natural shape of the branches (best done with a partner). Be sure to place the shelter flare-side-up, as shown in photo.

Steps 8 and 9 are specific to the plastic tube shelters pictured. Installation techniques vary for mesh shelters; check manufacturers' instructions.

8 Sink the tree shelter about an inch into the soil (this will help prevent damage to the tree from rodents). Twisting the shelter in a cutting motion can help achieve this.

9 Slip the stake through both zip ties (already attached to plastic tubes) and pound, using a mallet or hammer, until only 1 - 2 inches of the stake are above the top zip tie (soil conditions permitting). Tighten the zip ties. The stake should prohibit any major shelter movement.

10 Consider tying colored ribbons or flags to the tree shelter for visibility during maintenance.

11 If desired, slide a bird net onto the shelter so that half of the net's length is on the shelter and the other half extends above. Bird nets should be removed just prior to the tree exiting the tube.

HOW TO MAINTAIN YOUR BUFFER PLANTING

Continued maintenance of your riparian planting will greatly increase the survival rate of your trees. The most common causes of tree failure include rodent damage, invasive species competition, and flooding. Preventing these hazards and correcting any recent damage can save your riparian planting investment. See Appendix 2 for a list of local maintenance contractors.

THE FIRST FIVE YEARS

ALL SEASONS

Shelter and Stakes Maintenance: Proper maintenance of shelters and stakes can help prevent damage to trees by rodents, deer, herbicides, and mowers or weed-whackers. Ensure tree shelters are upright, straight, and that the bottom edge is pressed one inch into the ground to prevent rodent entry. Check stakes for cracks, curves, and rot.

For other types of tree protection, maintain according to manufacturer's instructions. Be sure to remove any bird nets from protective tubes where trees will exit the tube that seaseon. Cautiously remove any insect nests from trees or shelters.

A method of protecting trees from deer rub once trees have outgrown plastic tube shelters.

Tree shelters are made of #5 plastic (polypropylene). Check with your local refuse/recycling provider for recycling options.

LATE WINTER

Shelter Removal (Years 3, 4, 5): Shelter removal[1] can prevent rot, disease, and trunk girdling. Remove shelters when trees measure 1.5 to 2.5 inches in diameter at top of shelter. Avoid removing shelters too early, as deer rub their antlers on 1– or 2-inch-diameter trees and cause girdling (see photo left). Take steps to minimize damage to trees by herbivores, herbicides, and string trimmers before removing tree shelters from young trees.

http://www.serratedtussock.com/?q=content/spot-spraying

SPRING

Broad-Spectrum Herbicide Application (Years 1-4): Application of herbicide, a vital step in riparian reforestation success, keeps plant competition at bay, reduces the risk of rodent damage, and greatly increases tree survival and growth rates (Sweeney, Czapka, and Petrow 2007). However, herbicide application near waterways is controversial, as aquatic organisms are very sensitive to herbicides and pesticides. We recommend herbicide use in forested riparian buffer establishment because the long-term ecological benefits of a healthy, functioning buffer outweigh the potential short-term harm herbicides may cause to aquatic organisms. After leaves have emerged in the spring, small landowners can apply glyphosate in a 3-foot radius around the base of sheltered trees (alternatively, if trees are planted in a row, apply a 6-foot-wide strip of glyphosate centered on the line of seedlings). Landowners or developers with large areas to plant should hire a licensed professional to apply herbicide in the same fashion (a pre-emergent may also be included in the mix). Because riparian areas are sensitive ecosystems, always use aquatic-safe glyphosate and heed all instructions and warnings on labels. See Appendix 3 for herbicide application resources.

SUMMER

Selective Herbicide Spot-Application (Years 1-5): To control persistent woody invasive and noxious weeds (list on page 7), landowners with smaller-scale projects should cut undesirable stems near the ground and paint the surface of the stump with concentrated glyphosate (this technique is known as the cut stem treatment). For larger projects or more serious cases of woody invasives, landowners or developers should hire a licensed professional (Appendix 2) to perform spot application of a selective herbicide (for example, in the basal bark technique). Always use aquatic-safe herbicides and heed all instructions and warnings on labels. See Appendix 3 for herbicide application resources.

Cut Stem Treatment

Natural Areas Notebook (https://oaklandnaturalareas.files.wordpress.com/2014/11/imgp4285.jpg)

Basal Bark Treatment

http://www.thesanguineroot.com/?p=170

HOW TO MAINTAIN YOUR BUFFER PLANTING

Mowing (Years 2-3): Combine herbicide use with mowing during the first 2-3 years. Be sure to mow before undesirable plants set seed. Mowing suppresses the growth of vegetation around the saplings, freeing up sunlight, water, and nutrients for the saplings to use. To allow for spontaneous growth of native trees from seeds stored in the seedbank and dropped by birds, reduce mowing frequency once planted saplings reach a height of 15 feet and begin canopy closure. Continue woody invasive removal once mowing is reduced.

LATE SUMMER/EARLY FALL

Broad-spectrum Herbicide Application and Vole Suppression (Years 1-4): During the winter, voles nest in tree tubes and gnaw trees. Reducing groundcover deprives voles of hiding places, making them vulnerable to predation. To suppress vole populations in this way, apply another round of glyphosate around tree shelters in early fall (Appendix 3). Always use aquatic-safe herbicides and heed all instructions and warnings on herbicide labels. Large site landowners and developers should hire a licensed professional to apply herbicide. If vole damage is persistent and severe, a small amount of rodenticide may be applied by a professional.

Damage from voles can be fatal to young trees
Next-Door Nature (http://nextdoornature.org/tag/vole/)

A mowed tree planting.

ALL SEASONS

RESPONDING TO CHALLENGES

Replanting Due To Seedling Failure (Years 2-3 Likely): Replant if tree survival rate falls below 70% or density falls below 250 trees/acre. Replanting can occur in either fall (using containerized seedlings) or spring (using containerized seedlings or bare root stock). Before replanting, address the initial cause of seedling failure. Common causes include vole damage (visible as girding at the base of seedlings), excessive vegetative competition (usually vines that crowd seedlings within shelters), and improper shelter maintenance (fallen shelters or shelters not sunk into soil).

Floods (Years 1-4): After a flood, check for and correct damage to tree structures and stakes.

HERBICIDE-FREE PLANTING MAINTENANCE

While the use of herbicides is generally accepted as the most effective way to maintain a newly planted buffer, those wishing to limit the use of herbicides can mulch and mow to control and remove competitive vegetation instead.

Mulching: Site preparation is critically important, as mulching is most effective when the ground is nearly free of actively growing vegetation. Mulch can be either organic (wood chips, hardwood mulch, coconut fiber mats, or grass clippings) or inorganic (landscape/weed fabric squares). Apply mulch in a circular fashion at the base of the tree to a diameter of 18-36". Mulch must be kept away from tree trunks; mulch touching the trunk promotes decay. Organic mulches will need to be reapplied every couple years and after any flood event. Inorganic mulches should be secured to the ground with fabric staples and be removed once the tree planting is established.

Mowing: Another method of herbicide free maintenance, used in conjunction with mulch or as a stand-alone technique, is mowing. If mowing will be the primary maintenance method, be sure to design the planting to allow passage of the mower deck between all individual trees. Since the goal is to remove all competitive vegetation, mowing in both directions is recommended. Mowing can damage young trees and/or their protective tubes, so extra care is needed. When mowing a mulched planting, be sure to set the mower deck height to not interfere with the mulch. A recently planted site may need mowing several times over the course of the growing season. It is important to mow before undesirable plants set seed and also in late summer/fall to remove cover for voles. The use of weed whackers is not recommended, as they can quickly cut through the protective tubes causing considerable damage to the young trees.

ONGOING MAINTENANCE & MONITORING

MAINTENANCE AFTER FIVE YEARS

By the time a planting is five years old,the trees should stand roughly 10-15 feet tall (size will vary based on species); the canopy will likely not yet be fully closed. Any mortality should be evenly distributed and not exceed 20-25%. It is important to backfill any patches of significant mortality with new plantings, as consistent shade discourages invasive growth. After the first five years of maintenance, supplement your canopy tree planting with understory plantings such as native small trees, shrubs *(see table below)*, grasses, and forbs. Also, watch for and address any invasive resurgence.

APPROPRIATE SHRUBS TO SUPPLEMENT YOUR ESTABLISHED CANOPY TREE PLANTING

Serviceberry (*Amelanchier Canadensis***)**
Alleghany serviceberry (*Amelanchier laevis***)**
Sweet pepperbush (*Clethra alnifolia***)**
Silky dogwood (*Cornus amomum***)**
Red osier dogwood (*Cornus sericea***)**
Winterberry (*Ilex verticillata***)**
Spicebush (*Lindera benzoin***)**
Red chokeberry (*Photinia pyrifolia***)**
Arrowwood (*Viburnum dentatum***)**

Just as with young trees, shrubs should be protected from excessive deer browse. In many cases, 4-5' high mesh cages measuring 18-24" in diameter and held with 1" oak stakes will provide both protection and room for the shrub to grow.

Monitoring the Success of Your Project

After planting and maintaining your forested riparian buffer for the first five years, you may enjoy gathering feedback on the success of your project through a monitoring program.

MEASURES OF SUCCESS TO MONITOR INCLUDE:

degree of establishment of planted vegetation— *the goal is to have established diverse non-invasive vegetation*

amount of tree or shrub cover— *the goal is at least 60%*

changes in water quality— *the goal is to have cooler water temperatures with more oxygen present and to observe less algae and aquatic plants, while seeing an increase in woody debris and/or leaf packs*

changes in bank stability— *the goal is to observe less visible erosion*

changes in stream channel morphology— *the goal is to observe a widening and shallowing of the stream channel and a greater amount of coarser rocks in the stream bed*

wildlife population estimates and habitat use measurements— *the goal is to observe more diversity and abundance of both visiting and resident wildlife*

APPENDIX 1: SUGGESTED SPECIES TO PLANT

Tree	pH	Flood Tolerance	Shade Tolerance	Short-Lived (may need replacement)	Height	Pioneer Species
Boxelder (*Acer negundo*)	4.0-7.0	very tolerant	tolerant		understory	yes
Red Maple (*Acer rubrum*)	5.5-7.0	tolerant	tolerant		canopy	
Silver Maple (Acer saccharinum)	4.0-6.5	tolerant	intermediate	yes	canopy	
Sugar Maple (*Acer saccharum*)	4.0-7.0	intolerant	very tolerant		canopy	
Pawpaw (*Asimina triloba*)	5.0-7.0	intolerant	tolerant	yes	understory	
Sweet Birch (*Betula lenta*)	5.0-7.0	intolerant	intermediate		canopy	
River Birch (*Betula nigra*)	4.5-7.5	tolerant	intolerant		canopy	
Gray Birch (*Betula populifolia*)	5.0-6.5	intolerant	intolerant	yes	understory	
American Hornbeam (*Carpinus caroliniana*)	4.0-7.5	tolerant	very tolerant	yes	understory	
Hackberry (*Celtis occidentalis*)	6.0-8.0	intermediate	intermediate		canopy	
Eastern Redbud (*Cercis Canadensis*)	4.5-7.0	intolerant	tolerant	yes	understory	
Alternate Leaf Dogwood (*Cornus alternifolia*)	5.0-7.0	very tolerant	intermediate		understory	
American Holly (*Ilex opaca*)	<6.8	intolerant	tolerant		understory	
Eastern Red Cedar (*Juniperus virginiana*)	6.8-7.2	intolerant	intermediate		understory	yes
Sweetgum (*Liquidambar styraciflua*)	4.0-7.0	very tolerant	very intolerant		canopy	
Tulip Poplar (*Liriodendron tulipifera*)	4.5-6.5	intermediate	intermediate		canopy	
Black Gum (*Nyssa sylvatica*)	4.5-6.0	intermediate	intolerant		canopy	
White Pine (*Pinus strobus*)	<6.8	intolerant	intermediate		canopy	
American Sycamore (*Platanus occidentalis*)	5.0-6.5	intermediate	intermediate		canopy	
American Plum (*Prunus americana*)	5.5-7.5	intolerant	intolerant	yes	understory	
Black Cherry (*Prunus serotina*)	5.0-7.5	very intolerant	intolerant		canopy	yes
White Oak (*Quercus alba*)	4.5-7.0	intolerant	intermediate		canopy	
Swamp White Oak (*Quercus bicolor*)	4.5-6.5	tolerant	intermediate		canopy	
Chestnut Oak (*Quercus montana*)	4.5-7.0	intolerant	intermediate		canopy	
Pin Oak (*Quercus palustris*)	4.5-6.5	tolerant	intolerant		canopy	
Willow Oak (*Quercus phellos*)	4.5-5.5	tolerant	intolerant		canopy	
Black Locust (Robinia pseudoacacia)	4.5-8.0	tolerant	intolerant		canopy	yes
Black Willow (*Salix nigra*)	5.0-8.0	very tolerant	very intolerant	yes	canopy	
Sassafras (*Sassafras albidum*)	6.0-7.0	intolerant	intolerant		understory	yes
Basswood (*Tilia Americana*)	4.5-7.5	intolerant	tolerant		canopy	

APPENDIX 2: SOURCING AND CONTRACTORS

Basswood
http://thewalpolean.org/2014/07/27/distant-hill-gardens-8214/comment-page-1/

American Sycamore
http://davesgarden.com/guides/pf/showimage/185754/

Red Maple
http://www.florafinder.com/Species/Acer.php

Alternate Leaved Dogwood
Bargeron, University of Georgia, Bugwood.org

Black Locust, a pioneer species
http://greenskydesigns.com/weed-of-the-week-9-black-locust-robinia-pseudo-acacia-fabaceae

Mockingbird eating hackberries
http://www.birderslounge.com/2008/06/northern-mocking bird-a-beautiful-singer/mocking-bird-hackberry-1a-we/

Inclusion on this list does not imply a recommendation. Consider choosing a nursery that supplies phenotypes local to your property.

