

Gambone Property

NATURAL AREA STEWARDSHIP PLAN

May 2015

Whitemarsh Township, Montgomery County
23.1 acres



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Hildacy Farm Preserve
1031 Palmers Mill Road
Media, PA 19063
610-353-5587
www.natlands.org

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GENERAL PROPERTY DESCRIPTION

The 23.1-acre Gambone Property (Property) is located in Whitemarsh Township, Montgomery County (see *Location Map* and *2010 Aerial Photography*). It is generally located between Cedar Grove Road to the east, Hillcrest Avenue to the west, Butler Pike to the north, and Hector Street to the south. Additionally, Wells Street traverses through the northern portion of the Property; a PECO powerline borders its entire western boundary; the eastern boundary includes three residences and Cedar Grove Road; and the southern property boundary is shared with PQ Chemical Company. The Property is accessible from a parking lot in the adjoining Cedar Grove Park and a pull-off area on Wells Street. Nearby parks include Cedar Grove Park, Kline Park, and Leeland Park owned by Whitemarsh Township and Spring Mill Park owned by Montgomery County.

Historically, the Property was maintained as an arboretum (see *Historical Aerial Imagery (1942)*). By 1958, the Property appears to be transitioning from the formal arboretum structure to a less manicured state, roads/trails through the Property have increased, and the sewer line appears to have been installed running northwest to southeast across the Property (see *Historical Aerial Imagery (1958)*). *Historical Aerial Imagery (1971)* shows a transformation of the Property to a more natural area with areas of woodlands, scrub/shrub, meadows, and lawn, and the construction of Wells Street.

This report addresses stewardship of and potential public access to the site's natural features, including: (1) a description of the natural areas on the Property (2) a summary of stewardship issues and opportunities, and (3) general recommendations to address stewardship issues or fulfill stewardship opportunities.

Natural Lands Trust staff visited the site on two days in 2014. On July 22, we were accompanied by Doug Knauss, Director of Parks and Recreation at Whitemarsh Township. For our second site visit on December 4, NLT staff was joined by John Walker, Interim Director of Parks and Recreation. The Property's natural resources were assessed and documented by field notes, photographs, and Global Positioning System (GPS) data collection. In addition, a proposed conceptual trail system was identified and located using GPS data collection.



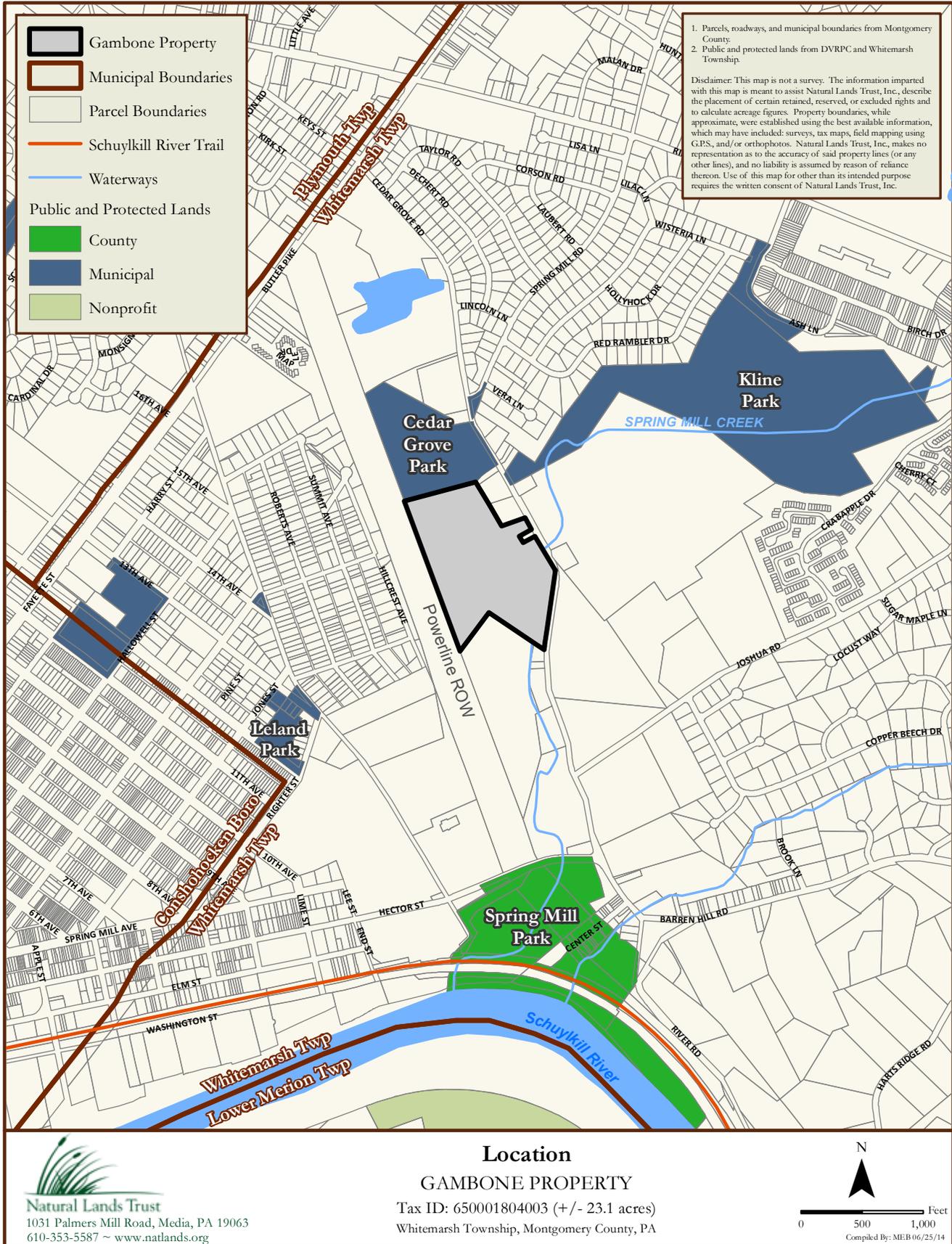
View from parking area along looking west



View from parking area into Cedar Grove Park



Parking area along Wells Street





1. Aerial photography from DVRPC.
 2. Parcel boundaries, roadways, and waterways from Montgomery County.

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

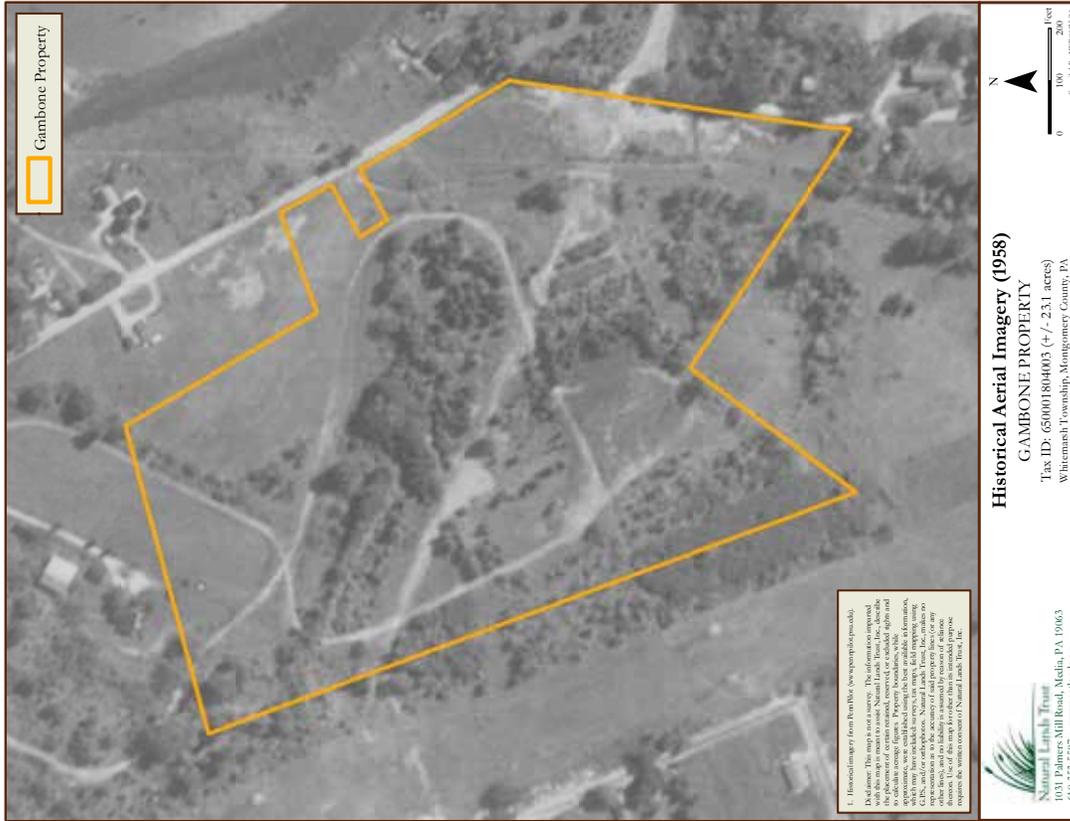
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2010 Aerial Photography
GAMBONE PROPERTY
 Tax ID: 650001804003 (+/- 23.1 acres)
 Whitmarsh Township, Montgomery County, PA