PLANT SOURCING IN PA

Berks County

Sugarbush Nursery
4272 Morgantown Rd., Mohnton, PA 19540
Phone: (610) 856-0998
www.sugarbushnursery.com

Bucks County

American Native Nursery (Archewild)
2191 Hillcrest Rd, Quakertown, PA 18951
Phone: (855) 752-6862
Email: contact@archewild.com
http://archewild.com/

Gino's Nursery and Landscaping
2237 Second Street Pike
Newtown, PA 18940
Phone: (315) 598-3992
http://www.ginosnursery.com/contact.html

Northeast Natives & Perennials
1716 E Sawmill Rd., Quakertown, PA 18951
Phone: (215) 901-5552
www.nenativesandperennials.com

Chester County

Arbor Glen Nurseries
500 Gum Tree Road, Cochranville, PA 1933
Phone: (610) 857-9810
http://www.arborglennnurseries.com/

Natural Landscapes Nursery (Wholesale only)
354 North Jennersville Road, West Grove, PA 19390
Phone: (610) 869-3788
http://www.naturallandscapesnursery.com

Chester County (continued)

North Creek Nurseries
(Specializes in native perennials, grasses, ferns and shrubs in plug form. Available wholesale only, so work with your landscaper. An especially good source for meadow restoration and/or rain garden installation.)
124 Wedgewood Road, Oxford, PA 19363
388 North Creek Road, Landenberg, PA 19350
Phone: (610) 255-0100
http://www.northcreeknurseries.com/

R-P Nurseries
649 Unionville Road, Kennett Square, PA 19348
Phone: (610) 444-1116
Fax: (610) 444-6476
http://www.rpnurseries.com/

Ticklewood Nursery
270 Baker Road, Cochranville, PA 19330
Phone: (610) 869-8086
Fax: (610) 869-8654
http://www.ticklewoodnursery.com/

Water Cress Farms Nursery
190 Woodcrest Road, West Grove, PA 19390
Phone: (610) 869-3883
Email: info@wdwells.com
http://www.watercrestfarmsnursery.com/

Yellow Springs Farm Native Plants Nursery
1165 Yellow Springs Rd., Chester Springs, PA 19425
Phone: (610) 827-2014
http://www.yellowspringsfarm.com/
(Hours by appointment only; orders can be made online)

Delaware County

Redbud Native Plant Nursery
643 West Baltimore Ave, Media, PA 19063
Phone: (610) 892-2833
http://www.redbudnativeplantnursery.com/

APPENDIX 2: SOURCING AND CONTRACTORS

Lancaster County
Go Native Tree Farm
Nursery: 678 S Chiques Rd
Office: 2310 Chestnut View Dr
Manheim, PA 17545
Lancaster, PA 17603
Phone: (717) 399-0195
Email: gonative@voicenet.com
http://www.gonativetrees.com/

Groff's Plant Farm
6128 Street Road, Kirkwood, PA 17536
Phone: (717) 529-3001
groffsplantfarm.com

Octoraro Native Plant Nursery
(Wholesale only)
6126 Street Road, Kirkwood, PA 17536
Phone: (717) 529-3160
https://www.octoraro.com/

Lehigh County
Edge of the Woods Native Plant Nursery
2415 Route 100, Orefield, PA 18069
Phone: (610) 395-2570
http://www.edgeofthewoodsnursery.com/

York County
Mid Atlantic Native Plants
(Wholesale only)
12506 Susquehanna Trail South
New Freedom, PA 17349
Phone: (717) 227-0924
https://midatlanticnatives.com/Native_Plants_.html

Sylva Native Nursery & Seed Company
3815 Roser Road, Glen Rock, PA 17327
Phone: (717) 227-0484
Email: sylvanat@aol.com
http://www.sylvanative.com/index.htm

OUT OF STATE PLANT SOURCING

Gateway Garden Center
7277 Lancaster Pike, Hockessin, DE 19707
Phone: (302) 239-2727
gatewaygardens.com

Pinelands Nursery & Supply
(Wholesale only)
323 Island Rd, Columbus, NJ 08022
Phone: (609) 291-9486
Email: sales@pinelandsnursery.com
http://www.pinelandsnursery.com/p/home-page.html

CONTRACTORS FOR TREE INSTALLATION

Applied Ecological Services
Ben Wollman
Phone: (607) 592-1684
http://www.appliedeco.com/

LandStudies, Inc
315 North Street, Lititz, PA 17543
Jimmy Kreider or Mark Gutshall
Phone: (717) 627-4440
www.landstudies.com

Red Tail Restoration & Land Management
Greg Gagliano: greg@redtailrestore.com
Phone: (610) 772-1837
http://www.redtailrestore.com/

Teti Farms / Bill Teti
486 Chesterville Road, Landenberg, PA 19350
Phone: (610)-888-8848
Email: tetifarm@verizon.net

MAINTENANCE CONTRACTORS

All Seasons Landscaping
3915 Market St, Upper Chichester, PA 19014
Steve Gansz
Phone: 610-494-8050

Applied Ecological Services
Ben Wollman
Phone: (607) 592-1684
http://www.appliedeco.com/

Cotswold Gardens, Inc
176 Woodview Road, West Grove, PA 19390
Lori Hollis: cotswoldgardensinc@verizon.net
Phone: (610) 345-1076
http://www.cotswoldgardensinc.com/

GreenWeaver Landscapes, LLC
Gregory Nichols: greg@green-weaver.com
Phone: (610) 772-1837; (610)-358-8900
www.green-weaver.com

LandStudies, Inc
315 North Street, Lititz, PA 17543
Jimmy Kreider or Mark Gutshall
Phone: (717) 627-4440
www.landstudies.com

Red Tail Restoration
Greg Gagliano: greg@redtailrestore.com
Phone: (610) 772-1837
http://www.redtailrestore.com/

Teti Farms / Bill Teti
486 Chesterville Road, Landenberg, PA 19350
Phone: (610) 888-8848
Email: tetifarm@verizon.net

Weeds, Inc.
250 Bodley Road, Aston, PA 19014
Phone: (610) 358-9430
http://www.weedsinc.com/

APPENDIX 3: HERBICIDE APPLICATION RESOURCES

Ferrell, Jason, Ken Langeland, and Brent Sellers. "Herbicide Application Techniques for Woody Plant Control." University of Florida IFAS Extension. 2012. http://edis.ifas.ufl.edu/ag245

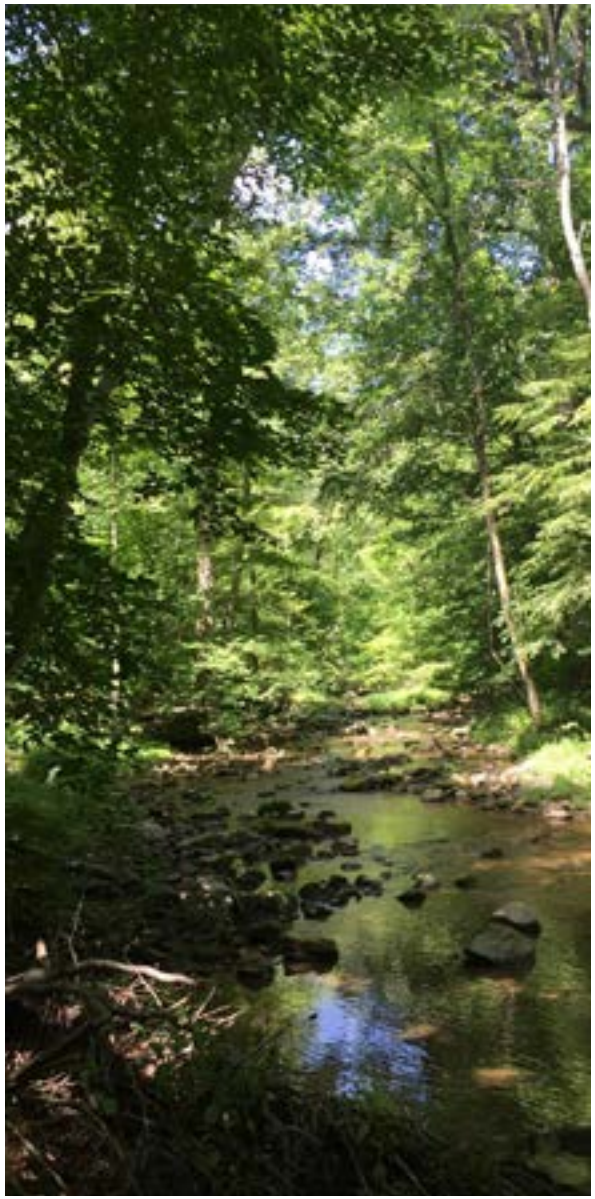
Glyphosate Facts. Industry Task Force on Glyphosate. 2013. http://www.glyphosate.eu/

Herbicide Application Handbook: A guide to proper handling and application of Monsanto herbicides. Monsanto. 2008. http://www.monsanto.com/sitecollectiondocuments/ito/2009%20herbicide%20handbook%20(2).pdf

Lingenfelter, Dwight D. and Nathan L. Hartwig. "Safe Herbicide Use." Penn State Extension. http://extension.psu.edu/pests/weeds/control/introduction-to-weeds-and-herbicides/safe-herbicide-use

Langeland, K.A. "Safe Use of Glyphosate-containing Products in Aquatic and Upland Natural Areas." Agronomy Department, Center for Aquatic and Invasive Plants, Florida Cooperative Extension Service. February 2009. http://edis.ifas.ufl.edu/ag248

Pauly, Doon."Quick Guide to Glyphosate Products–Frequently Asked Questions." Alberta Agriculture and Forestry. 2015. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/faq8069



APPENDIX 4: REFERENCE DOCUMENTS

The following documents and webpages were referenced in writing this guide, and can be used by landowners and developers to find more information about forested riparian buffer establishment and maintenance.

"A Guide to Riparian Tree Planting in Southwest Oregon." M. Bennett and G. Ahrens. September 2007. http://www.oregon.gov/oweb/docs/pubs/ripariantreeplantingguide.pdf

A Homeowner's Guide to Stormwater Management. Philadelphia Office of Watersheds. January 2006. http://www.phillywatersheds.org/doc/Homeowners_Guide_Stormwater_Management.pdf

"All about soil." The Morton Arboretum. 2015. http://www.mortonarb.org/trees-plants/tree-and-plant-advice/horticulture-care/all-about-soil

"Best Management Practices for Control of Non-Native Invasive." Montgomery County Department of Parks Park Planning and Resource Stewardship Division, Natural Resources Stewardship Section. April 2009. http://www.montgomeryparks.org/PPSD/Natural_Resources_Stewardship/Veg_Management/documents/nni-best_mngmnt_practices-april09.pdf

"Brush and Tree Removal". Pleasant Valley Conservancy. http://pleasantvalleyconservancy.org/brushandtrees.html

"Developing a Monitoring Program for Riparian Revegetation Projects. "University of California Division of Agriculture and Natural Resources. May 2009. http://anrcatalog.ucdavis.edu/pdf/8363.pdf

"Guidebook for Riparian Corridor Conservation." Montgomery County, Pennsylvania. http://www.montcopa.org/DocumentCenter/View/4122

"Fall Planting of Trees and Shrubs." The Morton Arboretum. http://www.mortonarb.org/trees-plants/tree-and-plant-advice/horticulture-care/fall-planting-trees-and-shrubs

"Forest Finance 2: Fencing for Forest Regeneration: Does It Pay?" Penn State Extension. http://extension.psu.edu/natural-resources/forests/finance/forest-tax-info/publications/forest-finance-2-fencing-for-forest-regeneration-does-it-pay

"Forest Finance 7: Tree Shelters: A Multipurpose Forest Management Tool." Penn State Extension. http://extension.psu.edu/natural-resources/forests/finance/forest-tax-info/publications/tree-shelters

"Forest Landowners Guide to Tree Planting Success." Penn State Extension. http://goo.gl/kAVZC8

"Landowner Guide to Buffer Success." USDA Farm Service Agency et al. http://www.creppa.org/pdf/landowner%20guide%20revised%2030oct07.pdf

Native Plants for Wildlife Habitat and Conservation Landscaping: Chesapeake Bay Watershed. U.S. Fish & Wildlife Service. 2003. http://www.nps.gov/plants/pubs/chesapeake/pdf/chesapeakenatives.pdf

Pennsylvania Field Guide: Common Invasive Plants in Riparian Areas. http://goo.gl/XDWAFE

Pennsylvania Stormwater Best Management Practices Manual. Pennsylvania Department of Environmental Protection. June 18, 2008. http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305

"Planning to Purchase a Tree." Vermont Urban & Community Forestry Program. http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Community_Forests_and_Trees/Library/Planning%20to%20Purchase%20a%20Tree.pdf

"Riparian Buffer Brochure." Stroud Water Research Center. October 2007. http://www.stroudcenter.org/research/projects/StroudPreserve/StroudPreserve-BufferBrochure_Oct2007.pdf

"Riparian Buffer Protection via Local Regulation: a Guide and Model Ordinance for Pennsylvania Municipalities." Pennsylvania Land Trust Association & Brandywine Conservancy. June 2014. http://conservationtools.org/guides/show/119-Riparian-Buffer-Protection-via-Local-Government-Regulation

"Riparian Forest Buffer Design and Maintenance." The Maryland Department of Natural Resources Forest Service. http://www.chesapeakebay.net/publications/title/riparian_forest_buffer_design_and_maintenance

"Riparian Forest Buffer Guidance." Pennsylvania Department of Environmental Protection. November 24, 2010. http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-10767

"Seedling Spacing Trees Per Acre." South Carolina Forestry Commission. http://www.state.sc.us/forest/nurspa.htm

"Selecting Trees. Treevitalize. http://www. treevitalize.net/TreeCare/SelectingTrees.aspx

"Soil Texture—Measuring in the Field." Soilquality.org, Soil Quality Pty Ltd. 2015. http://soilquality.org.au/factsheets/soil-texture

Sweeney, Bernard W. (Stroud Water Research Center) and Stephen J. Czapka (USDA Forest Service). "Riparian forest restoration: why each site needs an ecological prescription." February, 2004. Forest Ecology and Management 192: 361-373. http://www.stroudcenter.org/about/pdfs/bs_Sweeney_Czapka2004.pdf

Sweeney, Bernard W., Stephen J. Czapka, & L. Carol A. Petrow. "How Planting Method, Weed Abatement, and Herbivory Affect Afforestation Success." 2007. South. J. Appl. For. 31 (2).

BRANDYWINE
CONSERVANCY

U.S. Route 1, P.O Box 141
Chadds Ford, PA 19317

brandywine@brandywine.org

610.388.2700

This document was written and last revised May 2016.

PennState Extension

Roadside Guide to Clean Water: Streambank and Floodplain Restoration

This restoration includes stabilizing and/or altering the stream channel to slow and direct the flow of water to reduce erosion and flooding.

ARTICLES | **UPDATED: JULY 26, 2022**

Photo by Jennifer Fetter

Streambank and Floodplain Restoration at a Glance

Streambank and floodplain restoration is the practice of stabilizing and/or altering the stream channel to slow and direct the flow of water to reduce erosion and flooding. This practice might include regrading streambanks, installing large rocks or logs in the stream channel, or excavating the floodplain to create wetland habitat where the steep banks are located. Streambank and floodplain restoration projects require permits, heavy construction equipment, engineering, and specific expertise. Often this practice is enhanced by planting trees and shrubs next to the stream.

How Streambank and Floodplain Restoration Works

With increased development, greater volumes of water are directed into our streams when it rains than would occur in a natural setting. Higher-than-natural

volumes of water flowing quickly downstream causes streambanks to erode and become unstable. Eroding streambanks contribute to sediment pollution, which makes our streams look chocolate brown during rain events. In addition, when streambanks erode, there is a risk to nearby infrastructure like bridges and culverts as well as a loss of property. To fix this, stream restoration practices can be employed to redirect the water flow into the center of the stream where less erosion will occur. Water is slowed down and streambanks are protected. Additionally, the stream can be connected to the floodplain where water will flow more slowly, letting pollutants settle out and reduce downstream flooding damage. In general, a stream or floodplain restoration project creates a more naturally functioning, stabilized stream.