N

0 100 200 Feet

Compiled By: MEB 06/25/14





Erosion gully



Erosion gully



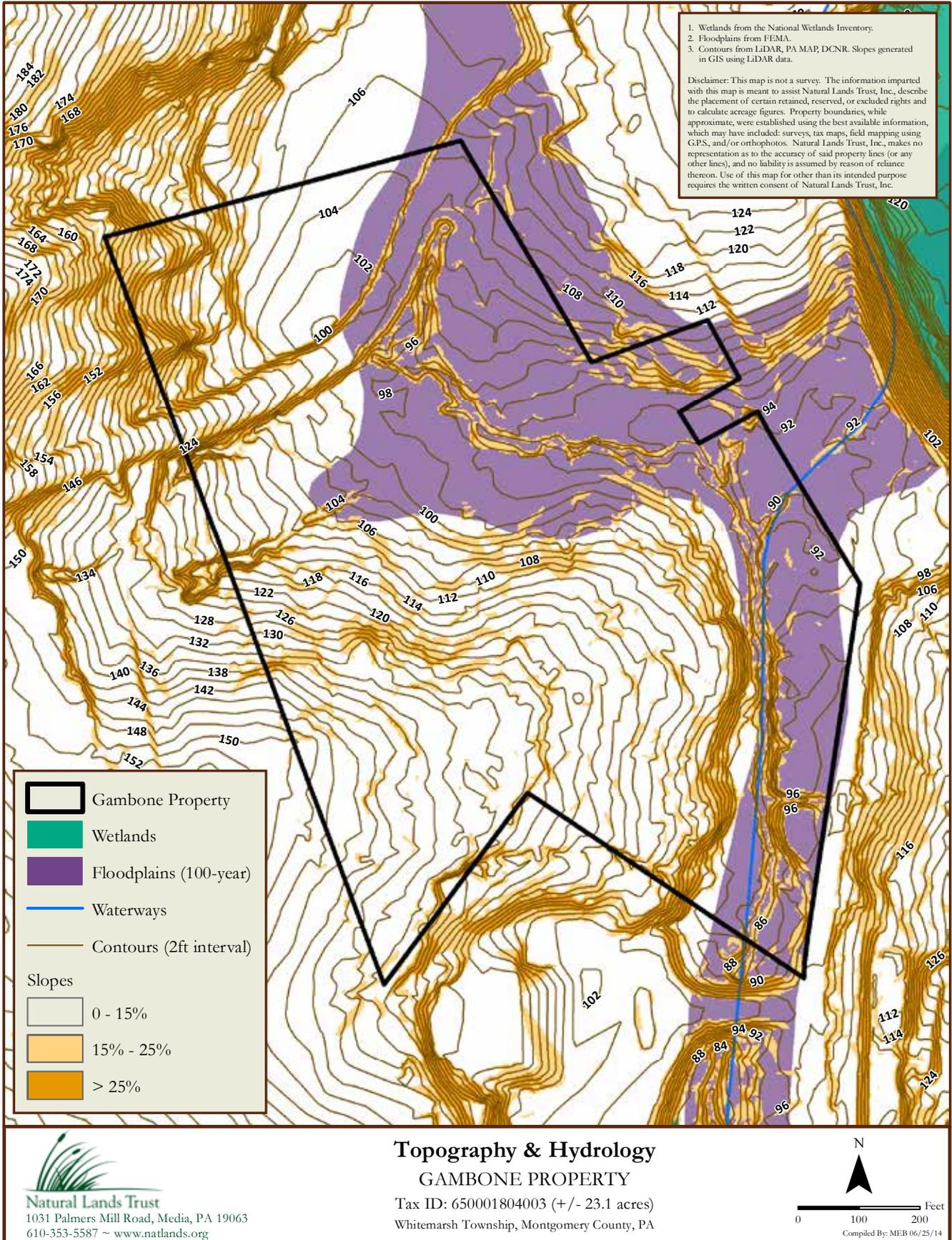
Spring Mill Creek streambed

TOPOGRAPHY

The topography of the Property ranges from about 86 feet to 152 feet above mean sea level according to LiDAR generated contours (see *Topography and Hydrology* map). The highest elevation is located in the northwestern corner of the Property where it adjoins Cedar Grove Park and the PECO powerline. The lowest elevation runs along the dry stream channel in the southeastern portion of the Property near Cedar Grove Road and PQ Chemical Company. The Property has a generally rolling topography with plateaus and steep slopes (15–25% and greater than 25%) scattered throughout. The steep slopes are primarily located along the stormwater channel banks, centrally in the Property below Wells Street, and along the western side above Wells Street. During our field inspection on July 22, 2014, we came across what appears to be an erosion gully from stormwater entering the Property along the southern boundary of the Property. The area is marked by steep slopes above and a flat area below.

WATER RESOURCES

The Property is located within the Spring Mill Creek watershed, a tributary to the Schuylkill River. The streambed of Spring Mill Creek traverses the Property for +/-795 feet parallel to the southeastern boundary along Cedar Grove Road. The streambed was dry during our field inspection on July 22, 2014. It appears that the creek flows only during and after storm events, collecting stormwater from several feeder channels within the Property that are fed by internal runoff and from adjoining lands upstream. Stormwater channels are located along both sides of Wells Street. On the southern side of Wells Street the channel flows from both the west and east and converges to flow south. Additional stormwater channels enter the Property along its western boundary. These channels originate within the Township owned land along Hillcrest Avenue and the PECO right-of-way and meander eastward through the Property. Floodplains are also located in the Property primarily along Spring Mill Creek.





Spring Mill Creek streambed



Stormwater channel along southern side of Wells Street



Stormwater erosion channel flowing south through the property

PLANT RESOURCES

The natural areas within the Gambone Property are primarily on the south side of Wells Street. A portion of the Property's natural area also lies north of Wells Street to the west of the active play area. The natural areas include three plant communities: mixed hardwood forest, terrestrial shrubland/meadow, and terrestrial meadow (see *Vegetation Communities* map). Invasive plants are listed in **bold**.

Mixed Hardwood Forest

The mixed hardwood forest is the largest vegetation community for the Property, covering +/-20.01 acres in two areas separated by Wells Street.

The canopy is composed of white ash (*Franxinus americana*), catalpa (*Catalpa bignonioides*), black walnut (*Juglans nigra*), white mulberry (*Morus alba*), tuliptree (*Liriodendron tulipifera*), Kentucky coffeetree (*Gymnocladus dioicus*), black oak (*Quercus velutina*), red maple (*Acer rubrum*), sassafras (*Sassafras albidum*), white pine (*Pinus strobes*), hemlock (*Tsuga canadensis*), **tree-of-heaven** (*Ailanthus altissima*), **Norway maple** (*A. platanoides*), and **sycamore maple** (*A. pseudoplatanus*). Understory trees include box-elder (*A. negundo*), umbrella magnolia (*Magnolia tripetala*), sweetgum (*Liquidambar styraciflua*), American elm (*Ulmus americana*), hackberry (*Celtis occidentalis*), dogwood (*Cornus florida*), and black-haw (*Viburnum prunifolium*). The shrub and vine layer has Canada moon seed (*Menispermum canadense*), poison ivy (*Toxicodendron radicans*), native grape vine (*Vitis. sp.*), bottlebrush buckeye (*Aesculus parviflora*), spicebush (*Lindera benzoin*), brambles (*Rubus spp.*), wineberry (*Rubus phoenoclasius*), Virginia creeper (*Parthenocissus quinquefolia*), **oriental bittersweet** (*Celastrus orbiculatus*), **wisteria** (*Wisteria sp.*), **porcelain-berry** (*Ampelopsis brevipedunculata*), **amur/shrub honeysuckle** (*Lonicera maackii*), **doublefile viburnum** (*Viburnum plicatum*), and **privet** (*Ligustrum sinense*). The herbaceous layer is composed of stinging nettle (*Urtica dioica*), jack-in-the-pulpit (*Arisaema triphyllum*), jewelweed (*Impatiens sp.*), spinulose wood fern (*Dryopteris carthusiana*), sensitive fern (*Onoclea sensibilis*), **mugwort** (*Artemisia vulgaris*), **Japanese stiltgrass** (*Microstegium vimineum*), and **garlic mustard** (*Alliaria petiolata*).





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Vegetation Communities
GAMBONE PROPERTY
Tax ID: 650001804003 (+/- 23.1 acres)
Whitemarsh Township, Montgomery County, PA

N



0 100 200 Feet
Compiled By: MEB 08/28/14



Porcelain-berry



Tree-of-heaven grove



Mixed hardwood forest



Large black oak



Large Kentucky coffeetree

Shrubland/Meadow

The +/- 0.96 acre shrubland/meadow is an open area within the mixed hardwood forest south of Wells Street. The area is heavily degraded by invasives.

There is no mature canopy layer, but there are saplings of box-elder, American elm, sweetgum, and **sycamore maple**. The shrub layer contains brambles, wineberry, **mile-a-minute** (*Persicaria perfoliata*), **kudzu** (*Pueraria lobata*), **multiflora rose** (*Rosa multiflora*), **oriental bittersweet**, **Japanese honeysuckle** (*Lonicera japonica*), **autumn-olive** (*Elaeagnus umbellata*), and **privet**. Herbaceous plants include goldenrods (*Solidago* spp.), dogbane (*Apocynum cannabinum*), asters (*Symphytotrichum* spp.), horse-nettle (*Solanum carolinense*), sensitive fern, Japanese stiltgrass, and **crownvetch** (*Securigera varia*).



Kudzu covering trees



Shrubland/meadow



Kudzu close-up



Shrubland/meadow



Kudzu leaf



Terrestrial meadow



Terrestrial meadow

Terrestrial Meadow

The +/- 0.31 acre terrestrial meadow lies on the north side of Wells Street and was intentionally planted using native vegetation. The field is mainly composed of herbaceous plants.

Norway maple and princess-tree (*Paulownia tomentosa*) saplings and mile-a-minute are present. The herbaceous layer contains asters, purple coneflower (*Echinacea purpurea*), common milkweed (*Asclepias syriaca*), bee balm (*Monarda* sp.), sweet coneflower (*Rubeckia subtomentosa*), mugwort, Japanese stiltgrass, and jewelweed.

CURRENT USE

The Gambone Property was purchased by Whitemarsh Township in 2011 as open space for the community. The Property is not currently being used for recreation.



Meadow interpretive sign

STEWARDSHIP ISSUES, OPPORTUNITIES AND RECOMMENDATIONS

The following stewardship issues and opportunities were observed during the field inspections of the Gambone Property on July 22, 2014 and December 4, 2014. They are described in the context of two overall stewardship goals for the natural areas on the Property: (1) to protect and enhance plant communities that support resident and migratory wildlife, and (2) to provide a safe and enjoyable environment for potential passive recreation and educational opportunities. Each stewardship issue and opportunity is followed by general recommendations to address the issue or fulfill the opportunity.

Invasive Plants

A ubiquitous problem encountered in the stewardship of natural lands in southeastern Pennsylvania—and increasingly recognized as a threat worldwide—is the presence of invasive plant species. An invasive species is one that rapidly spreads and out-competes multiple native species, chiefly because of the absence of predators, pathogens, and herbivores that keep it in check in its native range. Most invasive plants are particularly well adapted to colonize disturbed areas. In southeastern Pennsylvania, disturbance from human activities, particularly sprawl, coupled with the rich horticultural history of the southeastern counties, has afforded numerous invasive species the opportunity to become well established throughout the region. Even though the occasional immigration of new species into plant communities is a normal process, the current high rate of introduction—fueled by the planting of exotic (non-native) species for horticulture, wildlife management, and erosion control—is threatening the integrity of native plant communities and lowering native biodiversity. Not only do invasive plants alter the makeup of the plant communities on a site, but they also may affect soil chemistry and hydrology and are usually less beneficial to wildlife than the native plants they replace, contributing further to the loss of biodiversity.

Additionally, vines on trees increase the likelihood of downed trees. This is particularly important near roads,

trails, recreational facilities, and structures where damages and injuries may occur from falling trees. Some invasive species—such as poison hemlock—are highly toxic to humans and pets.

In general, the level of impact within the Gambone Property ranges from mild impact in the terrestrial meadow to heavy impact in the shrubland/meadow. Of most concern is **kudzu** which is well established in the shrubland/meadow. It is imperative to completely eliminate **kudzu** from the Property. **Kudzu** will grow over anything in its path and kill other plants it covers because it blocks out sunlight, girdles stems and tree trunks, breaks branches, and uproots trees and shrubs. Because **kudzu** has been reported to grow roughly one foot per day once established, it is the highest priority for eradication. Secondary to the **kudzu** are other vines, such as **oriental bittersweet**, **grape**, **mile-a-minute**, **Japanese honeysuckle**, **porcelain-berry**, and **wisteria** that are moderately heavy in the mixed hardwood forest and shrubland/meadow. Aggressive vines can greatly raise a tree's vulnerability to blowdown through the increased weight (that elevates the tree's center of gravity) and by the vast increase in surface area (that acts to collect wind, ice, and snow). Vines can also smother tree seedlings and prevent them from reaching the canopy to replace trees felled by old age, windthrow, or pathogens. Other invasive shrubs and trees of concern include **privet**, **amur/shrub honeysuckle**, **autumn-olive**, **tree-of-heaven**, **sycamore maple** and **Norway maple**. Invasive herbaceous plants of concern include **garlic mustard**, **mugwort**, **Japanese stiltgrass**, and **crownvetch**.

RECOMMENDATIONS

Since the diversity of native species in a system is vital to providing suitable habitat for resident and migratory wildlife, as well as providing an enjoyable environment for community residents, we suggest the following measures to control invasive plant species at the Gambone Property. In general, it is best to address invasive plant control with a *top-down* (starting in the canopy and working down through understory, shrub, and groundcover layers), *least-first strategy* (starting in the least impacted areas).

When considering invasive plant control, it is important to keep in mind that effective control of invasive plants, especially in the understory, shrub, and

groundcover layers of the forest, will only be possible if implemented in conjunction with a deer management program (see “Forest Sustainability” section below). It is also important to note that the extensive edge area and seed sources in the region and the prolific nature of these plants guarantee that even with complete eradication on the Property, invasive species can quickly reestablish themselves as a serious stewardship problem if not monitored and addressed on a regular basis.

The following invasive management recommendations for the Gambone Property are listed in general order of priority. The “Invasive Vegetation Management” section of Natural Lands Trust’s *Land for Life: A Handbook on Caring for Natural Lands* (2014) also provides guidelines for monitoring and controlling invasive plants typical of the southeastern Pennsylvania landscape.

Any volunteer or contractor used for invasive plant control should be able to distinguish native species from invasive species (e.g., **Norway maple** from native maples). In sensitive areas (wetlands, along streams and ponds), only herbicides approved for aquatic use (e.g., Rodeo) should be applied. In all cases, use of herbicides should be minimized and limited as much as possible to non-persistent and least-toxic formulations.

- Cut **kudzu** vines just above ground level during the hottest temperatures of summer and destroy all cut material. Treat the stems with a glyphosate herbicide (e.g., Rodeo) suitable for wetland habitats due to the high amount of runoff from the Property. Repeat applications will be necessary. Follow with close mowing or cutting the vines every month for two growing seasons. Total eradication of **kudzu** is necessary to prevent re-growth. The massive root system and crowns must be destroyed for long term control of **kudzu**.
- The shrubland/meadow—the area containing kudzu—should be mowed to clear the area. Mowing should occur in late fall or winter after inspecting the areas for obstacles (rock piles, old fences, stumps).
- Determine if the shrubland/meadow area should be maintained as a shrubland/meadow, converted to a meadow, or allowed to naturally succeed to become part of the mixed hardwood forest.

Shrubland:

- If the area will be allowed to succeed to a shrubland or woodland be sure to retain native tree saplings. Any seedlings should be flagged and protected from mowing. All deciduous trees (planted and volunteers) should be protected from deer browsing and rubbing with tree shelters and wraps and kept free from competition for several years through an annual mowing of the area and an herbicide application in a two-foot band around their base. Evergreens should be large enough at planting to tolerate deer browsing. They will also need to be kept free of vines and other competition through mowing and hand cutting.

Meadow:

- If the area will be converted to a meadow, the mowing should clear the area of all woody vegetation (see “Meadow Reclamation and Management” section below for more information).
- Cut vines that are climbing into canopy trees, starting in the interior, more intact, area of the forest and moving to the forest edges. All **oriental bittersweet**, **Japanese honeysuckle**, **porcelain-berry**, and **wisteria** vines should be cut and the cut stump treated with a systemic herbicide, if possible. Because the native grape vine is beneficial for native wildlife, only cut grape vines that are climbing into the canopy of the forest and compromising the structural integrity of native trees. Cut stumps of grape vines can be left to re-sprout. Care should be taken not to cut any Virginia creeper or poison ivy vines (unless the poison ivy impacts areas of high public use). These are native species that benefit wildlife and rarely become large enough to compromise canopy trees.
- Control **mile-a-minute** growing on native shrubs. Plants should be pulled (with gloves!) before they flower in the summer.
- Manage **Norway maple**, **sycamore maple**, and **tree-of-heaven** with a basal bark application of triclopyr ester (e.g., Garlon 4) herbicide and basal oil. We recommend using a 20–30% mix of triclopyr in basal oil applied in a band around the base of the trunk, avoiding runoff. Depending on the season, it may take time for this treatment to work; for example, a winter

application may result in leaf out in spring, followed by defoliation. Once the trees are dead, they can be cut down (if they create a potential hazard for visitors) without stimulating suckering or left as snags for wildlife habitat. Young **tree-of-heaven** (up to 1–2 feet) can be pulled by hand, as long as roots are not broken.

- Control **garlic mustard** in the forested areas. This is best done in early spring when the plant is in flower. Plants should be pulled, bagged and removed from the site. This is a great activity for volunteers of all ages.
- Manage **privet**, **shrub honeysuckle**, and **autumn-olive** by cutting to the stump and applying a glyphosate herbicide to the cut stump. Alternatively, after cutting, the shrub can be left to resprout and the young foliage treated with a glyphosate herbicide. In areas near water resources, a glyphosate herbicide (e.g., Rodeo) suitable for wetland habitats should be used.
- In gaps where invasive shrubs have been removed, replant with native species to improve wildlife value and protect exposed slopes from erosion. Development of a forest management strategy that identifies phases for the removal of tree and shrub invasives over several years will help to spread out costs and to maintain nesting sites for resident and migratory birds until native replacements are established. The “Native Plant Materials” section of Natural Lands Trust’s *Land for Life: A Handbook on Caring for Natural Lands* (2014) also provides a list of native species that are appropriate for the natural areas in the Property.
- New plantings should be monitored for deer browsing. If needed, protect newly planted trees from deer browse using tree shelters for plants less than 6 feet in height. For trees over 6 feet in height, tree wraps limit damage from buck rubbing. Newly planted shrubs should be protected with wire fencing.
- Mow meadows annually to prevent colonization by invasive plants and native trees and shrubs (see “Meadow Reclamation and Management” section below for more information).

Forest Sustainability

In addition to exotic invasive plants, forest sustainability is threatened by overabundant deer populations. Deer overabundance is a problem that affects most natural areas in our region. The habitat value of forests is greatest where there is an extensive unbroken canopy of mature trees with a diversity of native understory species that includes trees, shrubs, and herbaceous plants. Deer impact forest health by consuming seeds (particularly acorns) and browsing on seedlings, shrubs, and herbaceous plants. As deer population density increases, this activity can adversely affect populations of other wildlife species, especially songbirds, through a decrease in plant species and structural diversity within the forest.

Another method for determining the level of deer impact that is gaining favor with natural resource professionals (gathering accurate, useful deer density information is often complicated and expensive) is the condition of forest vegetation. A healthy mature forest has structural diversity with well developed herb, shrub, understory, and canopy layers that create a dense curtain of foliage during the growing season. There should be abundant natural regeneration (seedlings and saplings), particularly in forest gaps.

The sustainability of the mixed hardwood forest is in jeopardy from invasive plants, moderate deer overbrowsing, and active channel erosion, which acts to lower the water table, further stressing established vegetation. The forest has good structural and species diversity, with the exception of tree seedlings, which are necessary to replace canopy trees as they decline. The floodplain area has scattered patches of dense tree regeneration, but most of it is ash, a species that is likely to experience severe decline over the next decade due to the recent introduction of the emerald ash borer to southeast Pennsylvania. Adding to the diversity of the forest are remnants of the old arboretum. Although most of the species are exotic, the majority are not invasive (Norway and sycamore maple are the exceptions) and provide canopy and understory structure. These species can remain until the deer and invasives issues have been addressed. In the meantime they can also serve as interpretive elements to visitors about the history of the Property. One species that is abundant within the Property is Kentucky coffeetree, a tree native to the Midwest. It may provide a substitute for local natives (ash,



Fallen canopy tree in forest

walnut) that will likely decline due to recently introduced pathogens.

In addition to these immediate threats to forest sustainability, climate change is a long-term concern. Based on current predictions and the vegetation present, the forest will see shifts in all structural layers. Certain species, such as oaks, are predicted to be resilient to climate change in Pennsylvania, while others may not be able to adapt and will have to migrate to survive. For a vulnerability assessment of the vegetation communities present on the Gambone Property (see “Appendix A”). Vulnerability assessments analyze a population’s sensitivity to change, potential exposure, and adaptive capacity (Glick et al 2011).

RECOMMENDATIONS

The recommended deer density to allow for adequate tree regeneration is 20 deer per forested square mile (one deer per 32 acres). However, to perpetuate a healthy native forest with a diversity of native shrubs and wildflowers, the recommended deer density is 10 deer per forested square mile (one deer per 64 acres). With approximately 20 acres of forest cover, the Property can only sustainably support one deer part of the year.

Our recommendations for addressing the impact of deer overbrowsing are provided below.

- Consider implementing a deer management program. Natural Lands Trust’s program might serve as a useful model for the Property. Information about the deer management program and deer management opportunities are included in the “Deer Management Options” section of Natural Lands Trust’s *Land for Life: A Handbook on Caring for Natural Lands* (2014).
- Closely monitor the mature forest for deer browsing. Telltale evidence includes “pruned shrubs,” a shrub layer tending toward a spicebush monoculture, a more open understory, and the lack of tree seedlings in forest gaps, which should be dense patches of seedlings or young trees due to the abundance of sunlight.
- Monitoring the effects of deer browsing and educating the public about the effects of overabundant deer will be critical to the success of any future deer management program in the Township. One option

to visually demonstrate and monitor the impact of deer browsing is the installation of small (10 meters square) exclosures. The growth of vegetation within these exclosures is often dramatically different than in surrounding areas with unrestricted access by deer. Ideally, exclosures (with accompanying interpretive signage to educate the public about the importance of reducing the deer population to maintain forest health) should be erected in forested areas on relatively flat ground and near public trails. The setup and monitoring of deer exclosures is a valuable educational exercise that could be undertaken by local schools and colleges.

Meadow Reclamation and Management

Native meadows are characterized by a diverse structure and composition of short and tall grasses and native wildflowers that provide feeding and nesting habitat for declining grassland birds (e.g., Eastern Meadowlark, Bobolink) and small mammals, as well as nectar sources for numerous butterflies and other insects. Native meadow species are naturally adapted to the soils and climate of our region and can, if necessary, survive on very little rain (and no irrigation). Once established, native meadows usually require only a single mowing each year to limit encroachment by trees and shrubs. Such low maintenance requirements (one mowing, no fertilizer or irrigation) significantly reduce the costs of upkeep in comparison to the traditional suburban lawn.

Establishing and/or managing meadows at the Gambone Property would benefit the community and the native wildlife in the area, particularly small mammals, raptors, and pollinators (butterflies, moths, bees).

When planning the management of current meadows or planting of future meadows, climate change should be considered. As Pennsylvania warms and precipitation patterns change, meadows will be affected. Individual plant and animal species associated with meadows will have varying levels of adaptability, from no impact to complete elimination, resulting in shifts in species composition and abundance. Established connections between plant and animal species such as flowering times, pollination, migration, and fruit production, may be

disrupted as the rates of change vary, thereby threatening the health and sustainability of the meadow.