Community Benefits of Streambank and Floodplain Restoration

- **Climate Change**: Promotes climate change resiliency
- **Flooding**: Mitigates flooding
- **Stormwater**: Reduces stormwater runoff
- **Pollution**: Reduces pollution
- **Habitat**: Provides wildlife habitat

You can expect to find streambank and floodplain restoration in **urban**, **suburban**, and **rural** settings.

How to Recognize Streambank and Floodplain Restoration

Steep, eroding banks like this one are good places to do stream restoration, especially since the road is at risk. Photo by Sarah Xenophon

Mud sills are essentially logs that are built into the streambank that extend over the water's surface to protect the streambank from erosion and create cover for fish. Photo by Kristen Kyler

Stream and floodplain restoration work requires a permit, engineering, and earth-moving and construction equipment. Photo by Sarah Xenophon

Some projects completely remove the streambank by excavating "legacy sediment" and creating a flat wetland that slows down water, filters pollutants, and reduces flooding downstream. Photo by Kristen Kyler

Grading streambanks to a gentle slope allows water to escape to the floodplain during storms. Logs protect the banks and create cover for fish. Planting trees provides additional benefits. Photo by

Jennifer Fetter

Creating smooth, gradual bends slows water flow. This V-shaped cross-vane structure directs the flow of water and creates a small waterfall to add oxygen, which supports life in the water. Photo by Sarah Xenophon

An easy and affordable streambank restoration technique is to use branch cuttings called live stakes. These cuttings grow roots right where they are needed most to help prevent streambank erosion. To learn more, go to " Live Staking for Stream Restoration " or " Live Staking - A How-to Guide " for a live staking learn now video.

PennState Extension

Live Staking for Stream Restoration

A brief introduction and instructional guide to using live staking as an inexpensive and simple technique to restoring eroding stream banks.

Exposed and eroding stream banks can be restored and stabilized through the practice of live staking.

An Introduction To Live Staking

Development, agriculture, and a variety of other disturbances can often lead to unhealthy streams because they remove plant life along streams and increase flow of water. Stream banks that experience these disturbances are often left bare and without a strong root mass in the soil. Without plants and roots, soil particles are more likely to wash away during high waters, heavy rains, and rapid snow melts. This leads to a number of undesirable results including sediment pollution in the water, loss of land, and deeply channeled streams.

There are a number of practices that add plant life back to these stressed streams and help protect and stabilize stream banks, improving the health of the streams. You may have heard the words "riparian buffer" to describe the plants or forest along the sides of streams. Restoring a riparian buffer is one practice, and often includes planting young trees or seedlings, evenly distributed, along the sides of the stream and up to 30 meters away from the stream. These trees not only help hold soil in place but also soak up nutrients, absorb rain water, and provide habitat for wildlife.

Live Staking is another practice, which reintroduces plant life directly in the places that need it most, the stream banks. It has a low cost and is something that land owners can do easily on their own property. Stem cuttings taken from trees during their dormant season (before the buds break in the spring) are inserted directly into stream banks. These cuttings, referred to as "live stakes," will eventually grow into new trees and are an effective way to establish a root network in the stream banks and help prevent further soil loss.

Harvesting Live Stakes

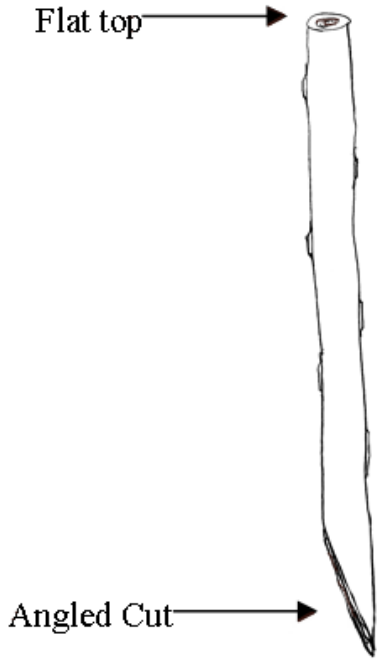
Live stakes can be purchased from some nurseries, but they can also be harvested directly from trees already on your property. Trees that grow readily along stream banks, such as Black Willow or Red Osier Dogwood, are the recommended species for live staking.

Harvesting live stakes can be done from trees growing right along the stream banks to be restored.

You may already have some of these trees growing on your property, or you may know somebody who does. To harvest live stakes, cut branches that are roughly 1/2 to 1 & 1/2 inches in diameter (some thinner widths may be successful as well) in 2-3 foot lengths. Pruners or loppers work well for this.

Cut the bottom of the stake on an angle to form a point. This will help with inserting the stakes and it also helps you remember which end is which (since trees do not grow as well upside down!) Some branches may be long enough to cut into

several stakes, so make blunt or straight across cuts to the tops to keep the ends distinguishable. Small side branches should be trimmed off of the stakes.



If you are collecting a large number of stakes, drop your cuttings into a bucket of water as you work to keep them from drying out.

Live stake cuttings should be made during the dormant season, before buds break. In Pennsylvania, mid to late March is usually an ideal time for live staking.

It's best to plant your live stakes right after cutting them. If you will be waiting a few days, keep them fresh by storing them in a bucket of water or wrapping them in wet burlap. If you ordered your live stakes from a nursery, it's best to soak the bottoms in a bucket of water for a day or two before planting them. Stored and purchased live stakes also benefit from a fresh, angled cut at the bottom.

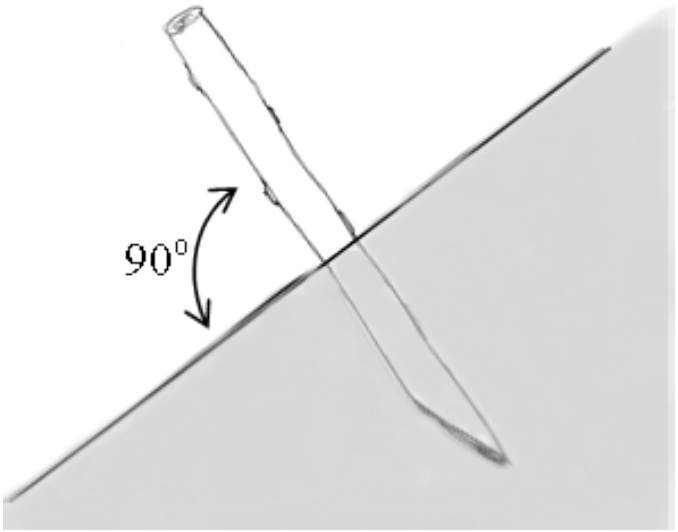
Planting Live Stakes

Planting live stakes typically requires getting into the stream, so waders or high boots will be helpful. You will also want a two foot length of rebar or similar material to help create pilot holes for your stakes. You can plan out your planting site in advance or just estimate as you go.

Live stakes should be placed two to three feet apart in several rows along the stream bank. A triangular arrangement helps fill spaces best. Live stakes are planted more densely than these tree species normally would be because there is an expectation that not all of the stakes will survive. Don't plant stakes so high in the stream bank that they won't reach the water table. They need to be in contact with the moisture to succeed.

Live stakes should be positioned approximately 2-3 feet apart in several rows.

Create a pilot hole at a 90 degree angle to the soil surface by pushing the re-bar into the soil and then removing it. Then insert stakes, pointed end first and on the same 90 degree angle, so that about 1/2 to 2/3 of the stake is in the soil.



If banks are nearly vertical, planting stakes so that they are pointed slightly upward can help increase growth success. A rubber mallet can help drive a stake into firm soil, but make a fresh cut on the exposed end afterwards to remove mallet damage.

After Planting

You may see some leaf growth on stakes in the first growing season, but good root growth is more important in the first year. Don't assume stakes didn't survive just because you don't see new growth above ground.

A gentle tug in the fall on a few stakes will help you determine how successful your planting was. Additional stakes can be added in future years to fill in areas that didn't survive. Other than that, they don't require much maintenance at all.

Live stakes may produce some leaves in the first spring after planting, but root development is the most important growth in the first year.

This article was prepared as part of Penn State's Greening the Lower Susquehanna Project, supported by a grant from the National Fish and Wildlife Foundation.

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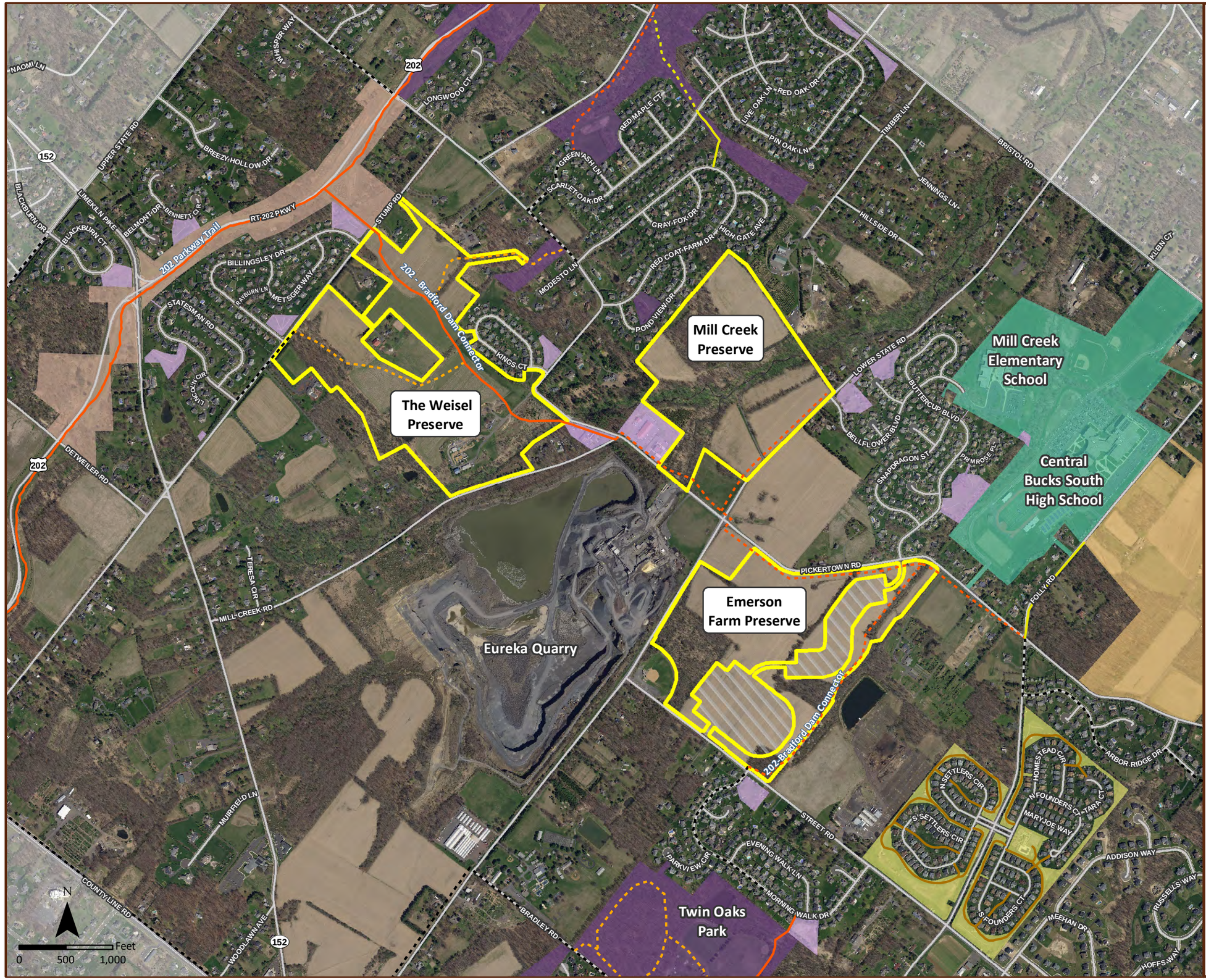
Penn State College of Agricultural Sciences research and extension programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

Code: ART-2531

Appendix D

Maps



Map 1: Warrington Township Open Space Master Plan Sites

Warrington Township, Bucks County, PA

- Township Open Space Sites
- Roadways

Existing Trails

- Multi-Use
- Connector
- Private

Planned Trails

- Multi-Use

Proposed Trails

- Multi-Use
- Pedestrian
- Connector
- Road Improvement

Public and Protected Lands

- Agricultural Easement
- Homeowners Association
- Municipal Open Space
- Municipal - other lands
- School District
- State Lands

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

1. Aerial photography (2018) from PEMA.
2. Parcel boundaries and roadways from Bucks County.
3. Public/Protected lands from WeConservePA, Natural Lands, and Bucks County.
4. Trails from PAMAP and Warrington Twp.

Compiled By: MEB 12/17/2020

EMERSON FARM PRESERVE

Tax ID: 50-004-139 and 50-004-141

Warrington Township, Bucks County, PA

Map 2: Historical Aerial (1938)

Emerson Farm Preserve Open Space

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

1. Parcels from Bucks County.
2. Historical aerial imagery from PennPilot www.pennpilot.psu.edu).

Compiled By: MEB 08/13/2020

EMERSON FARM PRESERVE

Tax ID: 50-004-139 and 50-004-141

Warrington Township, Bucks County, PA

Map 3: Historical Aerial (1958)

Emerson Farm Preserve Open Space

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

1. Parcels from Bucks County.
2. Historical aerial imagery from PennPilot www.pennpilot.psu.edu).

Compiled By: MEB 08/18/2020

EMERSON FARM PRESERVE

Tax ID: 50-004-139 and 50-004-141

Warrington Township, Bucks County, PA

Map 4: Historical Aerial (1971)

Emerson Farm Preserve Open Space

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

1. Parcels from Bucks County.
2. Historical aerial imagery from PennPilot www.pennpilot.psu.edu).

Compiled By: MEB 08/18/2020

EMERSON FARM PRESERVE

Tax ID: 50-004-139 and 50-004-141

Warrington Township, Bucks County, PA

Map 5: 2018 Aerial Photography

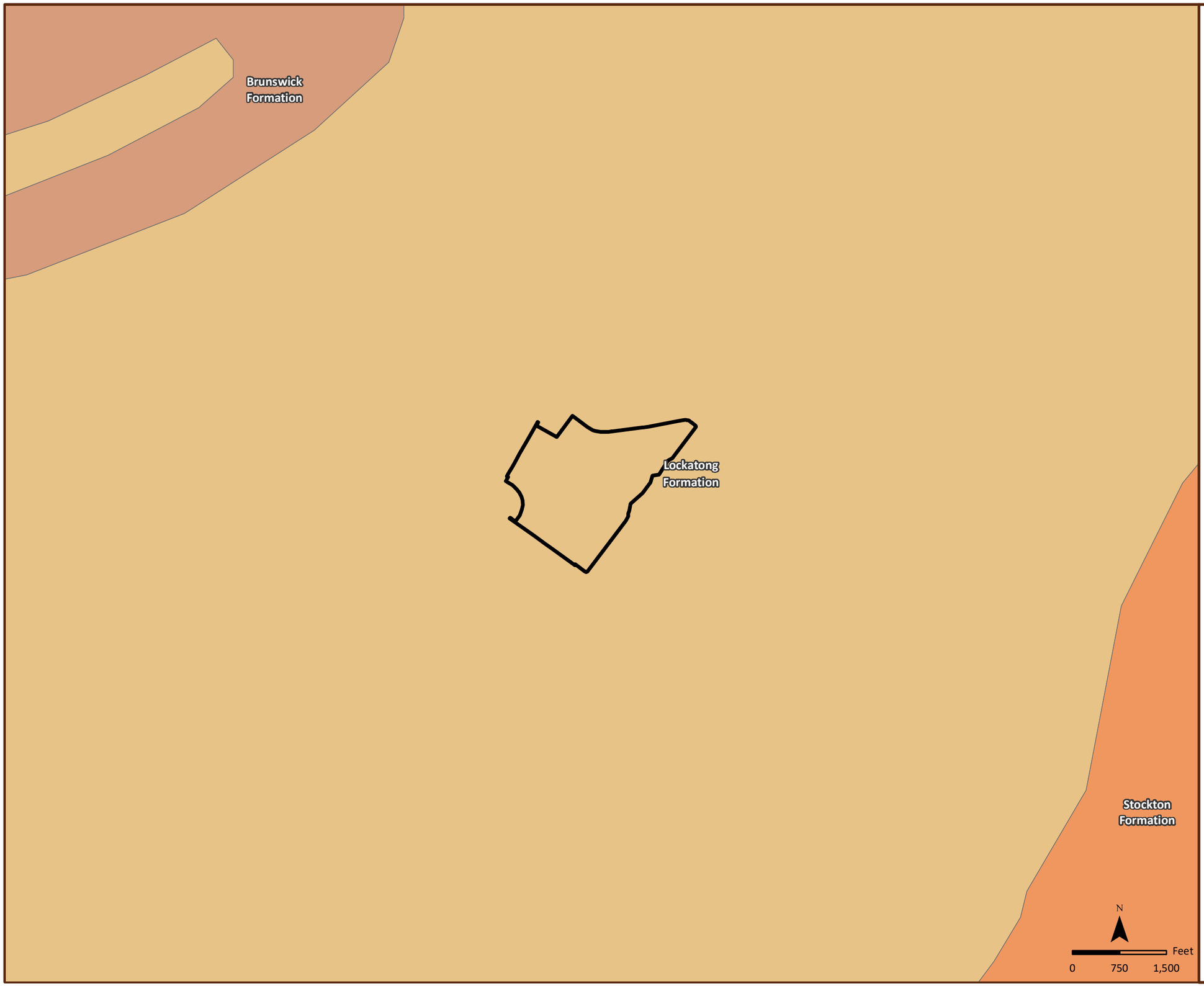
Emerson Farm Preserve Open Space Parcel Boundaries

Waterways

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

1. Parcels, roadways, and waterways from Bucks County.
2. Aerial imagery from PEMA.

Compiled By: MEB 08/13/2020



EMERSON FARM PRESERVE

Tax ID: 50-004-139 and 50-004-141 Warrington Township, Bucks County, PA

Map 6: Geology

Emerson Farm Preserve Open Space

Surface Geology

- Brunswick Formation
- Lockatong Formation
- Stockton Formation

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

1. Parcels from Bucks County.
2. Geology from PA Geological Survey.

Compiled By: MEB 08/18/2020

EMERSON FARM PRESERVE

Tax ID: 50-004-139 and 50-004-141

Warrington Township, Bucks County, PA

Map 7: Soils

- Emerson Farm Preserve Open Space
- Prime farmland
- Farmland of statewide importance

Soils

- AbA, Abbottstown
- AbB, Abbottstown
- BeB, Bedington
- BwB, Buckingham
- CbA, Chalfont
- CbB, Chalfont
- DdA, Doylestown
- DdB, Doylestown
- LkA, Lawrenceville
- LkB, Lawrenceville
- Pr, Pits
- ReB, Readington
- RlB, Reaville
- RlC, Reaville

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

1. Parcels from Bucks County.
2. Soils from USDA-NRCS.

Compiled By: MEB 08/18/2020

N

0 150 300 Feet

EMERSON FARM PRESERVE

Tax ID: 50-004-139 and 50-004-141

Warrington Township, Bucks County, PA

Map 8: Topography/Hydrology

- Emerson Farm Preserve Open Space
- Contours (5 ft)
- Waterways
- Hydric Soil

Natural Lands

1031 Palmers Mill Road, Media, PA 19063

610-353-5587 | natlands.org

1. Parcels from Bucks County.
2. Contours from DVRPC.
3. Hydric soils from USDA-NRCS.

Compiled By: MEB 08/18/2020

Map 9: Plant Communities and Stewardship Features

EMERSON FARM PRESERVE

Tax ID: 50-004-139 and 50-004-141

Warrington Township, Bucks County, PA

PICKERTOWN RD

BUTTERCUP BLVD

TOWER STATE RD

STREET RD

MORNING WALK DR

N SETTLERS CIR

N

0 150 300 Feet

- Property Boundary
- Development Area
- Waterways
- Parcel Boundaries

Plant Communities

- Agricultural Field/Meadow
- Ash-Mixed Hardwood Forest
- Hedgerow
- Red Oak-Mixed Hardwood

Stewardship Features

- Hazardous Ash Tree
- Debris Piles

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

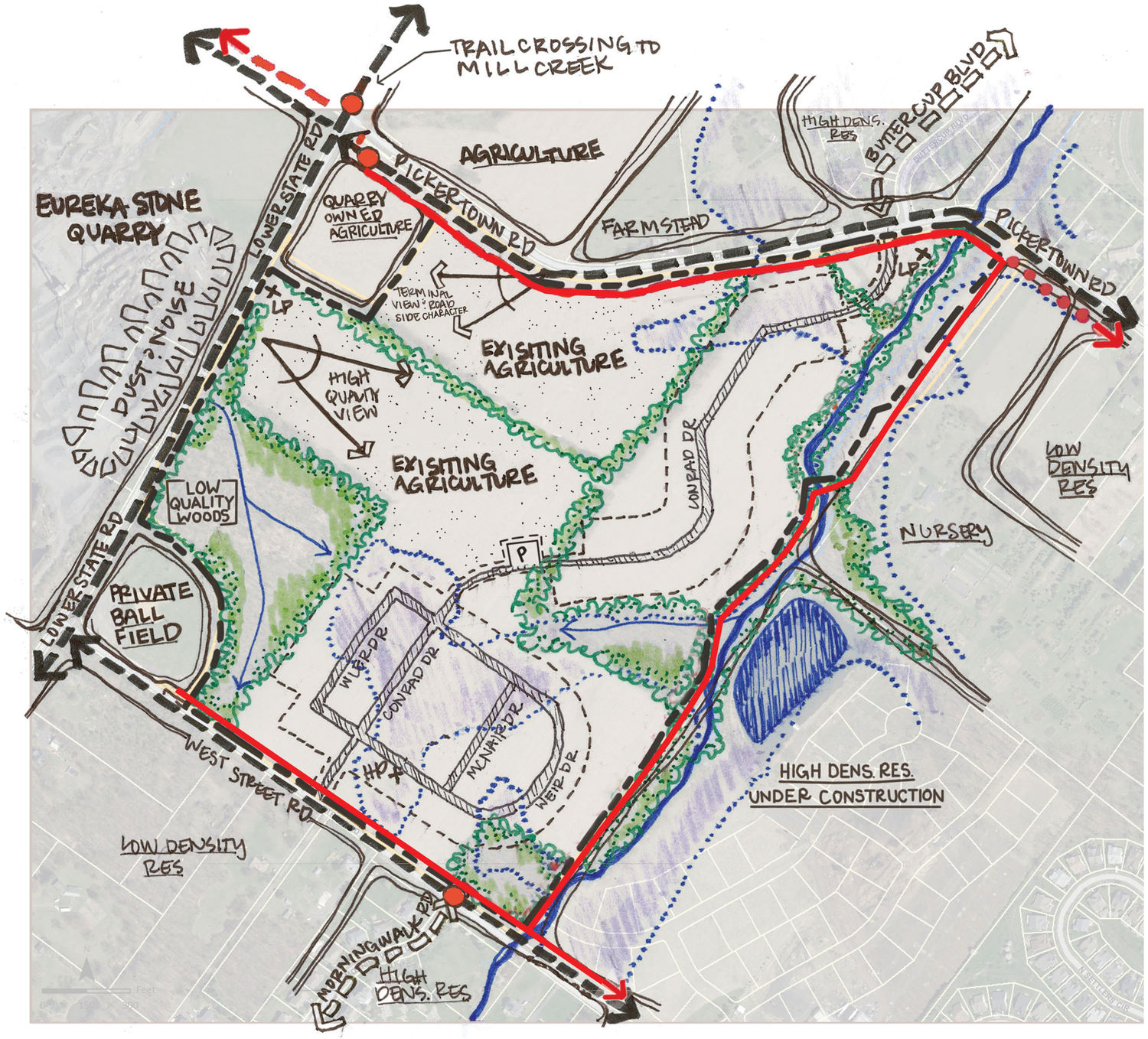
1. Parcels, roadways, and waterways from Bucks County.
2. Aerial imagery from PEMA.
3. Property boundary and open space areas from STA Engineering Inc. subdivision completed March 4, 2019, revised September 30, 2019.

Compiled By: KEB 07/07/2021

Map 10

Emerson Farm Preserve

Site Analysis



- PRIMARY ROADWAY
- SECONDARY ROADWAY
- LIMITS OF DEVELOP.
- EXISTING TRAIL
- PLANNED MULTI USE TRAIL
- PROPOSED MULTI USE TRAIL
- TRAIL/ROAD CROSSING
- CONTINUOUS WATERWAY
- INTERMITTENT WATERWAY
- HYDRIC SOIL
- WOODLAND
- VIEW
- SITE HIGH POINT

0' 100' 200' 300' 400'

N

Site Area: Approx. 68.5 acres

Natural Lands

Map 11

Emerson Farm Preserve

Master Plan

- PROPERTY BOUNDARY
- ROADWAY
- EXISTING PAVED MULTIUSE TRAIL
- PROPOSED MULTI-USE TRAIL
- NATURALLY PAVED TRAIL
- FUTURE TRAIL
- FENCE
- DEVELOPMENT AREA
- TREE LINE
- EXISTING WOODLAND
- REFORESTATION
- MEADOW
- AGRICULTURE
- STORMWATER BASIN
- LANDSCAPING AREAS
- CREEK
- STANDING WATER
- ROAD CROSSING
- INFO./WAYFINDING SIGN
- P PARKING
- BIRD BOXES
- HIGH PROTECTION AREA
- STANDARD PROTECTION AREA
- MINIMAL PROTECTION AREA

Site Area: Approx. 68.5 acres

0' 200' 400'
100' 300'

N

WARRINGTON TOWNSHIP PENNSYLVANIA

Natural Lands

Map 12

Recommended Native Deciduous Shade Trees
White Oak (*Quercus alba*)
Northern Red Oak (*Quercus rubra*)
Black Gum (*Nyssa sylvatica*)
Thornless Honey Locust (*Gleditsia triacanthos inermis*)
Kentucky Coffee Tree 'Espresso' (*Gymnocladus dioicus*)**

Recommended Native Shrubs
Red Chokeberry (*Aronia arbutifolia*)
Black Chokeberry (*Aronia melanocarpa*)
Bayberry (*Myrica pensylvanica*)
Witch-hazel (*Hamamelis virginiana*)
Gray dogwood (*Cornus racemosa*)

**It is important that a male cultivar, such as 'Espresso' is selected in order to limit the amount of litter, or organic material, dropped by the tree.

Site Area: Approx. 68.5 acres

0' 200' 400'
100' 300'
N

Emerson Farm Preserve - Landscape Plan

Recommendations:

1. Row of shade trees along the trail at Pickertown Road
2. Tree and shrub buffer around stormwater basin
3. Shade trees around Conrad Drive parking lot

1. Deciduous shade trees are recommended along the southwestern edge of the existing multi-use trail along Pickertown Road. At Emerson, deciduous trees are recommended to provide shade for trail users, as well as habitat and forage for wildlife.

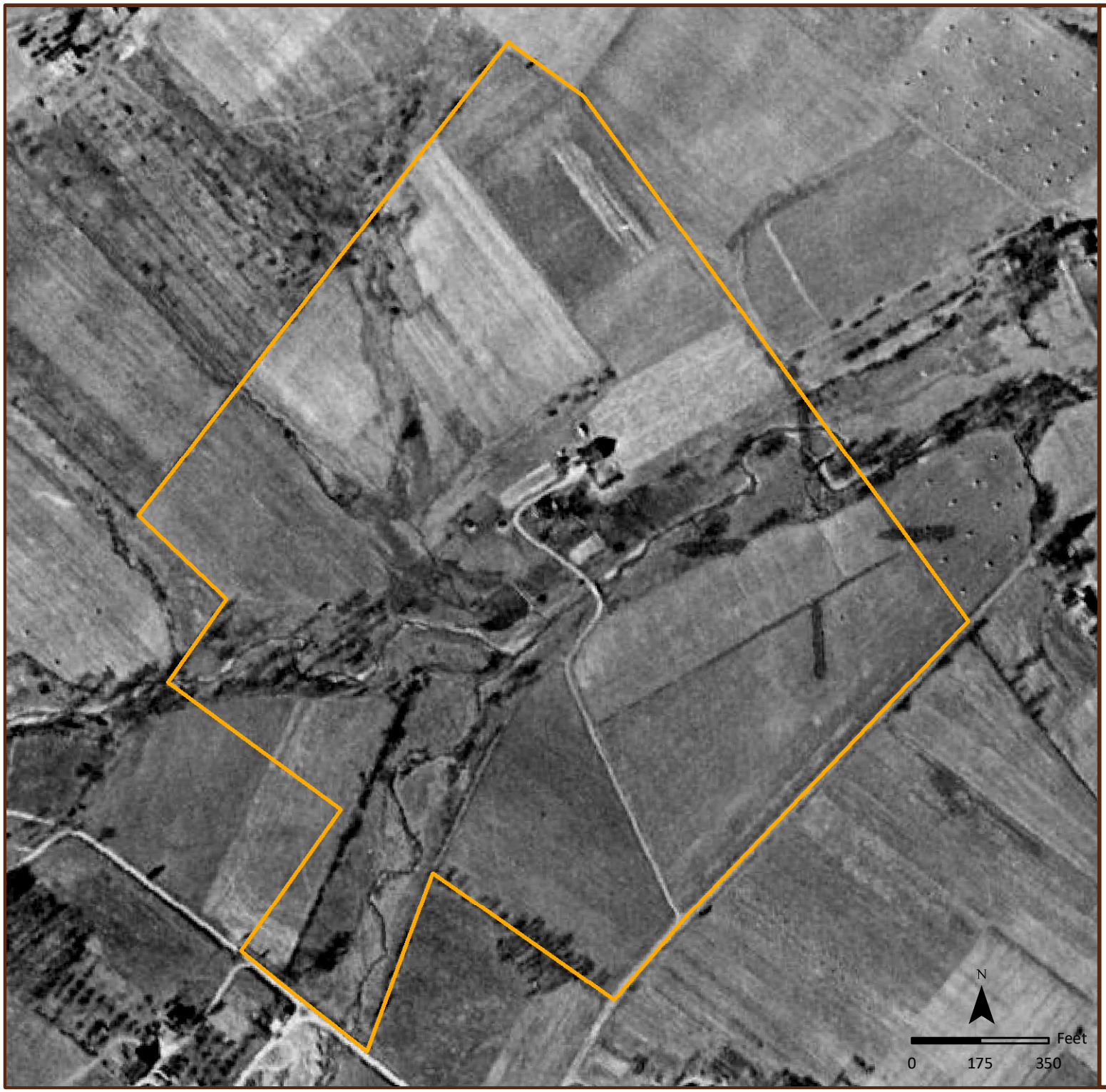
Trees should be planted at a consistent spacing. 25' on-center spacing will accommodate the mature size of the recommended species below.