Monitoring of flora and fauna, as well as temperature and precipitation, could track any population changes and seasonal changes. If it becomes evident that plants are not adapting as quickly as wildlife, consider introducing non-invasive plants that would produce food and provide cover during the new/predicted migration and nesting times. Changing migration and nesting times would also impact when mowing should occur. If birds are nesting earlier, meadow mowing should be done earlier in the year to minimize impact on wildlife (see “Appendix A” for more information).

RECOMMENDATIONS

- Consider the option of converting the shrubland/ meadow to a terrestrial meadow.
- Enhance the wildlife habitat value of the terrestrial meadows by mowing on a once-yearly schedule in March. Mowing at this time of year minimizes impact on the nesting and foraging activities of native wildlife (birds, small mammals, butterflies) and often allows for easy equipment access if the ground is still frozen.
- Monitor the newly-managed meadows for several years and catalog changes in species composition. If, after that time, most of the species are native, continue to mow annually and add plugs to enhance native species composition, if desired. If most of the species are invasive or otherwise undesirable, consider eliminating the existing vegetation using herbicides and replanting with native meadow species. Under this second alternative, meadows can be seeded with desirable species using a no-till drill once the existing vegetation is eliminated. For more information about establishing native meadows, see the “Meadow Management” section of the Natural Lands Trust’s *Land for Life: A Handbook on Caring for Natural Lands* (2014).
- Monitor for invasive plants and spot treat with herbicide as necessary.
- Monitor phenological links between species to identify any disruptions that would potentially need to be addressed.



Outflow from Wells Street



Channel from Wells Street

Water Quality and Ecology

While Spring Mill Creek traverses the Property, it appears to only carry water during and directly after rain events. Within the Property, the length of the Spring Mill Creek and the stormwater channels that feed into it are within the mixed hardwood forest and have a large riparian buffer. Riparian buffers help to safeguard water quality, stabilize stream channels, and maximize infiltration and groundwater recharge that feed the stream. The riparian vegetation also benefits the aquatic ecology by shading the stream and adding organic matter (leaves, branches) that provide structure and nutrients for aquatic organisms. Preserving this cover by addressing the issues above will maintain these benefits.

Multiple areas of erosion were seen on the Gambone Property related to stormwater flowing into and across the site. Stormwater enters the Property at locations both planned and unplanned. The pipe from Wells Street conveys stormwater collected by inlets in the road surface. Other channels have formed as a consequence of inadequate stormwater management on neighboring properties. In each instance, additional study and enhanced stormwater management is needed to slow or stop the degradation being caused by stormwater runoff.

The large pipe which feeds water from Wells Street into the Property collects water from the adjacent road surface. However, it is unclear whether other inlets or additional pipes also feed the outflow pipe. It appears that the water which flows from the pipe is still determining its ultimate course through the site. The channel is greatly incised in some places, but much less defined in others. It seems that the water has been diverted into the open space, with hopes that it would all infiltrate within the woodlands. Instead, much of the water is travelling overland, eroding the site, and creating deep channels through the woodlands.

On the western side of the Property, stormwater is flowing into the site due to a lack of stormwater management on neighboring properties. At least three channels enter the site from the PECO right-of-way. It's possible that more exist, but are hidden by vegetation. Some channels originate within the PECO site, but one begins near Hillcrest Avenue. All of these channels appear to have formed by their own accord. One channel originates at the driveway into the PECO right-of-way, flowing off the stone surface. Another crosses the right-of-

way, flowing through a pipe beneath the driveway. A third enters the Property near the neighboring industrial site.

The driveway into the PECO right-of-way appears to be one source of unmanaged stormwater flowing into the site. The driveway has minimal paving, and consists of two tire width strips of crushed stone. The driveway slopes down in three directions. Water flows off the side of the driveway, through an area vegetated with meadow plants and into the woodlands, where it is eroding the soil.

A more fully developed channel crosses the width of the right-of-way. It flows from the area near Hillcrest Avenue, is piped beneath the PECO driveway and falls from the pipe. It then flows through the same vegetated area described above, before entering the woodland and joining the channel which originates at the driveway. This channel is lined with meadow vegetation along both sides for its entire length. This very small riparian buffer is likely helping to preserve the channel.



PECO pipe



Channel from PECO driveway



Combined channel

A third stormwater channel enters the Property from the PECO right-of-way in the vicinity of the neighboring industrial site. The channel may actually cross through the industrial site property. This channel appears to be the result of the confluence of many smaller stormwater rivulets collecting in a vegetated meadow area. While this channel has origins in tiny rivulets, it also appears to have the greatest negative impact on the site. Within the woodlands, the channel flows unimpeded until it hits a large geologic feature. Unable to pass through the stone, the channel has been spread, as the water seeks an alternate path. During this process, it has dug out a channel over six feet deep and, in some places, twice as wide.

The stormwater issues described above will have an impact on how the Township can use and develop the Property. If the Township develops trails, it will be important to monitor them regularly to quickly correct any erosion and prevent degradation of natural resources, particularly as stormwater may flow across the trail. When trails are constructed the natural surface drainage patterns are interrupted which can intercept more surface water, and lead to soil erosion. Not only does the trail itself endure irreversible changes, the soil transported off of the trails can cause problems elsewhere as it may smother vegetation, provide a place for invasive plants to thrive, or be washed into waterways where it can change the drainage patterns of the streams and harm aquatic organisms and vegetation.



PECO channel with buffer



Runoff from neighborhood

RECOMMENDATIONS

- The Property should be carefully managed to protect and enhance the water quality of on-site and downstream water resources associated with the Spring Mill Creek and to realize the many wildlife benefits and ecosystem services these resources provide.
- Contact the Montgomery County Conservation District and Pennsylvania Department of Environmental Protection for technical assistance and potential funding sources for stormwater management.



Bottom of large channel

- Conduct further study of stormwater management on the site. Engineering and planting projects should both be considered:
 - Some or all of the water flowing from the outlet pipe could be drained into an infiltration pit installed at the mouth of the outlet pipe.
 - Understory trees and shrubs may be planted along the edges of the channel to help reduce ongoing erosion.
 - Where and when possible, changes to the existing stormwater drainage system may be considered to reduce the amount of water flowing into this property. It will be difficult to mitigate the damage caused by water flowing from this pipe if the amount of water is not reduced.
- Work with PECO to partner on upstream stormwater management projects within their right-of-way including:
 - Establishment of additional meadow plantings between Wells Street and the existing channel.
 - Installation of stormwater BMP's such as check dams, rain gardens, and other infiltration areas adjacent to the driveway.
- Work with the neighbors on Hillcrest Avenue to install stormwater BMP's on the thin strip of land between the road and the PECO right-of-way. These



PECO channel with buffer



Grass along road



PECO turf to meadow area



Small channels in grass along road

will capture stormwater before it can make its way into the channels in the PECO right-of-way.

- Monitor any future trail system regularly to correct any erosion and natural features degradation.
- If trails are developed on the Property, install signage about the importance of picking up trash and dog waste to protect water quality.

Wildlife Enhancement

Additional opportunities for enhancing wildlife habitat on the Property are described below:

- Determine the future management of the shrubland/meadow area. Converting the area to a terrestrial meadow, scrub/shrub, or forest will provide specialized habitat for plants and animals. Habitat diversity could be enhanced under either scenario.
- Leave dead down wood within the forests as it serves as the base of the forest food web and a nutrient reservoir for living trees. Dead standing trees (snags) should also be left if they are located in areas that are not heavily used by the public. Snags benefit wildlife by providing cavities and loose bark for nesting and shelter, perching sites, and decaying wood for numerous insects that provide food for woodpeckers and nuthatches (see attached article “Critter Condos—Managing Dead Wood for Wildlife” for more information about these wildlife enhancements).
- Consider installing nesting boxes for Eastern Bluebirds along the forest/meadow edge. Bluebirds nest in tree cavities, but in the absence of these natural niches, these species readily adopt nest boxes to raise their young and reduce competition for cavities with other birds. The article “Artificial Nesting Structures” published by the Natural Resources Conservation Service Wildlife Habitat Management Institute and the Wildlife Habitat Council has been provided electronically for more information.
- Support pollinator (bees, butterflies, and other insects) habitat by mowing current and future meadows in late winter and by including a good component of forbs

(non-grass perennial herbs) in the seed mix for the meadows.

- If trails are established in the future, provide educational signage for park users related to the effects of leaving their dogs off-leash—including disturbance of wildlife and concerns of other park users.

When considering how to best manage for wildlife, climate change should be considered. Vulnerability assessments should be done for wildlife to identify which populations are most at risk and which ones have a greater chance of adapting on their own. Vulnerability assessments can help determine which populations may need additional support, such as aided migration, to survive. NatureServe has created a Climate Change Vulnerability Index to assess the potential of species to adjust to climate change. Pennsylvania Natural Heritage Program has used NatureServe’s framework to determine the vulnerability of certain rare and endangered PA species.

If species are identified as vulnerable, migration corridors can help them keep pace with climate and habitat shifts. Fragmentation of the landscape due to development has limited the movement of many species. Surrounding areas should be considered for protection to create migration corridors to another habitat area (see “Appendix A” for more information).

Hazards and Debris

A few hazards exist at the Gambone Property, including an unsecured deep well pump house, sections of old chainlink fence, above ground sewer manholes, and possible hazard trees along Wells Road. Additionally, a deer stand was seen on the Property (indicating unwarranted hunting), and various types of debris, and roadside and streamside trash are scattered in a few areas, including the remains of a bridge made of creosote telephone poles that is unsightly and a pollution source. Finally there is an area within the forest with a clear understory that appears to be an old party site.

There is a potential for hazard trees along roadways, future trails, and other locations where the public might pause for any extended time in the future—such as a sign, bench, or picnic table. As a landowner, Whitemarsh Township is responsible for preventing trees and branches



Deep well pump house



Remnant bridge with creosote poles



Deep well pump house with open doors



Chainlink fence



Deep well pump



Sewer manhole



Hazard tree



Deer stand



Scattered trash



Clearing from possible previous inhabitant

from falling into the adjacent right-of-way on the bordering roads through the monitoring and removal of hazard trees (trees that due to structural defects could fall in part or whole on a “target” such as a road, residence, or person). At the field inspection on July 22, 2014, potential hazard trees were noted within the Property and along Wells Street.

RECOMMENDATIONS

- Remove the deep well pump and its building and close the well properly.
- Remove old bridge and chainlink fence.
- The above-ground sewer manholes should be well-marked to prevent tripping and made sure that they are not able to be open by users of the Property.
- Monitor potential hazard tree areas along public roads, trails, lawn areas, and places where people may linger in the future—such as benches, picnic tables, or interpretive signs—by foot once each year and following severe storms, and address potential hazard trees (pruned or removed) as needed. Ideally, a certified arborist should be hired to complete this task and address any identified hazards through pruning or removal (see the “Hazard Tree Monitoring Program” section of the Natural Lands Trust’s *Land for Life: A Handbook on Caring for Natural Lands* (2014) for information about procedures for hazard tree monitoring. In addition, Morris Arboretum in Philadelphia offers courses on identifying hazard trees.
- Remove scattered debris and trash.
- Remove the deer stand(s).

Boundary Encroachment

Proper maintenance of Property boundaries is an important stewardship priority on open space parcels. These undeveloped properties are often subject to unwarranted (and frequently unintentional) use by neighbors (e.g., dumping of yard waste) due to poorly marked boundaries.