The approximate length of trail along Pickertown Road within the site is 975'. **At 25' spacing, along one side of the trail, 39 trees are required.**

In order to avoid damage to the asphalt trail, the allee trees should be planted at least 10' from the edge of the pathway. This will allow space for the trees roots to expand without heaving/cracking the pathway.

2. The existing stormwater basin located along the Pickertown trail, at the northern corner of the property, shows a limited amount of vegetation and could be improved through the installation of a vegetated buffer consisting of trees and shrubs. The list of native deciduous trees listed below could be used to plant around the perimeter of the basin. In addition, native species of shrubs, a list of which appears below, could be planted around the perimeter of the basin. This would improve biodiversity at the basin, providing habitat and forage for wildlife, as well as improve the function of the basin by providing additional uptake of stormwater runoff.

3. The existing approximately 65' x 85' parking lot along Conrad Drive should be planted with shade trees around its perimeter. As with the trail plantings, the trees should be located at least 10 feet from the edge of the paving in order to prevent damage to the parking lot paving. The list of recommended trees species below would be appropriate for planting around the parking lot. They would provide shade while limiting the amount of litter, or cast down organic material emanating from the trees, and thus limit maintenance considerations.



Map 13: Historical Aerial (1938)

MILL CREEK PRESERVE

Tax ID: 50-004-109, 50-004-106, and 50-004-107

Warrington Township, Bucks County, PA

Mill Creek Preserve (+/- 66.2899 acres)

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

1. Property boundary from CKS Engineers.
2. Historical aerial imagery from PennPilot (www.pennpilot.psu.edu).

Compiled By: MEB 09/27/19

Map 14: Historical Aerial (1958)

MILL CREEK PRESERVE

Tax ID: 50-004-109, 50-004-106, and 50-004-107

Warrington Township, Bucks County, PA

Mill Creek Preserve (+/- 66.2899 acres)

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

1. Property boundary from CKS Engineers.
2. Historical aerial imagery from PennPilot (www.pennpilot.psu.edu).

Compiled By: MEB 09/27/19

Map 15: Historical Aerial (1971)

MILL CREEK PRESERVE

Tax ID: 50-004-109, 50-004-106, and 50-004-107

Warrington Township, Bucks County, PA

Mill Creek Preserve (+/- 66.2899 acres)

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

1. Property boundary from CKS Engineers.
2. Historical aerial imagery from PennPilot (www.pennpilot.psu.edu).

Compiled By: MEB 09/27/19

Map 16: 2015 Aerial Photography

MILL CREEK PRESERVE

Tax ID: 50-004-109, 50-004-106, and 50-004-107

Warrington Township, Bucks County, PA

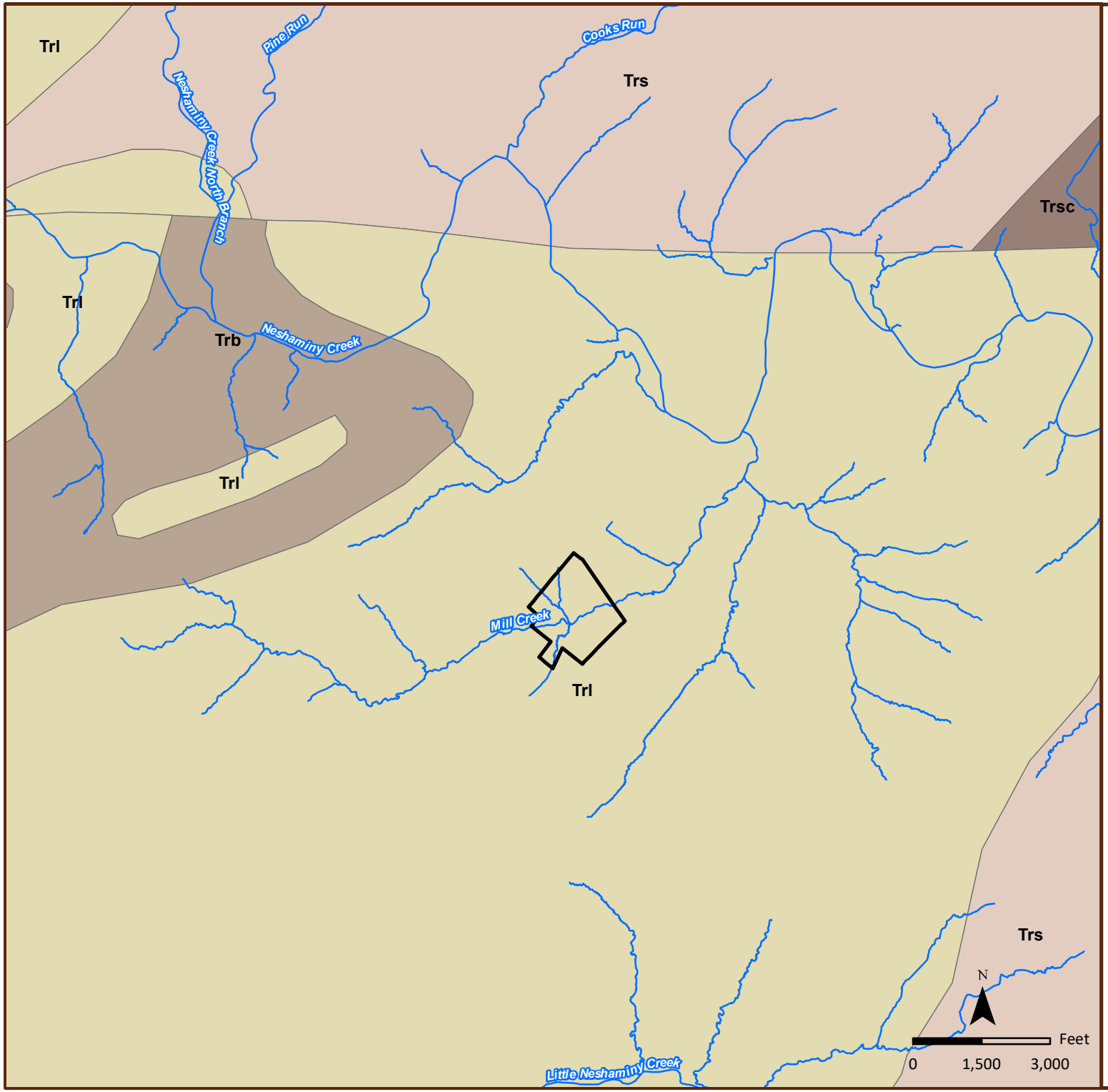
Mill Creek Preserve
(+/- 66.2899 acres)

Waterways

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

1. Property boundary from CKS Engineers.
2. Aerial imagery from DVRPC.
3. Waterways and roadways from Bucks County.

Compiled By: MEB 10/08/19



Map 17: Geology

MILL CREEK PRESERVE

Warrington Township, Bucks County, PA

Mill Creek Preserve

Waterways

Geology

Brunswick Formation (Trb)

Lockatong Formation (Trl)

Stockton Formation (Trs)

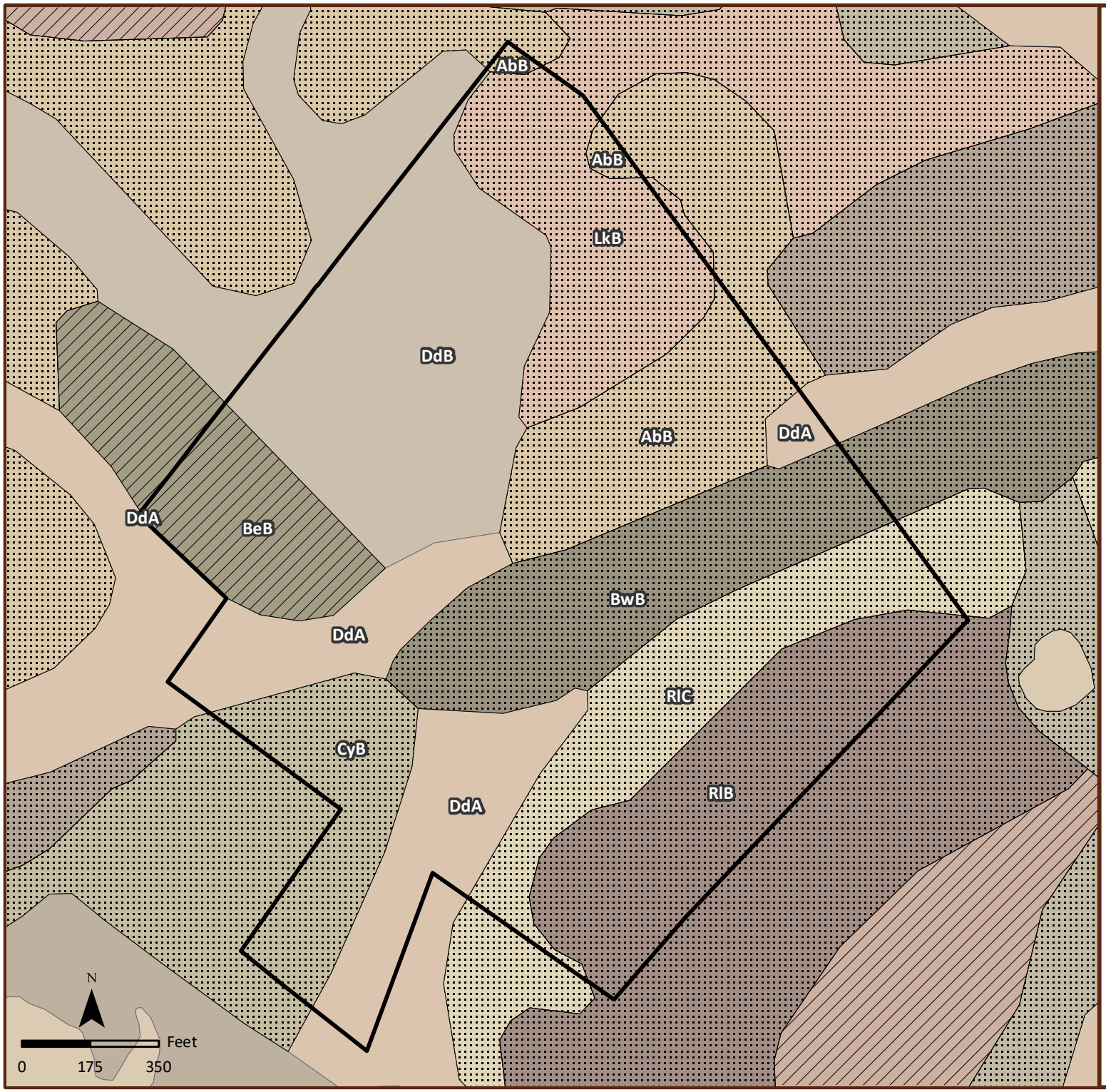
Stockton conglomerate (Trsc)

Natural Lands

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

1. Geology from PA Geological Society.
2. Streams, and parcel boundaries from Bucks County.

Compiled By: KEB 11/13/18



Map 18: Soils

MILL CREEK PRESERVE

Tax ID: 50-004-109, 50-004-106, and 50-004-107
Warrington Township, Bucks County, PA

Mill Creek Preserve (+/- 66.2899 acres)

All areas are prime farmland

Farmland of statewide importance

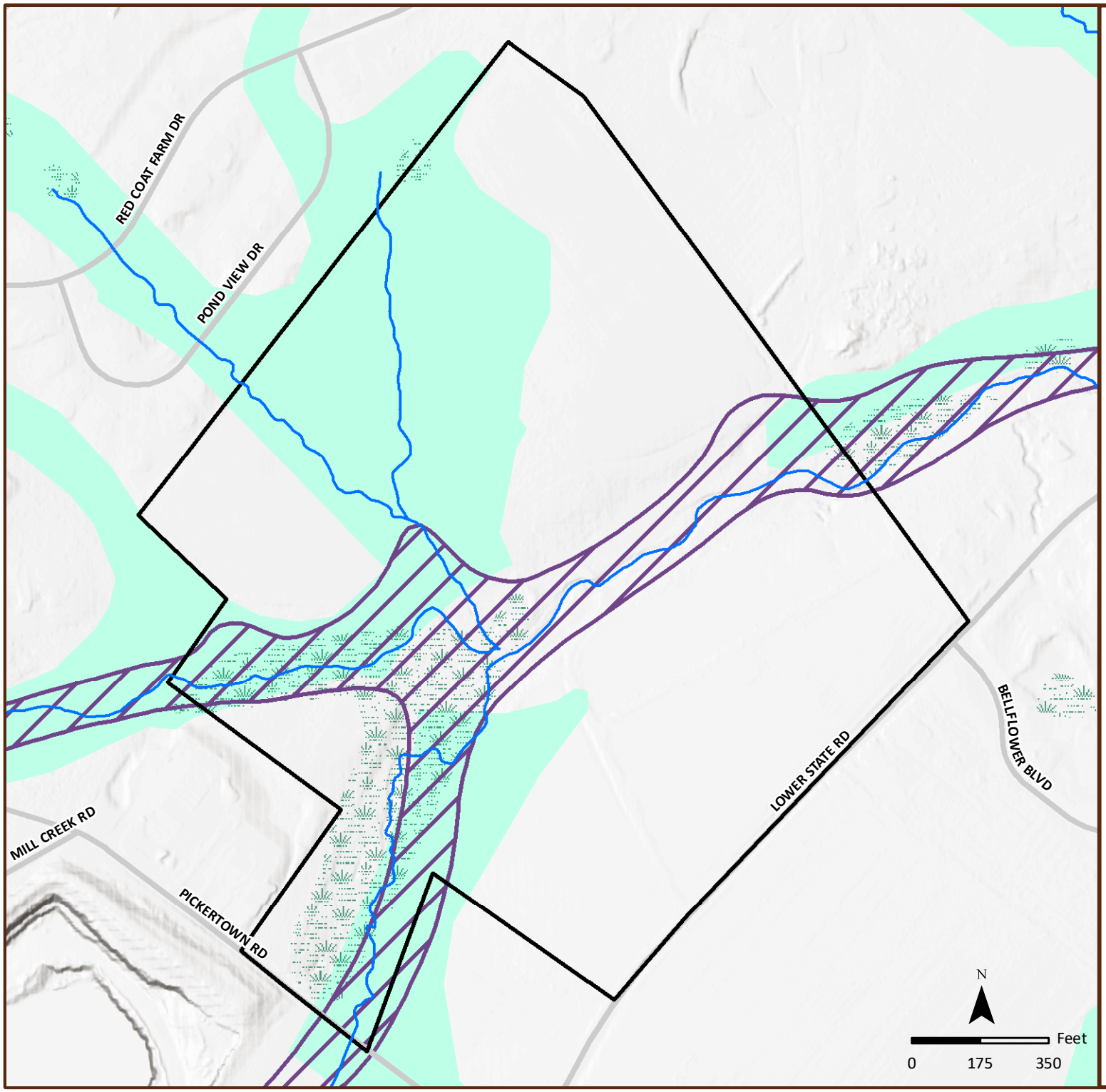
Soils

- AbB, Abbottstown
- BeB, Bedington
- BwB, Buckingham
- CyB, Culleoka
- DdA, Doylestown
- DdB, Doylestown
- LkB, Lawrenceville
- RlB, Reaville
- RlC, Reaville

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

1. Property boundary from CKS Engineers.
2. Soils from USDA-NRCS.

Compiled By: MEB 09/25/19



Map 19: Hydrology

MILL CREEK PRESERVE

Tax ID: 50-004-109, 50-004-106, and 50-004-107

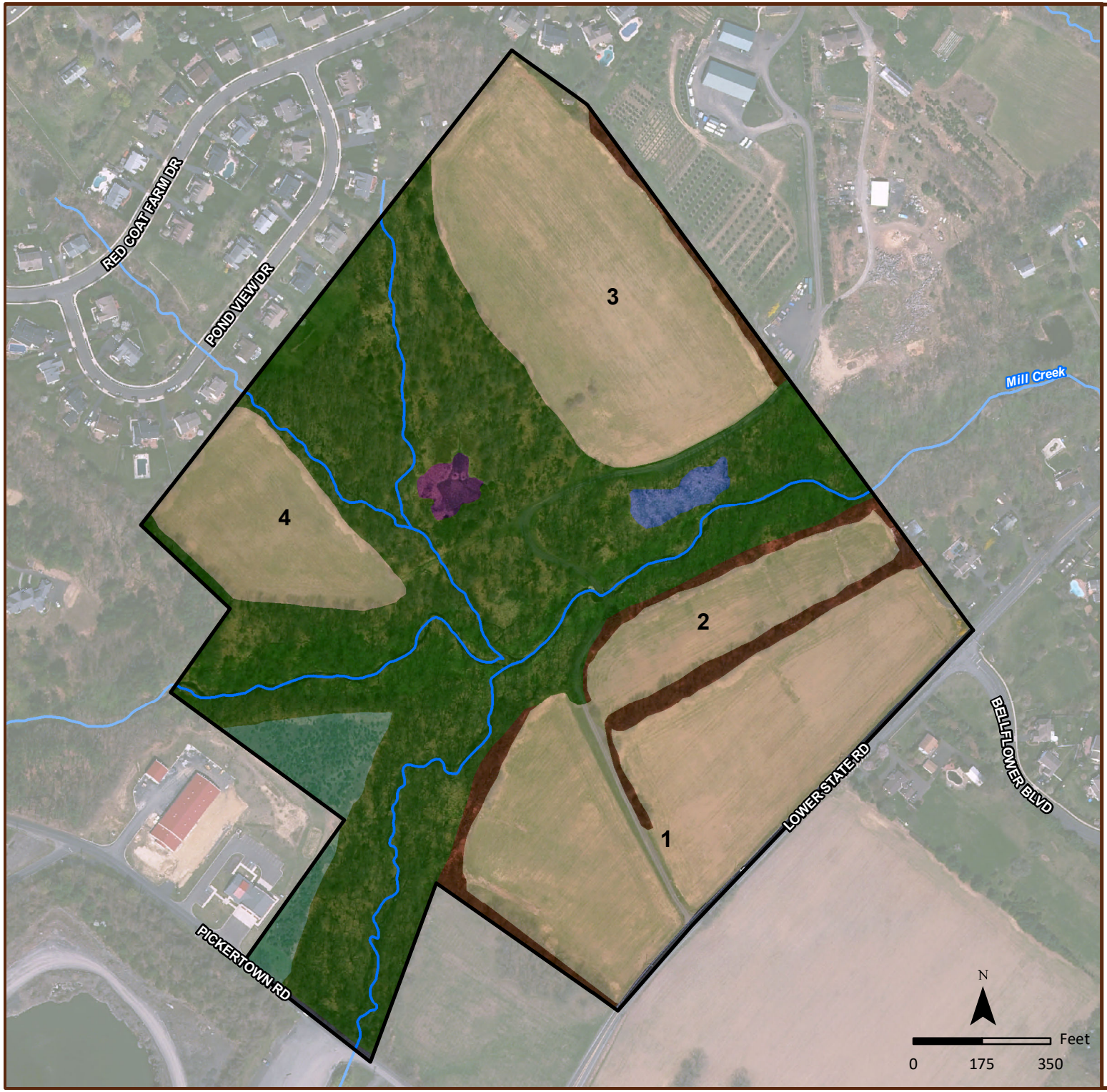
Warrington Township, Bucks County, PA

- Mill Creek Preserve (+/- 66.2899 acres)
- Waterways
- Hydric Soils
- 100-Year Floodplain
- Wetlands

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

1. Property boundary from CKS Engineers.
2. Hydric soils from USDA-NRCS.
3. Floodplains from FEMA.
4. Wetlands from the National Wetlands Inventory.
5. Terrain basemap from Esri, Inc.

Compiled By: MEB 09/25/19



Map 20: Plant Communities

MILL CREEK PRESERVE

Warrington Township, Bucks County, PA

Mill Creek Preserve

Waterways

Vegetation

- Agricultural Field
- Eastern Red-Cedar Woodland/Shrubland
- Green Ash - Mixed Hardwood Floodplain Forest
- Mixed Hardwood Forest
- Palustrine Shrubland/Wet Meadow
- Wet Meadow

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

1. Roads and streams from Bucks County.
2. Aerial photography from DVRPC.

Compiled By: KEB 1/04/19

Map 21

Mill Creek Preserve

Site Analysis

- PRIMARY ROADWAY
- SECONDARY ROADWAY
- SHARED ACCESS
- POTENTIAL ACCESS CONNECTIONS
- PLANNED MULTIUSE TRAIL
- CONTINUOUS WATERWAY
- INTERMITTENT WATERWAY
- HYDRIC SOIL
- WOODLAND

WARRINGTON TOWNSHIP PENNSYLVANIA

Natural Lands

Map 22

Mill Creek Preserve
Master Plan

- ROADWAY
- PROPOSED NAT. SURFACE TRAIL
- PROPOSED MULTI-USE TRAIL
- PLANNED PAVED MULTUSE TRAIL
- EXISTING ROADWAY TO BE USED AS TRAIL
- PROPOSED WILDFLOWER MEADOW
- PROPERTY BOUNDARY
- REFORESTATION
- EXISTING WOODLAND
- PLANTED BUFFER
- RIPARIAN BUFFER
- TREE
- CREEK
- EXISTING WETLAND
- EXISTING WET MEADOW
- EXISTING BRIDGE TO REMAIN
- PROPOSED BOARDWALK
- BIRD BLIND
- BIRD BOXES
- POTENTIAL PICNIC AREA
- POTENTIAL EDUCATION AREA
- INFO./WAYWINDING SIGN
- FENCE

WARRINGTON TOWNSHIP · PENNSYLVANIA ·

Natural Lands

Map 23

Recommended Native Deciduous Shade Trees
White Oak (*Quercus alba*)
Northern Red Oak (*Quercus rubra*)
Black Gum (*Nyssa sylvatica*)
Thornless Honey Locust (*Gleditsia triacanthos inermis*)
Kentucky Coffee Tree 'Espresso' (*Gymnocladus dioicus*)**

Recommended Native Shrubs
Red Chokeberry (*Aronia arbutifolia*)
Black Chokeberry (*Aronia melanocarpa*)
Bayberry (*Myrica pensylvanica*)
Witch-hazel (*Hamamelis virginiana*)
Gray dogwood (*Cornus racemosa*)

**It is important that a male cultivar, such as 'Espresso' is selected in order to limit the amount of litter, or organic material, dropped by the tree.

Mill Creek Preserve - Landscape Plan

Recommendations:

1. Shade tree allée along the entry drive
2. Tree and shrub plantings to separate parking lot from picnic area
3. Tree and shrub plantings around picnic area and outdoor education area

1. An allée, or double row of evenly spaced trees, is recommended along the entry drive to create a scenic arrival experience and provide habitat and forage for native wildlife. A single row of shade trees is also recommended along the site frontage at Lower State Road.

Trees should be planted at a consistent spacing. 25' on-center spacing will accommodate the mature size of the recommended species below.

The approximate length of the entry drive at Mill Creek is 475'. However, on the northern side of the drive, there are existing mature trees along part of that distance. Therefore, the southern edge of the drive (475') would require, at 25' spacing, 19 trees. The northern edge of the drive (225') would require, at 25' spacing, 9 trees. **The total number of trees required for the entry drive would be 28.**

The western section of frontage along Lower Street Road is 250' and would require 10 trees at 25' spacing. The eastern section of frontage along Lower Street Road is 975' and would require 39 trees at 25' spacing. **The total number of required street trees would be 39.**

In order to avoid damage to adjacent drives, all shade trees should be planted at least 10' from the edge of the drive. This will allow space for the trees' roots to expand without heaving the drive.

2. A border consisting of native trees and shrubs should be planted around the perimeter of the parking lot. This will serve to provide shade for parked cars on hot days, and more importantly, will serve to visually separate the parking lot from the picnic area, thereby providing visual cues for visitors on the separation of uses.

3. The picnic area should also be landscaped with trees to provide shade over the tables. The surrounding meadow plants can be allowed to grow right up to the edge of the picnic area. Native shrubs could also be planted at the entrance and along the paths to beautify the area and make it better fit into its surroundings. The list of trees and shrubs below are appropriate for this area.

Site Area: Approx. 62 acres

THE WEISEL PRESERVE
Tax ID: 50-004-070-006, 50-004-070-007, 50-004-073-003, 50-004-070-003, 50-057-043
+/- 92.6 acres
Warrington Township, Bucks County, PA

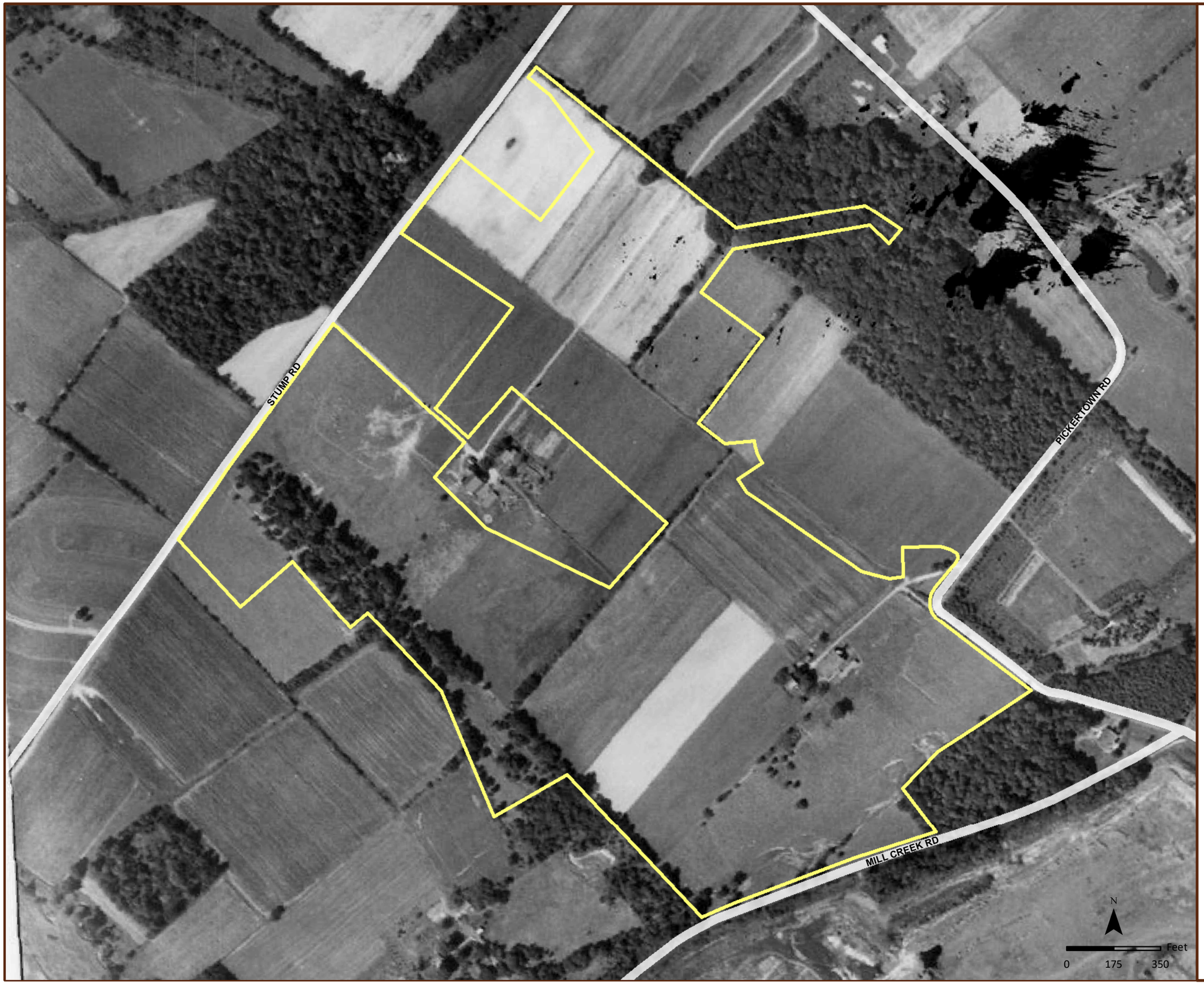
Map 24: Historical Aerial (1938)

The Weisel Preserve Property

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

1. Parcels from Bucks County.
2. Historical aerial imagery from PennPilot (www.pennpilot.psu.edu).

Compiled By: MEB 08/17/2020



THE WEISEL PRESERVE
Tax ID: 50-004-070-006, 50-004-070-007,
50-004-073-003, 50-004-070-003, 50-057-043
+/- 92.6 acres
Warrington Township, Bucks County, PA