RECOMMENDATION

- Where needed, survey and post the boundaries of the Gambone Property to assist in preventing encroachment issues and to inform passing motorists about the location of the public open space. Signs could be small (3 ¾" x 3 ¾"), 0.12 gauge aluminum diamond shape signs and should indicate Whitemarsh Township ownership. Posting every 50–100 feet is adequate and particularly important where the Property abuts private land.

Trails, Environmental Education, and Volunteers

The natural communities, water resources, and scenic landscape within the Gambone Property provide good opportunities to connect the community to their natural surroundings and provide meaningful volunteer and educational experiences. The following suggestions could further enhance community educational opportunities on the Property.

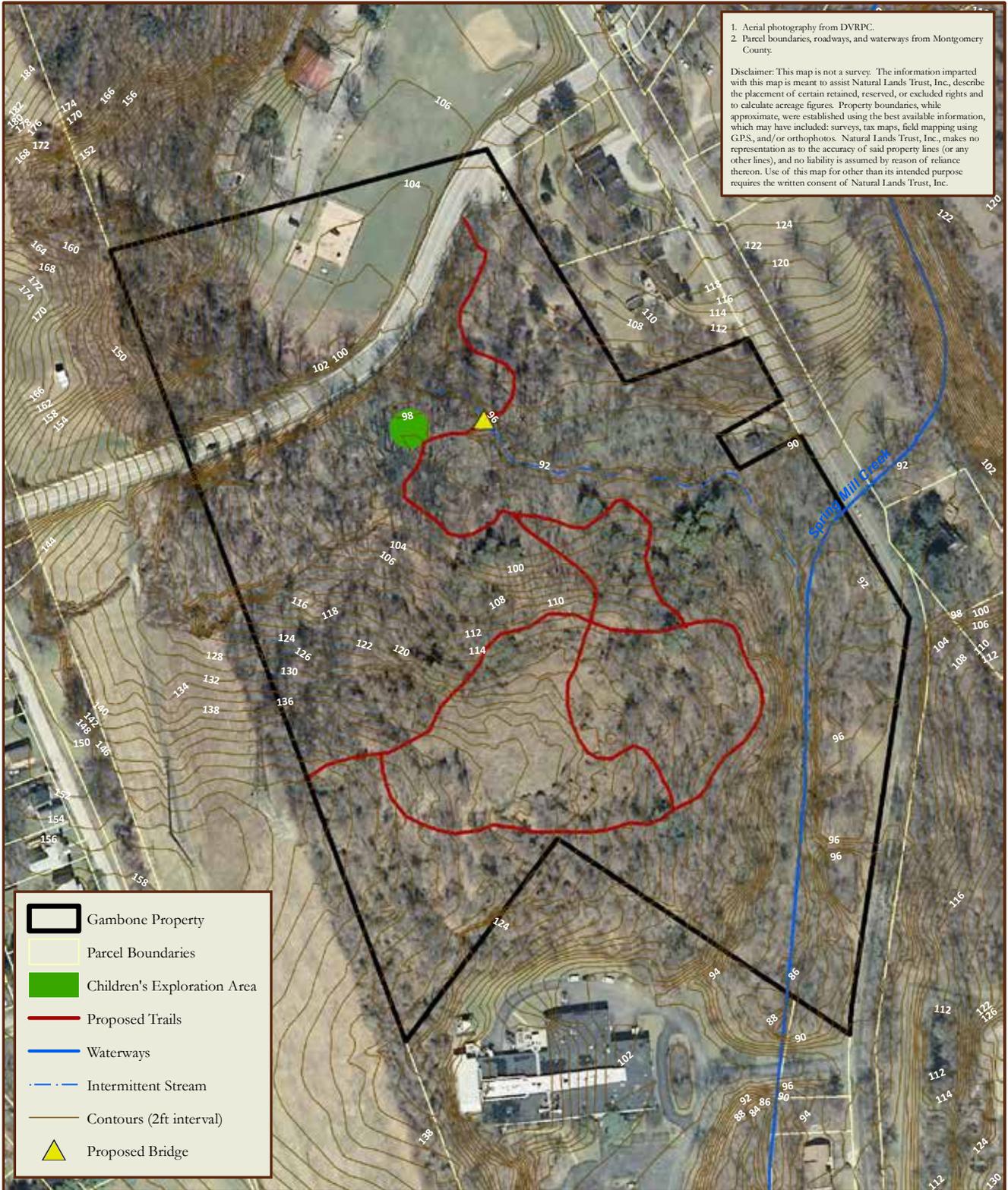
RECOMMENDATIONS

- Consider developing a trail system on the Property (see *Conceptual Trail System* maps). Building a trail system for passive recreation could offer opportunities for an educational trail and exploration area for residents and summer camp programs to use the Property as an environmental education component. As part of the trail system, establishing a children’s exploration area for outdoor play has been included on the maps. The trail system could also connect to Cedar Grove Park and to the PECO powerline property as a regional trail and through to connect to other Township and County parks.
- Install interpretive signs in key areas along the future trail that describe the importance of open space preservation, natural resources (e.g., vegetation communities, wildlife habitat, floodplains, water quality), stormwater issues, stewardship initiatives (e.g., deer management, invasive plant management), or history of the Property (arboretum vegetation).



PECO adjoining property

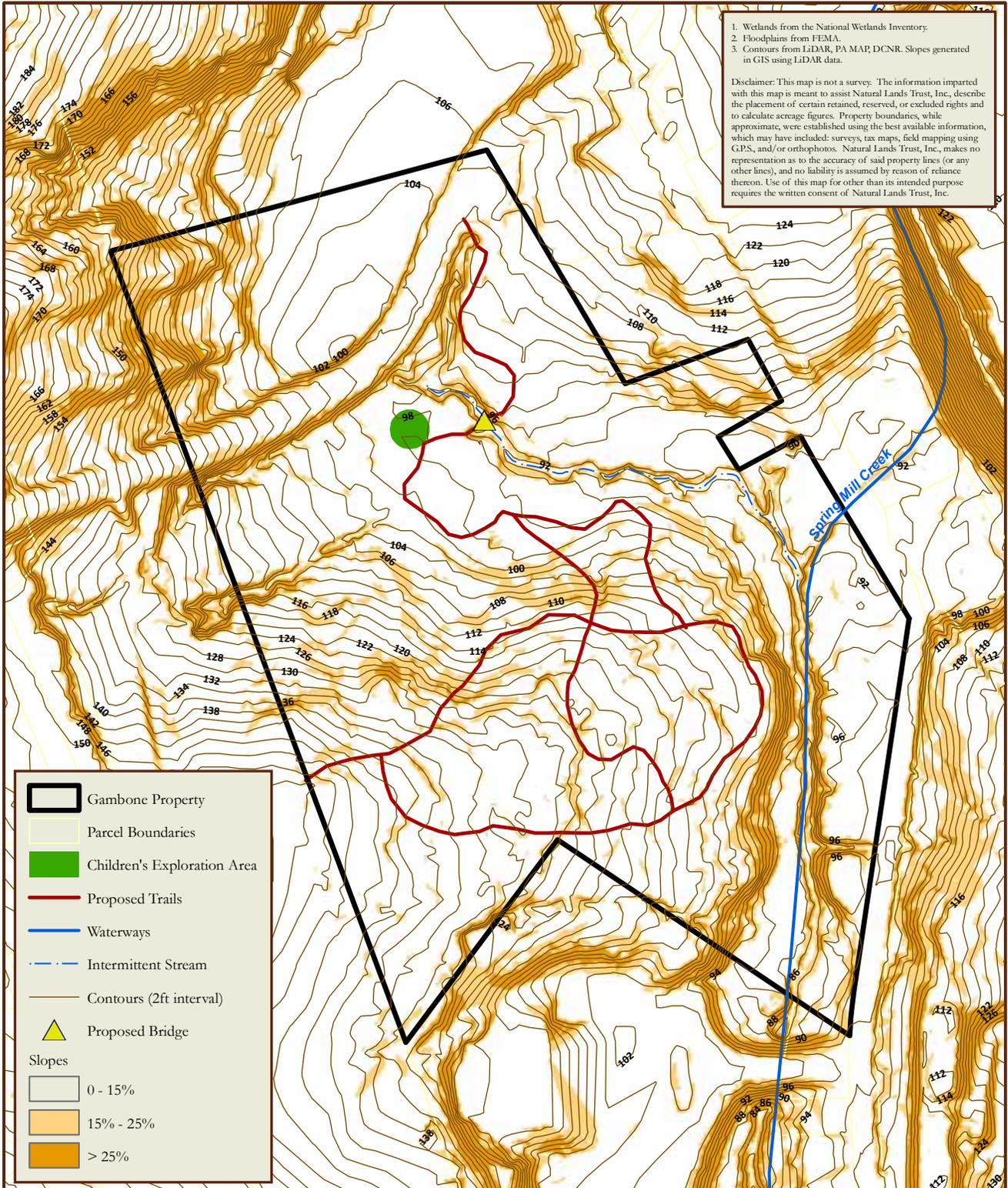
- Label healthy examples of native trees along the future trail with scientific and common names in a manner that will not harm the trees.
- Invite Township residents to participate in natural areas stewardship projects. Schedule “workdays” on environmentally friendly days such as Earth Day or Arbor Day. Volunteers, including the current volunteer corps, local scout troops, hiking clubs, birding groups, schools, and businesses could be recruited to assist with projects recommended in this report, including:
 - Cutting vines from trees
 - Pulling **garlic mustard**
 - Planting the forest with native tree, shrub, and herbaceous plant species
 - Building, installing, and maintaining a kiosk
 - Building and installing nest boxes
 - Maintaining trails
 - Removing debris and trash
 - Providing a presence at the Property
 - Encourage local schools, environmental groups, and birding groups to schedule educational walks on the Property such as native plant and tree identification and bird identification



Conceptual Trail System - Aerial Photography
GAMBONE PROPERTY
 Tax ID: 650001804003 (+/- 23.1 acres)
 Whitemarsh Township, Montgomery County, PA

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

0 100 200 Feet
 Compiled By: MEB 12/16/14



1. Wetlands from the National Wetlands Inventory.
 2. Floodplains from FEMA.
 3. Contours from LiDAR, PA MAP, DCNR. Slopes generated in GIS using LiDAR data.