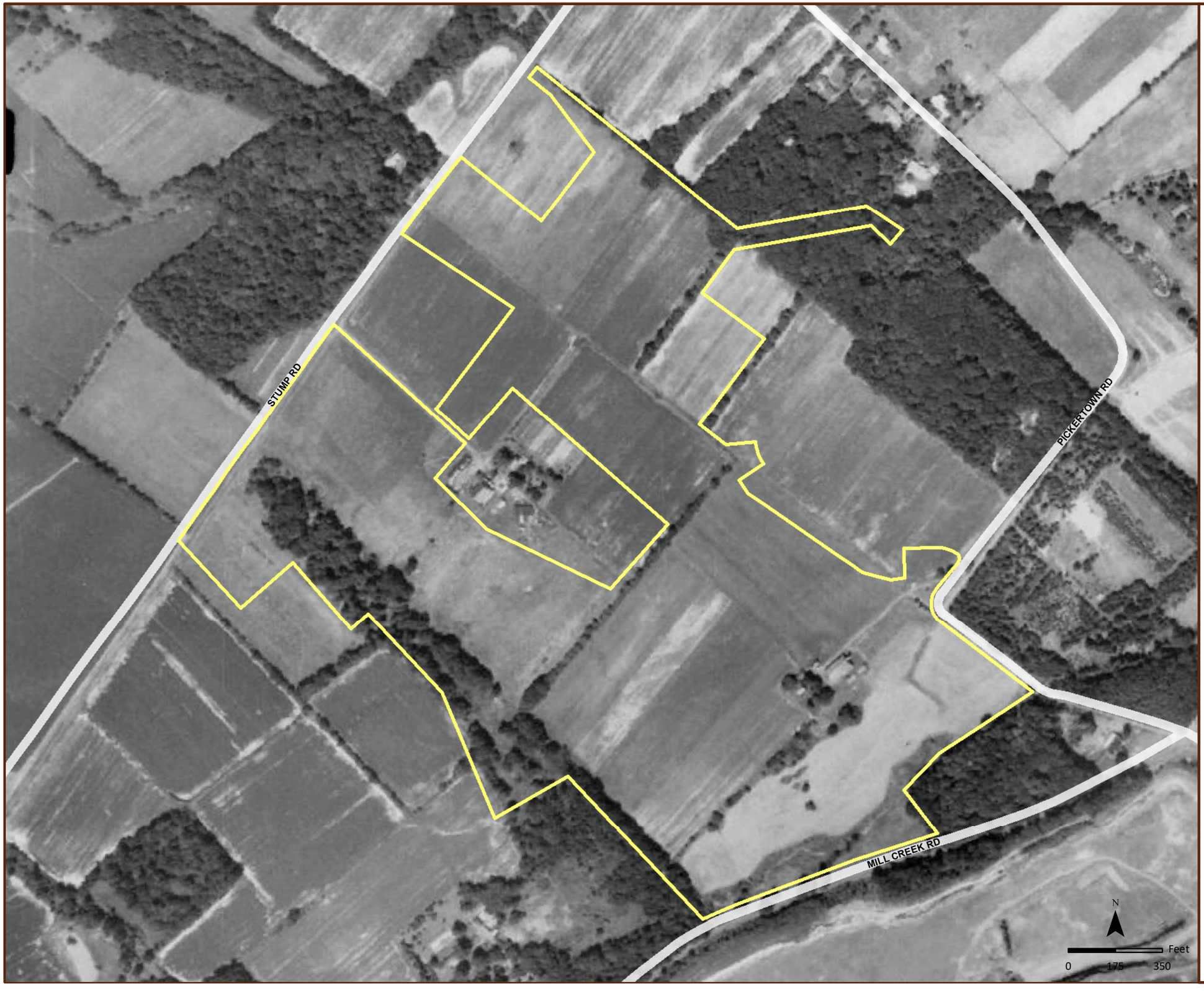
Map 25: Historical Aerial (1958)

The Weisel Preserve

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

1. Parcels from Bucks County.
2. Historical aerial imagery from PennPilot (www.pennpilot.psu.edu).

Compiled By: MEB 08/17/2020



THE WEISEL PRESERVE
Tax ID: 50-004-070-006, 50-004-070-007, 50-004-073-003, 50-004-070-003, 50-057-043
+/- 92.6 acres
Warrington Township, Bucks County, PA

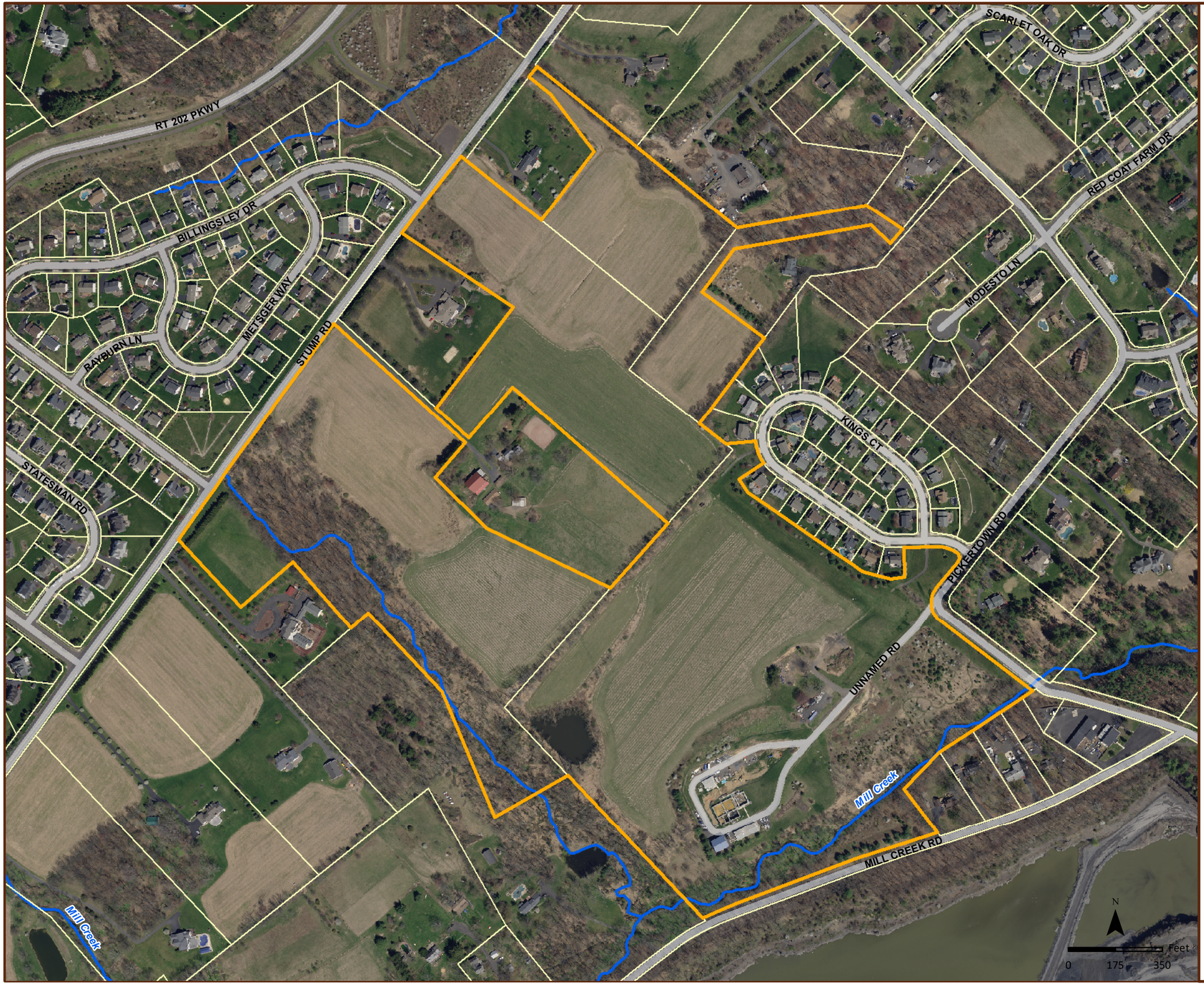
Map 26: Historical Aerial (1971)

The Weisel Preserve

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

1. Parcels from Bucks County.
2. Historical aerial imagery from PennPilot (www.pennpilot.psu.edu).

Compiled By: MEB 08/17/2020



THE WEISEL PRESERVE

Tax ID: 50-004-070-006, 50-004-070-007, 50-004-073-003, 50-004-070-003, 50-057-043
+/-92.6 acres
Warrington Township, Bucks County, PA

Map 27: 2018 Aerial Photography

The Weisel Preserve

Parcel Boundary

Waterways

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

1. Parcels, roadways, and waterways from Bucks County.
2. Aerial imagery from PEMA.

Compiled By: MEB 08/17/2020

Brunswick Formation

Lockatong Formation

N

Feet

0 500 1,000

THE WEISEL PRESERVE

Tax ID: 50-004-070-006, 50-004-070-007, 50-004-073-003, 50-004-070-003, 50-057-043
+/- 92.6 acres
Warrington Township, Bucks County, PA

Map 28: Geology

The Weisel Preserve

Surface Geology

Brunswick Formation

Lockatong Formation

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

1. Parcels from Bucks County.
2. Geology from PA Geological Survey.

Compiled By: MEB 08/17/2020

THE WEISEL PRESERVE

Tax ID: 50-004-070-006, 50-004-070-007,
50-004-073-003, 50-004-070-003, 50-057-043
+/- 92.6 acres
Warrington Township, Bucks County, PA

Soils

- The Weisel Preserve
- Prime farmland
- Farmland of statewide importance

Soils

- AbB
- BeB
- CbA
- CbB
- CyB
- CyC
- DdA
- DdB
- LkA
- LkB
- PeC
- Pr
- ReA
- ReB
- RlB
- W

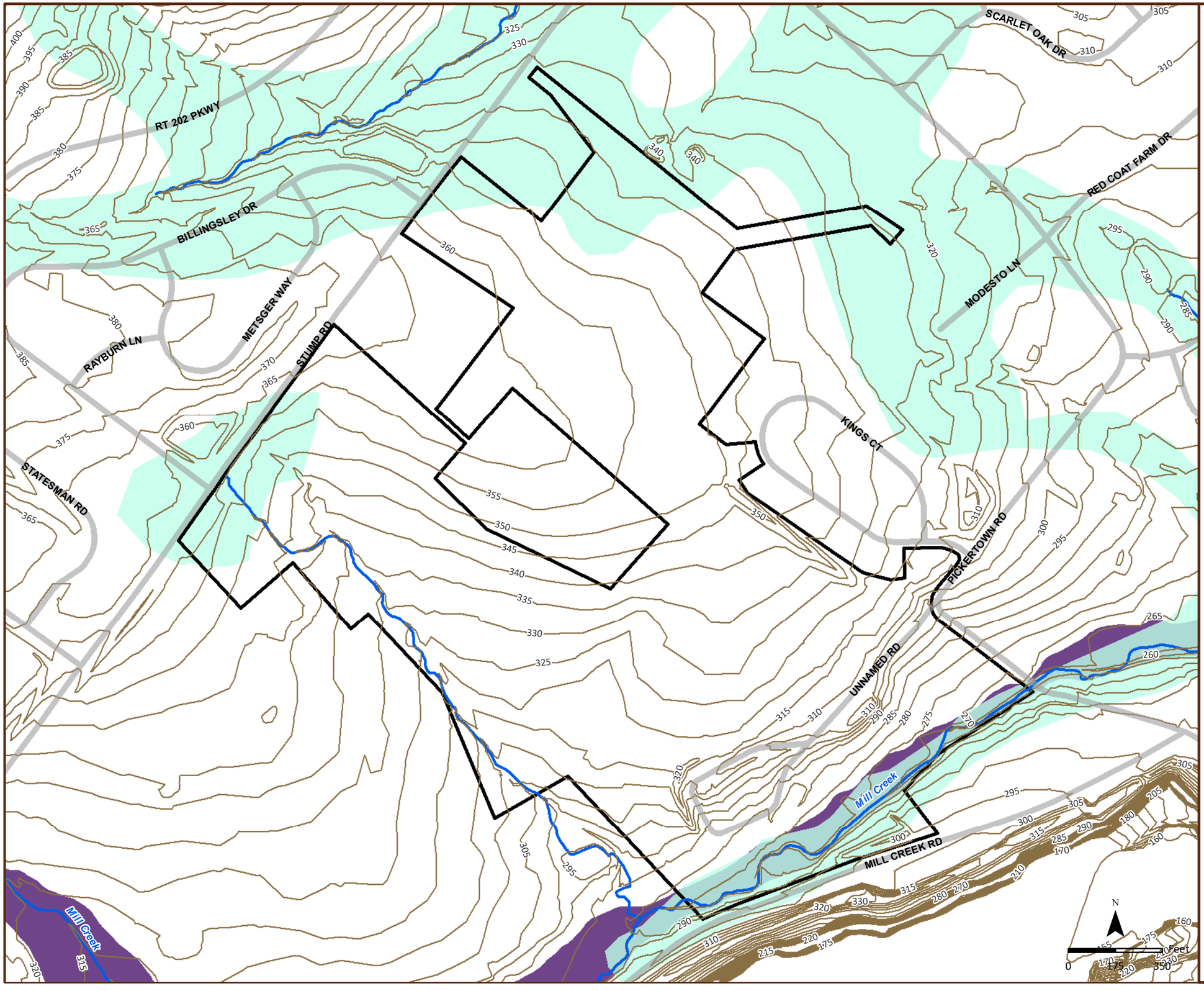
Natural Lands
1031 Palmers Mill Road, Media, PA 19063
610-353-5587 | natlands.org

1. Parcels from Bucks County.
2. Soils from USDA-NRCS.

Compiled By: MEB 08/17/2020

N

0 175 350 Feet



THE WEISEL PRESERVE

Tax ID: 50-004-070-006, 50-004-070-007, 50-004-073-003, 50-004-070-003, 50-057-043
+/- 92.6 acres
Warrington Township, Bucks County, PA

Map 30: Topography/Hydrology

- The Weisel Preserve
- Contours (5 ft)
- Waterways
- Hydric Soil
- 100-Year Floodplain

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

1. Parcels from Bucks County.
2. Contours from DVRPC.
3. Hydric soils from USDA-NRCS.
4. Floodplains from FEMA.

Compiled By: MEB 08/17/2020

Map 31: Plant Communities and Stewardship Features

The Weisel Preserve

Tax ID: 50-004-070-006, 50-004-070-007, 50-004-073-003, 50-004-070-003, 50-057-043
+/- 92.6 acres
Warrington Township, Bucks County, PA

- The Weisel Preserve
- Parcel Boundaries
- Waterways

Plant Communities

- Agricultural Field
- Ash-Mixed Hardwood Forest
- Berm
- Hedgerow
- Leaf Collection Building
- Mixed Hardwood Woodland/Forest
- Planting Area
- Pond
- Pond Buffer
- Red Oak-Mixed Hardwood Forest
- Stormwater Basin
- Terrestrial Meadow

Stewardship Features

- Debris
- Culvert
- Seep

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

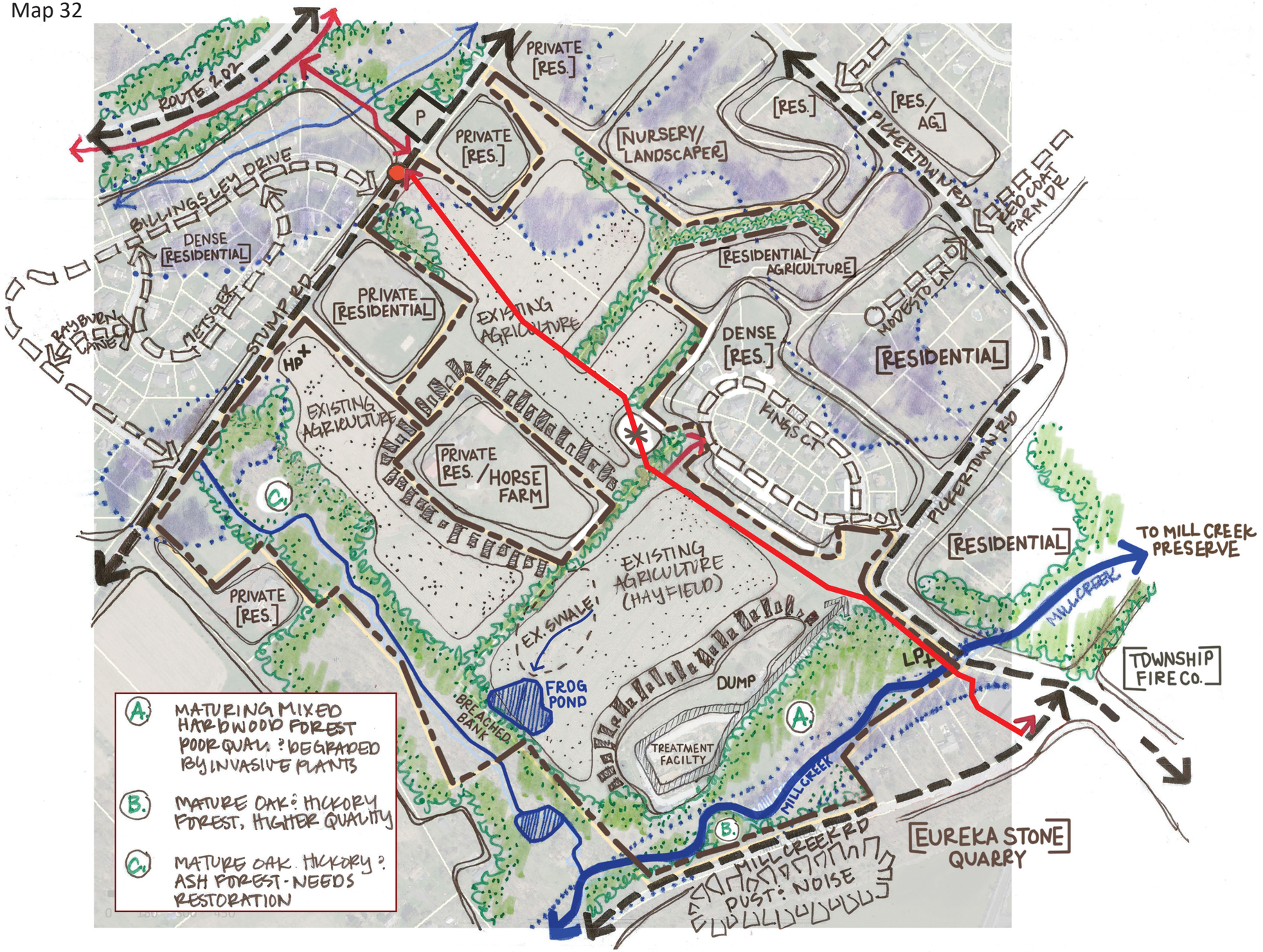
1. Parcels, roads, and waterways from Bucks County.
2. Aerial imagery from PEMA.

Compiled By: KEB 07/07/2021

Map 32

The Weisel Preserve

Site Analysis



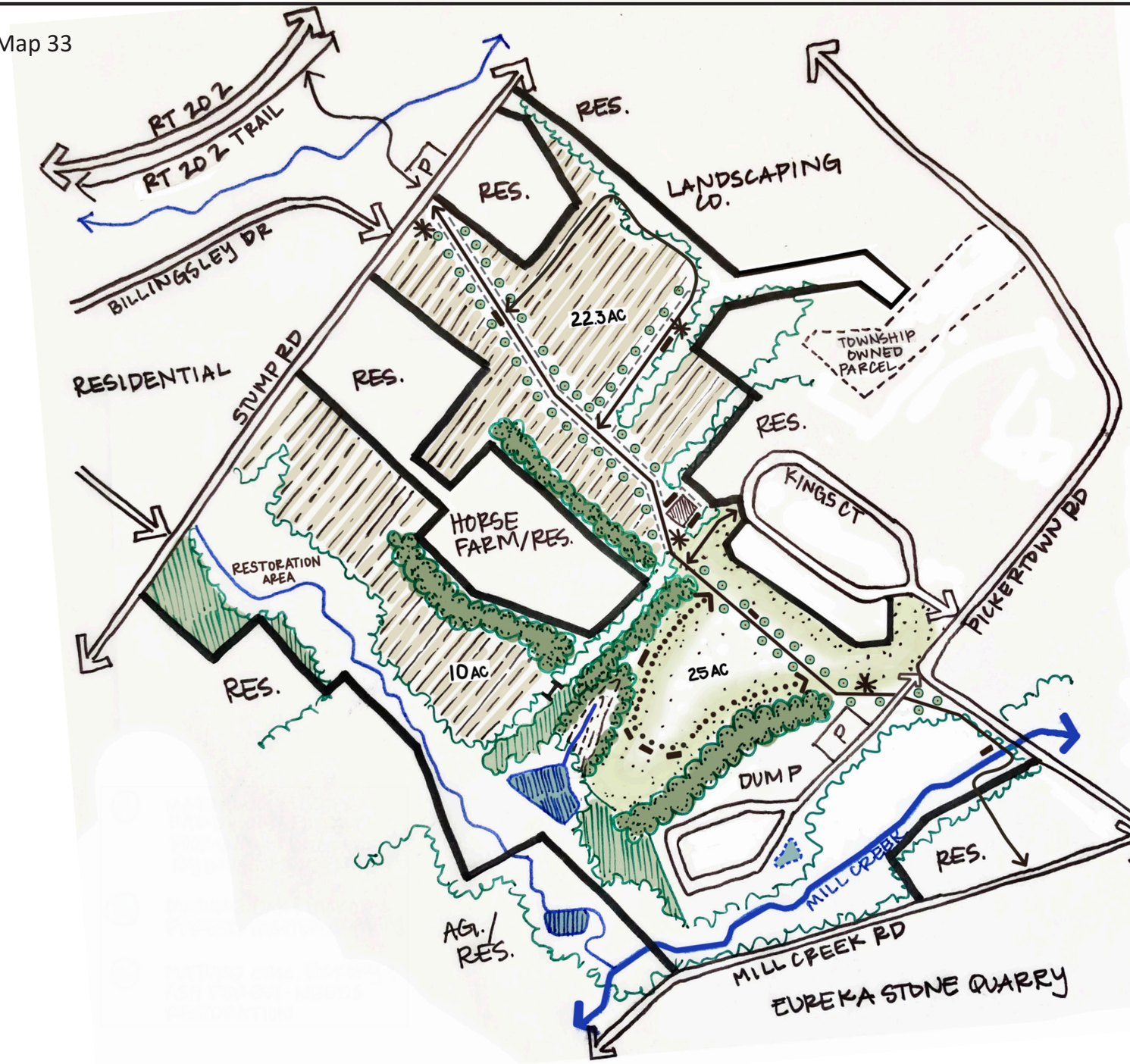
- PRIMARY ROADWAY
- SECONDARY ROADWAY
- EXISTING PROPERTY ROADWAY
- EXISTING MULTIUSE TRAIL
- TRAIL/ROAD CROSSING
- CONTINUOUS WATERWAY
- INTERMITTENT WATERWAY
- STANDING BODY OF WATER
- HYDRIC SOIL
- WOODLAND
- BUFFER NEEDED
- POLLINATOR GARDEN
- SITE HIGH POINT
- SITE LOW POINT
- P PARKING AREA

Site Area: Approx. 94 acres

Natural Lands

Map 33

The Weisel Preserve
Master Plan

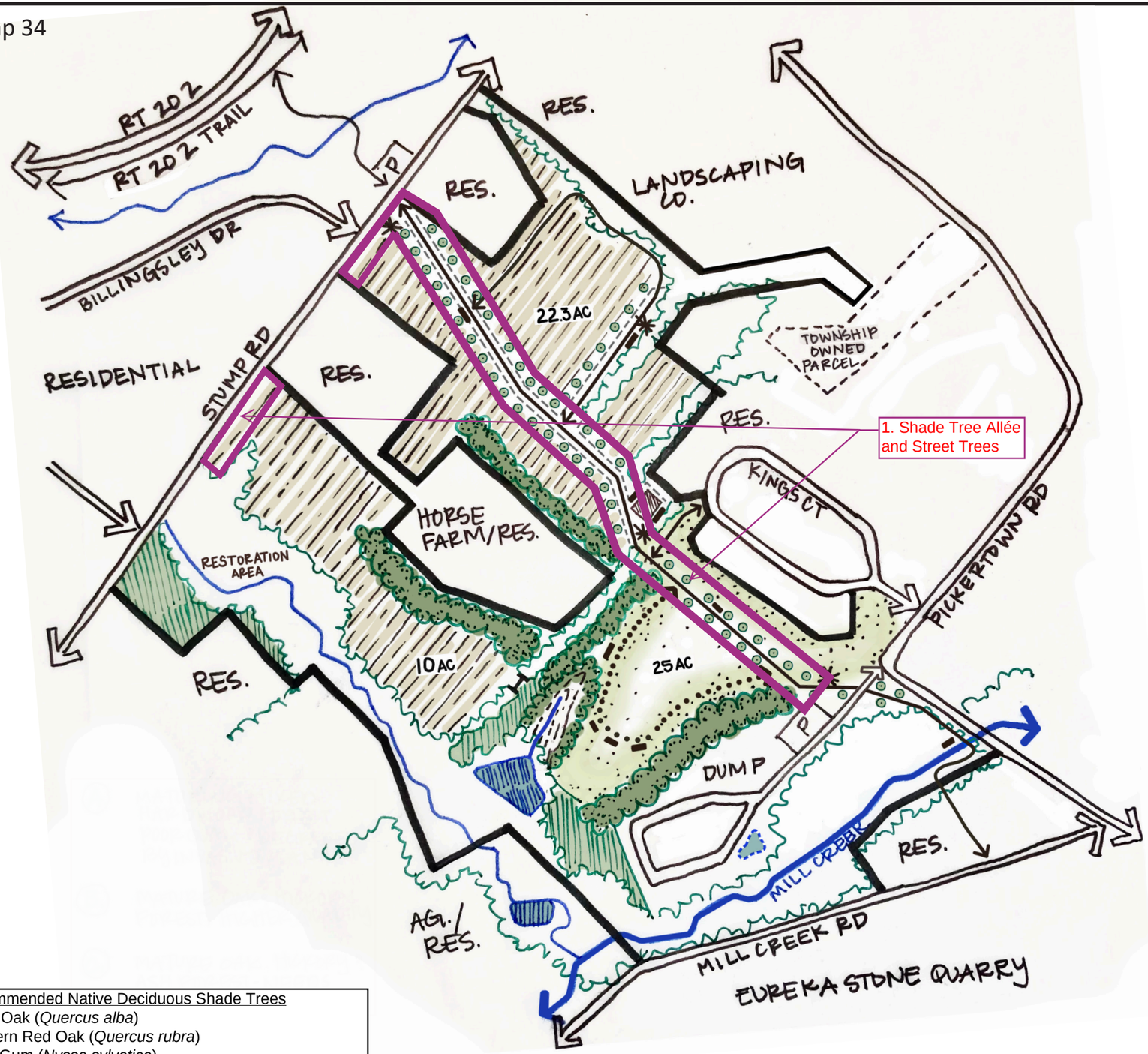


- PROPERTY BOUNDARY
- PROPOSED WILDFLOWER MEADOW
- PROPOSED AG.
- PROPOSED FENCE
- ROADWAY
- EXISTING PAVED TRAIL
- PROPOSED NAT. SURFACE TRAIL
- FENCE
- REFORESTATION
- EXISTING WOODLAND
- PLANTED BUFFER
- TREE
- CREEK
- POND
- STORMWATER MANAGEMENT BASIN
- INFO./WAYWINDING SIGN
- BENCHES
- POLLINATOR GARDEN
- SWALE
- PROPOSED GATE

Site Area: Approx. 94 acres

Natural Lands

Map 34



Recommended Native Deciduous Shade Trees
White Oak (*Quercus alba*)
Northern Red Oak (*Quercus rubra*)
Black Gum (*Nyssa sylvatica*)
Thornless Honey Locust (*Gleditsia triacanthos inermis*)
Kentucky Coffee Tree 'Espresso' (*Gymnocladus dioicus*)**

**It is important that a male cultivar, such as 'Espresso' is selected in order to limit the amount of litter, or organic material, dropped by the tree.

The Weisel Preserve - Landscape Plan

Recommendation:

1. Shade tree allée along the existing multiuse trail and street trees

An allée consists of evenly spaced trees to create a scenic pathway while providing shade and/or wind protection.

At Weisel, deciduous trees are recommended to be planted as an allée in order to structure the site, provide shade for trail users, as well as habitat and forage for wildlife.

Although allées often consist of only one species of tree, this approach is not recommended, as a monoculture of only a single species is less resilient to health threats. To maintain the effect of an allée, it is recommended that a variety of trees is selected, and then planted in groups of 10-12, e.g. 5 red oaks on either side of the pathway, followed by 5 black gums on either side of the pathway. This will preserve a visual unity, while promoting greater biodiversity.

Trees should be planted at a consistent spacing. 25' on-center spacing will accommodate the mature size of the recommended species in the box to the left.

The approximate length of trail through the Weisel Farm is 2,550'. **At 25' spacing, along both sides of the trail, 204 trees are required.**

If the Township desires to plant fewer trees, it is recommended to use half as many trees, still spaced at 25', along one side of the trail. It is recommended that trees be planted along the southwestern side of the trail to provide maximum shade during summer months.

In order to avoid damage to the asphalt trail, the allee trees should be planted at least 10' from the edge of the pathway. This will allow space for the trees roots to expand without heaving/cracking the pathway.

Shade trees are also recommended for planting along two segments of Stump Road frontage. These street trees should also be planted at 25' intervals and should be located with sufficient spacing from the overhead powerlines along the road to limit future pruning. The expected mature diameter of foliage for a chosen trees can be referenced to determine how far off the powerlines these trees should be sited. The western segment of frontage is 400' long. At 25' spacing, the section would require 16 trees. The eastern segment of frontage is 225' and at 25' spacing, would require 9 trees. **The total number of recommended trees for the Stump Road frontage is 25.**

Site Area: Approx. 94 acres

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