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

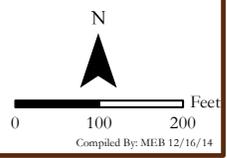
- Gambone Property
 - Parcel Boundaries
 - Children's Exploration Area
 - Proposed Trails
 - Waterways
 - Intermittent Stream
 - Contours (2ft interval)
 - Proposed Bridge
- Slopes
- 0 - 15%
 - 15% - 25%
 - > 25%

Conceptual Trail System - Topography

GAMBONE PROPERTY

Tax ID: 650001804003 (+/- 23.1 acres)
 Whitmarsh Township, Montgomery County, PA

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



STEWARDSHIP PRIORITIES AND IMPLEMENTATION SCHEDULE

PRIORITY ¹	STEWARDSHIP RECOMMENDATIONS	SEASON	WHO COULD IMPLEMENT? ²
FIRST YEAR			
<i>Invasive Plants</i>			
1	Control kudzu	Summer—cut (destroy all cuttings) and herbicide (repeat applications will be necessary) Summer and Fall—mow closely or cut vines every month	Contracted for mowing and herbicide use
1	Control oriental bittersweet, Japanese honeysuckle, porcelain-berry, and wisteria vines on canopy trees	Anytime—cut Fall—cut & herbicide stump	Contracted for herbicide use
2	Control mile-a-minute	Spring—pull with gloves	Contracted
2	Control garlic mustard	Early Spring—pull, bag, and remove from site	Contracted
<i>Shrubland/Meadow</i>			
1	Area will be maintained as a shrubland (in the future it is possible to convert it to a terrestrial meadow if desired)	Anytime	Contracted
1	Mow shrubland/meadow	Late Fall/Early Winter—mow if maintaining as shrubland, flag native tree and shrub seedlings/saplings to protect from mowing, install tree shelters	
<i>Wildlife Enhancement</i>			
2	Leave dead wood and snags for wildlife habitat	Anytime	Volunteers
<i>Hazards</i>			
1	Secure pump house to prevent access	Anytime	Municipal staff— Public Works

1	Monitor roadside boundaries and high use areas for hazard trees	Late Winter/Early Spring	Municipal staff— Public Works— Grounds Crew
2	Remove scattered debris	Anytime	Volunteers
2	Remove deer stand(s)	Anytime	Municipal staff— Public Works
Public Access and Environmental Education			
2	Begin installing the trail system as laid out in the <i>Conceptual Trail System</i> map	Anytime	Municipal staff with volunteers
2	Invite town residents to participate in stewardship projects	Anytime—November 2015	Municipal staff—Parks and Recreation and volunteers

SECOND YEAR			
Invasive Plants			
1	Control kudzu	Spring/Summer/Fall—mow closely or cut vines every month If additional kudzu is located, begin treating the new area as noted under “first year” above.	Contracted
2	Control tree-of-heaven, Norway maple, and sycamore maple	Anytime—pull seedlings and saplings Fall—basal herbicide	Contracted
2	Manage privet, shrub honeysuckle, and autumn-olive	Fall—cut to stump and herbicide	Contracted
Forest Sustainability			
1	Replant with native species	Spring or Fall—in forest gaps, particularly where invasive plants have been removed; clear area of competition and protect with tree shelters	Volunteers

1	Implement a Deer Management Program	Anytime	Municipal staff— Policy
2	Monitor for deer impacts	Anytime	Municipal staff
3	Public education about the effects of overabundant deer (deer exclosures with interpretive signage, articles about impacts from overabundant deer in Township newsletters)	Anytime	Municipal staff and volunteers
Shrubland Management			
1	Monitor for invasive vegetation and spot treat, as needed	Anytime	Contracted
3	Monitor and track plant composition in shrubland for native plants and diversity	Late Spring to Early Fall	Contracted and volunteers
Meadow Reclamation and Management (reference as possible future conversion)			
1	Mow to enhance habitat value and control invasive woody vegetation	Early Spring (March)—once annually	Municipal staff or contracted
1	Monitor for invasive vegetation and spot treat, as needed	Anytime	Municipal staff, contracted or volunteers
3	Monitor and track plant composition in meadow for native plants and diversity	Late Spring to Early Fall	Municipal staff or contracted
Water Quality and Ecology			
1	Conduct further study of stormwater management on the site with consideration of engineering and planting projects	Anytime	Municipal staff, Montgomery County Conservation District, State Agencies, Engineer, PECO
1	Monitor trails for erosion issues and maintain	Anytime	Municipal staff, contracted, and volunteers
3	If trails are created, install signage about picking up trash and dog waste using “Leave No Trace” messaging	Anytime	Municipal staff—Parks and Recreation

Wildlife Enhancement			
2	Install, maintain, and monitor nesting boxes for Eastern Bluebirds and Kestrels along powerline right-of-way	Late Winter—install and maintain Spring to Fall—monitor	Volunteers
3	Install signage about the effects of having dogs off-leash using “Leave No Trace” messaging	Anytime	Municipal staff—Parks and Recreation
Hazards			
1	Remove old well pump and pump house; close well properly	Anytime	Municipal staff—Public Works
Boundaries			
2	Post boundaries to assist in preventing encroachment	Anytime	Municipal staff—Parks and Recreation, and volunteers
Public Access and Environmental Education			
2	Continue installing the trail system as laid out in the <i>Conceptual Trail System</i> map	Anytime	Municipal staff, contracted, and volunteers
3	Install interpretive signs about land conservation, natural resources, and property history in key areas	Spring to Fall	Municipal staff and contracted

THIRD YEAR			
Invasive Plants			
1	Control tree-of-heaven, Norway maple, and sycamore maple	Anytime—cut down dead trees that have been treated if they create potential hazards	Municipal staff or contracted
Forest Sustainability			
1	Maintain native species plantings	Spring—mow annually between planted trees/shrubs and herbicide a two foot band around their base—careful not to get on the plantings	Contracted

Shrubland Management			
1	Determine shrubland composition and improve shrubland plant diversity	Spring or Fall—Plant native shrubs to increase diversity and provide wildlife habitat and food	Contracted
Meadow Reclamation and Management (reference as possible future conversion)			
1	Determine meadow composition and improve meadow plant diversity	Spring— a) if mostly native plants, continue to mow annually and add plugs of grasses and forbs to increase diversity and provide pollinator habitat b) if most species are invasive or non-native, consider eliminating the existing vegetation using herbicides and seeding with native grass and forb species using a no-till drill	Municipal staff or contracted
Water Quality and Ecology			
1	Continue study of stormwater management on the site with consideration of engineering and planting projects	Anytime	Municipal staff, Montgomery County Conservation District, State Agencies, Engineer, PECO
1	Work with PECO to partner on upstream stormwater management projects within their right-of-way	Anytime	Municipal staff
1	Work with the neighbors on Hillcrest Avenue to install stormwater BMPs on the thin strip of land between the road and the PECO right-of-way	Anytime	Municipal staff
Public Access and Environmental Education			
2	Encourage local schools and groups to utilize property for educational walks	Anytime	Municipal staff— Parks and Recreation
3	Label examples of healthy trees	Anytime	Volunteers and contracted

ON-GOING			
<i>Invasive Plants</i>			
1	Control kudzu	If additional kudzu is located, treat the new area as noted under “First Year” and “Second Year” above	Contracted
1	Control oriental bittersweet, Japanese honeysuckle, porcelain-berry, and wisteria vines on canopy trees	Anytime—cut Fall—cut and herbicide stump	Contracted
2	Control mile-a minute	Spring—pull with gloves	Contracted
2	Control garlic mustard	Spring—pull, bag, and remove from site	Contracted
2	Control tree-of-heaven, Norway maple, and sycamore maple	Anytime—pull seedlings/saplings and cut down dead trees that have been treated if they create potential hazards Fall—basal herbicide	Contracted
2	Manage privet, shrub honeysuckle, and autumn-olive	Fall—cut to stump and herbicide	Contracted
<i>Forest Sustainability</i>			
1	Replant with native species and maintain plantings	Spring or Fall—in forest gaps, particularly where invasive plants have been removed; clear area of competition and protect with tree shelters Spring—mow annually between planted trees/shrubs and herbicide a two foot band around their base—careful not to get on the plantings	Volunteers and contracted
2	Monitor for deer impacts	Anytime	Municipal staff
2	Public education about the effects of overabundant deer	Anytime	Municipal staff, contracted, and volunteers
<i>Shrubland Management</i>			
1	Monitor for invasive vegetation and spot treat, as needed	Anytime	Contracted
2	Monitor and track plant composition in shrubland for native plants and diversity	Late Spring to Early Fall	Contracted and volunteers

Meadow Reclamation and Management (reference as possible future conversion)			
1	Mow to enhance habitat value and control invasive woody vegetation	Early Spring (March)—once annually	Contracted
1	Monitor for invasive vegetation and spot treat, as needed	Anytime	Contracted
2	Monitor and track plant composition in meadow for native plants and diversity	Late Spring to Early Fall	Contracted and volunteers
Water Quality and Ecology			
1	Work with PECO and neighbors to monitor and maintain upstream stormwater management projects within the PECO right-of-way and from neighbors on Hillcrest Avenue	Anytime	Municipal staff
1	Monitor trails for erosion issues	Anytime	Municipal staff and volunteers
2	If trails are created, install signage about picking up trash and dog waste using “Leave No Trace” messaging	Anytime	Municipal staff
Wildlife Enhancement			
2	Leave dead wood and snags for wildlife habitat	Anytime	Volunteers
2	Install, maintain, replace when necessary, and monitor nesting boxes for Eastern Bluebirds and Kestrels along powerline right-of-way	Late Winter—install, maintain, and replace Spring to Fall—monitor	Volunteers
2	Monitor and maintain signage about the effects of having dogs off-leash using “Leave No Trace” messaging	Anytime	Municipal staff
Hazards			
1	Monitor roadside boundaries and high use areas for hazard trees	Late Winter to Early Spring	Municipal staff— Public Works Grounds Crew
2	Remove scattered debris	Anytime	Volunteers
2	Remove deer stand(s)	Anytime	Municipal staff— Public Works

Boundaries			
1	Maintain boundary signs to assist in preventing encroachment	Anytime	Municipal staff and volunteers
Public Access and Environmental Education			
1	Monitor and maintain the trail system	Anytime	Municipal staff, contracted, and volunteers
2	Invite town residents to participate in stewardship projects	Anytime	Municipal staff—Parks and Recreation and volunteers
2	Monitor and maintain interpretive signs in key areas	Spring to Fall	Municipal staff
2	Monitor and maintain signage labels on healthy tree examples	Anytime	Volunteers
2	Encourage local schools and groups to utilize property for educational walks	Anytime	Municipal staff—Parks and Recreation

¹ 1 = high priority; 2 = mid-priority; 3 = low priority

² Must have PA Pesticide Applicator Certification to apply herbicides on public property

APPENDICES

CLIMATE CHANGE

Potential Effects of Climate Change

Climate change is a large uncertainty facing the environment. As such, it should be carefully considered when creating stewardship priorities, goals, and strategies. Numerous climate models analyzing varying emissions rates predict that Pennsylvania will get warmer and wetter. Based on high and low emission scenarios modeled by the International Panel on Climate Change, temperature could increase by approximately 2.5°F in the next decades and between 2–5.5°F by mid century. By the end of the century, average temperature during winter months is predicted to increase between 4–8°F and 5.5–11°F during the summer. Precipitation could increase 5% by mid century and by the end of the century increase 12%. Most of this increased precipitation would occur in the spring and fall, potentially causing more short term droughts during the summer. Days above 90°F per year are expected to increase, which will further increase the risk of droughts.

As the climate changes, habitat regions will shift north, possibly as much as 350–500 miles. The rate of change and distance will affect species' ability to migrate with or adapt to any changes. Some species, such as oaks may experience an increase in suitable habitat in PA, while many others, such as black cherry trees and numerous birds will face a shifting and decreasing habitat availability. Aquatic species could also be at risk due to increasing water temperatures (Union of Concerned Scientists, 2008).

Species may also shift in elevation and based on soil conditions. To reach colder microclimates, species may migrate higher topographically, putting species already near the topographic apex of their region at risk of habitat loss. Species that colonize dry or variable soils may expand their range as species that require hydric soils or high water tables may face a contracting range.

Managing for Climate Change

The combined uncertainty of when and by how much greenhouse gas emissions will be reduced, the level of climactic response, and potential for feedback systems make it difficult to predict the exact impacts of climate change. However, that should not lead to the decision to wait and see what will happen. Proactive management, as long as it is not maladaptive, could help mitigate potential effects or speed the process and likelihood of adaptation.

One of the first steps is to do a vulnerability assessment of the vegetation communities to assess the potential impacts of climate change and pests moving into the region, and how the composition of the vegetation communities may change over time as a result. The following assessment is based on the U.S. Forest Service Tree Atlas and NatureServe's Climate Change Vulnerability Index (CCVI) framework¹. Species information for the CCVI framework was gathered mainly from the US Forest Service Silvics Manual, Lady Bird Johnson Wildflower Center, and USDA Plants Database. A range of factors were considered for the vulnerability assessment. These included natural and anthropogenic barriers, preferred hydrologic and physiologic regimes, interdependence on other species, and past response to climate change. For a complete list of risk factors, see NatureServe's CCVI and the US Tree Atlas.

These results are a prediction of what may happen based on current information, but comprehensive, relevant information was not available for all species. The canopy and understory species have more in depth information available, while the shrub and vine layer has very little information; relevant information for the herbaceous layer was

¹ One adjustment was made to the framework: susceptibility to pests moving into the area was incorporated as a factor increasing vulnerability into the category "Forms part of an interspecific interaction not covered by C4a-d." This was done to account for the effects of insects such as the emerald ash borer and hemlock woolly adelgid that are currently impacting vegetation and are likely to experience less winter die off and expand their range as the climate warms.

dependent on the species. Another important caveat is that these assessments do not account for all possible impacts and scenarios. Actual future emissions, feedback systems, and interactions of biogeochemical processes will impact the species composition, as will migration of species into the area. While these results are uncertain, it is still important to attempt to build resiliency or adaptive capacity in natural systems to mitigate possible harmful future effects. When utilizing vulnerability assessments in management planning, vulnerability should not be the main factor in setting priorities. Importance of a species to the ecosystem, resource demand, and probability of success should be considered as well.

The following assessments outline the possible effects of climate change as related to the vegetation communities identified at the Gambone Property.

Mixed Hardwood Forest

The canopy trees in the mixed hardwood forest will likely experience a range of reactions to future changes and pressures. Black oak will likely increase, and white mulberry, tuliptree, Kentucky coffeetree, and sassafras are predicted to remain stable. Catalpa, red maple, white pine, and hemlock are “moderately vulnerable,” and could experience a decline in population numbers. White ash and black walnut are extremely vulnerable to insects moving into the area and will likely die out in this area in the near future.

Black oak is considered a “keystone” species in forest communities as it provides food and shelter for a range of species². Of the other stable species, white mulberry is also an important food source. Although it is invasive, it may occupy an important niche providing food, especially during the winter, and shelter as other species decline. Loss of trees such as hemlock which function as a “foundation” species by retaining moisture and cooler temperatures may change the microclimate and affect other species. The allelopathic effects of black walnut will decrease as the species dies out, possibly allowing other species to be more competitive.

Overall, the understory species are predicted to remain stable or increase in range. American elm is likely to remain an understory tree as the Dutch elm disease kills off larger specimens. Dogwood is predicted to remain in the area, but depending on the amount of warming may decrease in prevalence due to its drought intolerance. These species will continue to provide critical understory functions such as providing food and shelter for wildlife and improving soil quality through rapid leaf decay, especially noted for the American elm and dogwood.

Plants in the shrub and vine layer are all predicted to increase with a warming climate, making survival a matter of successfully competing with the other plants in the layer. One exception to this is Canada moonseed, which is predicted to increase at first but then decline as effects heighten³. Vines and invasives are both likely to benefit greatly from climate change and could alter the composition of the layer if they edge out other native species. Vines could also alter other layers by choking the stems or trunks and shading out the canopy layer.

The herbaceous layer for this area is likely to be the most vulnerable. The herbaceous plants present are mainly facultative wetland plants, making them vulnerable to climate change, specifically possible extended summer droughts.

Invasive plants and pests are likely to have an even greater impact on the plant community as a result of climate change. The factors that allow them to successfully compete with native plants will also help them adapt to climate change: prolific seeding and wide ranging dispersal, able to colonize disturbed and marginal areas, and few predators or diseases. Without long cold spells, these species will be less restricted in their range and be able to outcompete natives in more areas. Gaps produced by plant die offs, especially in the canopy, will open more ground for fast growing invasives and provide more sunlight⁴.

While there are likely to be changes to the plant community, many ecological functions will be preserved. Nesting

2 Fralish, James S. 2004. “The Keystone Role of Oak and Hickory in the Central Hardwood Forest” Gen. Tech. Rep. SRS-73. Asheville, NC: U.S. Department of Agriculture

3 planthardiness.gc.ca

4 USDA Climate Change Resource Center

and food sources can still be maintained by numerous species including white mulberry, black oak, sassafras, box-elder, umbrella magnolia, spicebush, grape vine, and Virginia creeper.

Shrubland/Meadow

Again for this plant community the understory species are presumed resilient to climate change and will continue to serve their ecological functions, until they are overwhelmed by invasives. The shrub and vine layer is mainly invasives, which are likely to increase. Though brambles are not highly sensitive to climate change, they will face even stronger competition from invasives and may not be able to compete in such a heavily invaded area. The herbaceous layer will likely see a range of responses to climate change. Species that prefer wet soils, including horse-nettle and sensitive fern, are likely to be stressed by summer droughts. Goldenrods are expected to have a higher inherent resilience. Dogbane may be stable, however, high levels of ozone would have a negative impact.

While all invasives pose a risk to this area, kudzu is of highest concern. Currently, this patch of kudzu is at the far northern end of its range. As climate change warms the region, this area will be even more favorable to kudzu, allowing it to thrive and worsening its effect on the area. Due to its rapid growth, it is likely to fully overwhelm the shrubland/meadow and extend into the mixed hardwood forest unless managed.

Terrestrial Meadow

The plants in the terrestrial meadow are likely to exhibit a range of vulnerability to climate change. Jewelweed, a species that favors wet soils, is at risk due to prolonged summer drought. Both coneflowers and common milkweed are expected to remain stable or increase in prevalence. While this area is currently well maintained and has only limited impact by invasives, climate change will likely increase pressure from invasives.

Vulnerability Assessment by Plant Species	
INCREASE LIKELY/NOT VULNERABLE	
Black Oak <i>Quercus velutina</i>	General Information
	Flower: June
	Fruit: Sept/Oct
	Food and shelter source
	Resiliency Factors
	Far seed dispersal by range of wildlife
	Historic precipitation range: 200mm–500mm
	Fire causes regeneration
	High genetic variation
	Risk Factors
	Snow cover improves seed germination
White Mulberry <i>Morus alba</i> *invasive	General Information
	Food source for wildlife
	Common to floodplains and riparian environments, also found in uplands
	Flower: April/May
	Fruit: May/July
	Alleopathic
	Resiliency Factors
	Current distribution includes all US
	Able to hybridize with red mulberry
	Seed dispersal by wildlife, including birds
	Prefers hot summers and mild winters
	Tolerant to a range of temperatures, precipitation, and soil pH
	Historic precipitation range: 11–60 inches
	Risk Factors
Seed reproduction only	
American Elm <i>Ulmus americana</i>	General Information
	Soil improving—fast leaf decay
	Food source
	Resiliency Factors
	Historic precipitation range: 1140mm
	Moderately shade tolerant
	Drought resistant
	Risk Factors
	Dutch elm disease—will remain understory tree
	Seeds susceptible to spring frost
Some genetic diversity, but minimal disease resistance	

Box-elder <i>Acer negundo</i>	General Information
	Important winter food source for birds, small mammals, and deer
	Flower: March/May
	Fruit: Aug/Oct
	Resiliency Factors
	Range all of US
	Flood tolerant
	Able to grow on disturbed, developed areas
	Prolific seeds with wide dispersal, easily germinated, low oxygen demand, and fast growth
	Risk Factors
Prefers wet soils	
Hackberry <i>Celtis occidentalis</i>	General Information
	Elm family
	Winter food source
	Bottomland tree
	Indicator of high pH
	Flower: May
	Fruit: Sept/Oct
	Resiliency Factors
	Center of distribution
	Historic precipitation range: 1260mm
	Historic great temperature ranges
	Drought resistant
	Dispersed by birds and small mammals, water
Likely high genetic variation	
Sweetgum <i>Liquidambar styraciflua</i>	General Information
	Associated with pine forests
	Fruit: early spring
	Seedfall early fall
	1 yr seed banking
	Resiliency Factors
	Can tolerate wide range of sites
	Pollinated by wind
	Wind seed dispersal up to 100m
	Moderately fire tolerant
	Risk Factors
Sensitive to repeated fires and subsequent diseases and pests	
Moderately sensitive to ozone	

Native Grape Vine <i>Vitis</i> spp.	General Information
	Food for birds and small mammals
	Flower: May–July
	Fruit: July–Oct and can remain throughout the winter
	Resiliency Factors
	Benefits from canopy die off—more light
	Vines likely to increase quickly with CO ₂ increase
Poison Ivy <i>Toxicodendron radicans</i>	General Information
	Food source for wildlife
	Resiliency Factors Increase in CO ₂ likely to increase vine growth and higher toxicity levels; could lead to an increase in tree mortality and limited regeneration (“Biomass and Toxicity Responses of Poison Ivy (<i>Toxicodendron radicans</i>) to Elevated Atmospheric CO ₂ ,” pnas.org)
Spicebush <i>Lindera benzoin</i>	General Information
	Food for wide range of animals
	Flower: March/April
	Fruit: Aug–Oct
	One of the first plants to flower in the spring
	Resiliency Factors
	Center of range
	Range of pollinators
	Drought tolerant
	Tolerant of dry to wet soil conditions
	Risk Factors
	Low levels of genetic diversity
	Prefers moist habitats (streambanks, swamps)
Virginia Creeper <i>Parthenocissus quinquefolia</i>	General Information
	Food and nesting source
	Flower: June–Aug
	Fruit: Aug–Oct
	Resiliency Factors
	Fast growth
	Center of range
	Wide range of soil moisture
Moderately drought tolerant	

Common Milkweed <i>Asclepias syriaca</i>	General Information
	Flower: May–Aug
	Fruit: late summer–fall
	Resiliency Factors
	Center of range
	Wide habitat range
	Seed and rhizome regeneration
	Low to medium water use
	Drought tolerant
	Wide seed dispersal
	Rapidly colonizes disturbed areas
PRESUMED STABLE/NOT VULNERABLE	
Kentucky Coffeetree <i>Gymnocladus dioica</i>	General Information
	Toxic leaves and seeds—not a good food source
	Flowers: May/June
	Fruit: Sept/Oct
	Associated with limestone bluffs
	Resiliency Factors
	Full sun, moist soils
	Drought and flooding tolerant
	Seed and vegetative reproduction
	Northern edge of range
	Traditionally in warmer climates
	Wide range of precipitation in current distribution
	Risk Factors
	Seeds not readily dispersed except by streams
	Long possible germination period
Sparse population in region, heavily dependent on pollinators for germination	

Sassafras <i>Sassafras albidum</i>	General Information
	Flower: March/April
	Shade intolerant
	Alleopathic
	Food source and deer browse
	Resiliency Factors
	Northern edge of range
	Historic precipitation 760–1400mm
	Pioneer species
	Dispersed by birds, water, small mammals
	Vegetative and seed regeneration
	Risk Factors
	Needs moisture to germinate
	Shallow roots
Highly susceptible to fire, storm damage, and weather extremes	
Minimal genetic variation	
Tuliptree <i>Liriodendron tulipifera</i>	General Information
	Flower: age 15–20 yrs, April/June
	Fruit: Aug/Oct
	Resiliency Factors
	Range from FL to PA/NJ/NY
	Dry, high temperatures aid seed dispersal—mid Oct/mid March
	Carried by wind ~600 feet
	Vegetative and seed regeneration
	Rapid growth
	Rainfall range: 760mm–2030mm
	High genetic variation
	Risk Factors
	Not tolerant of very wet or dry conditions
	Saplings intolerant of flooding, frost heaving, fire
Cannot grow on floodplains	
Low germination rate	

Flowering Dogwood <i>Cornus florida</i>	General Information
	Wildlife food source
	Improves soils through rapid leaf decay
	Flower: May (March in southern extent)
	Fruit: Sept/Oct
	Good seed crop every other year
	Resiliency Factors
	Northern portion of range
	Precipitation range of 1270mm
	Wide temperature range
	Birds and other wildlife primary seed disperses
	Risk Factors
	Susceptible to drought—requires moderate levels of soil moisture
	Umbrella Magnolia <i>Magnolia tripetala</i>
Food and shelter source	
Resiliency Factors	
Northern edge of range (outside of range—ornamental)	
Cold hardy	
Seeds dispersed by birds	
No serious threat from disease or insects	
Risk Factors	
Prefers moist soils	
Sensitive to drought and fire	

Brambles <i>Rubus</i> spp.	General Information
	Food and cover source for birds, mammals, and pollinators
	Resiliency Factors
	Center of range; found throughout US
	Wide genetic variation
	Will flower sooner in response to a warmer season/climate
	Seed bank remains viable for years
	Seeds dispersed by birds and mammals
	Risk Factors
	Shallow root system, more susceptible to blow down
	Intolerant of prolonged drought
	CO2 increase likely to decrease resistance to aphids
	Primarily pollinated by bees, some by flies and beetles (more specialized pollinators)
	Need adequate soil moisture
	Source: “Phenological and Physiological Responses to Drought Stress and Subsequent Rehydration Cycles.” <i>Science Direct</i>
Dogbane <i>Apocynum cannabinum</i>	General Information
	Bloom: June–Aug
	Nectar source
	Related to milkweed
	Resiliency Factors
	Center of range
	Seed and root regeneration
	Wind dispersal of seeds
	Wide habitat range
	Wetland or upland plant
	Dry soils
	Full sun to shade
	Rapid spreader
	Hybridization common
	Fire tolerant; benefits from disturbance
	Range of pollinators
	Wide range of elevations
	Risk Factors
	Medium water use
	Ozone negatively affects flowering and reproduction
No indication of seed bank persistence	

Goldenrods <i>Solidago</i> spp.	General Information
	Flower: late summer–early fall
	Resiliency Factors
	Center of range
	Tolerates moist or dry soils
	Full sun to partial shade
	Wide genetic variability
	Range of habitats
Long distance seed dispersal	
Purple Coneflower <i>Echinacea</i> <i>purpurea</i>	General Information
	Blooms: April–Sept
	Resiliency Factors
	Center of range
	Dry soils
	Sun to part shade
	Range of pollinators
	Drought tolerant
	Risk Factors
Medium water use	
Stinging Nettle <i>Urtica dioica</i>	General Information
	Cover for small mammals
	Flowers: May–Oct
	Resiliency Factors
	Center of range
	Vegetative and seed regeneration
	Spreads quickly
	Moderate flooding tolerance
	Strong competitor, pioneer plant
	Tolerant of low severity fire
	Sea level to subalpine habitat range
	Pollination and seed dispersal by wind
	Risk Factors
	Associated with riparian communities, specifically marshes and meadows
Requires moist soils	

MODERATELY VULNERABLE	
Red Maple <i>Acer rubrum</i>	General Information
	Flower: March/May
	Resiliency Factors
	Central part of range
	Shade tolerant
	Prolific sprouter
	Wide range of elevations and microclimes
	Benefits from disturbances—able to colonize areas quickly
	High genetic variability
	Risk Factors
	Wind dispersal of seeds
	Highly susceptible to disease
	Very susceptible to fire
Southern Catalpa <i>Catalpa bignonioides</i>	General Information
	Flower: May/June
	Seeds: autumn
	Wildlife food and shelter
	Resiliency Factors
	Northern edge of range (US zones 5–9)
	Vegetative and seed regeneration
	Risk Factors
	Moist, deep soils
	Historic precipitation range: 200mm–325mm
	Wind dispersal of seeds
	Historic temperature range: 50°–75° F

White Pine <i>Pinus strobus</i>	General Information
	Food for songbirds, squirrels, deer, mice
	Cover for wildlife
	Flower: May/June
	Resiliency Factors
	Genetic diversity
	Historic precipitation range: 510mm–2030mm
	Seed dispersal by wildlife
	Risk Factors
	Southern—mid-extent of range
	Prefers cool and wet climates
	Seedlings not very drought tolerant
	Seed regeneration only
	Damaged by deer, ice, snow
	Sensitive to air pollution
Pine bug risk	
Accustomed to northern aspects and stream bottoms	
Canada Moonseed <i>Menispermum canadense</i>	General Information
	Poisonous
	Flowers: June/July
	Berries eaten by birds
	Risk Factors
	Canada’s Plant Hardiness website models that moonseed will increase in prevalence at first, but will decline with increasing impacts of climate change—first migrating out of current zone and then possibly facing extirpation (planthardiness.gc.ca)

Jack-in-the-pulpit <i>Arisaema triphyllum</i>	General Information
	Flower: April/May
	Becomes dormant mid-summer
	Food source for birds and mammals
	Resiliency Factors
	Center of range
	Tolerant of shade to full sun
	No serious diseases or pests
	Propagates by root division and seed
	Tolerant to a wide pH range
	Risk Factors
	Needs moist soils
	High water use
	Faculative wetland plant
Jewelweed <i>Impatiens capensis</i>	General Information
	Bloom: July–Oct
	Resiliency Factors
	Center of range
	Range of pollinators including hummingbirds, bees, and butterflies
	Able to compete with garlic mustard
	Risk Factors
	Medium water use
	Shade needed
	Moist to wet soils
	Faculative wetland plant
Sensitive Fern <i>Onoclea sensibilis</i>	General Information
	Spores borne June–Nov
	Resiliency Factors
	Center of range
	Risk Factors
	Medium to high water use
	Moist to wet soils needed
	Low drought tolerance
	Frost intolerant
Faculative wetland plant in all ranges	

Spinulose Woodfern <i>Dryopteris carthusiana</i>	Resiliency Factors
	Center of range
	Tolerates variety of soil types
	Risk Factors
	Restricted to cool, moist, or wet woodlands
	Susceptible to fire
HIGHLY VULNERABLE	
Eastern Hemlock <i>Tsuga canadensis</i>	General Information
	Creates cool, moist microclimate with acidic soils and slow rates of nitrogen cycling
	Stabilizes soil
	Food and nesting source
	Resiliency Factors
	Historic precipitation range: 740mm–1270mm
	Risk Factors
	Woolly adelgid—likely to continue decimating populations
	Center of range
	Prefers cool, moist air
	Not tolerant of drought or dry soils, especially seedlings
	Susceptible to air pollution
	Short wind dispersal of seeds
	Low genetic diversity
Shallow root system makes susceptible to strong winds and fire	

EXTREMELY VULNERABLE	
Black Walnut <i>Juglans nigra</i>	General Information
	*Likely die off from Thousand Cankers disease
	Associated with Kentucky Coffeetree
	Alleopathic
	Flower: June
	Fruit: Sept/Oct
	Food and shelter source
	Resiliency Factors
	Northern edge of range
	Historic precipitation range: 640mm–1786mm
	Moderately tolerant of flooding
	High genetic variation
	Risk Factors
	Temperature range: 45°–67° F
	Thousand Cankers disease
	Short seed dispersal
Prefers constant soil moisture throughout year	
White Ash <i>Fraxinus americana</i>	General Information
	*Likely die off from Emerald Ash Borer
	Food source
	Flowers: April/May
	Good seed crop every third year
	Resiliency Factors
	Intermediate tolerance of flooding
	Grows on low to middle slopes
	Wind dispersal ≤150m
	Risk Factors
	Moist conditions necessary for seed germination
Sensitive to air pollution	

INSUFFICIENT EVIDENCE	
Blackhaw <i>Viburnum prunifolium</i>	General Information
	Food and nesting source
	Resiliency Factors
	Northern portion of range
	Low to upland habitats
	No serious diseases or pests
	Risk Factors
	Prefers moist soils
Medium water use	
Bee Balm <i>Monarda sp.</i>	General Information
	Bloom: mid-summer–fall
	Resiliency Factors
	Cold tolerant
	Sun to partial shade
	Range of habitats
	tRisk Factors
	Moist and wet soils
Medium water use	

Stormwater Best Management Practices Fact Sheet

Rain Garden

PURPOSE: Rain gardens are small-scale bioretention areas that benefit water quality by removing pollutants from runoff. They also reduce the speed of runoff and promote infiltration of runoff into the groundwater supply.

Rain gardens are designed to mimic the layered conditions of a forest floor, which naturally filters pollutants from water. The rain garden consists of a vegetated or stone ponding area, a mulch layer, a planting soil layer, a sand bed, and a gravel base. The multiple layers work together to filter pollutants from water, allowing it to infiltrate into the groundwater supply uncontaminated.

Rain gardens are well-suited for use on individual residential sites, as they provide for stormwater management on a lot-by-lot basis. The vegetated or stone surface layer initially slows the velocity of runoff and provides temporary storage for runoff before water either evaporates or infiltrates the soil. Plant material aids with evapotranspiration of water, and plant roots create pathways for water to infiltrate soil. Water retained in the ponding area is absorbed into the mulch layer, where bacteria that live among plant roots digest pollutants, even petroleum-based solvents. Mulch also aids with preventing erosion, protects underlying soil from drying, and provides a medium for biological growth and decomposition of organic matter. The soil layer provides water and nutrients to plants. Voids within the soil are where runoff is stored prior to infiltration to deeper ground. Addition of a subsurface infiltration bed will help to move water from the surface ponding area into the ground, and will aid with aerating the soil layers in order to enable them to absorb additional runoff. Runoff then filters through a layer of nonwoven geotextile material before seeping into a bed of sand for additional filtering. Lastly, water is received into a stone base, which allows the water to drain into the ground below.

Unlike bioretention areas, rain gardens traditionally do not include an underdrain feature to convey water to a storm sewer system because their purpose is to allow runoff to infiltrate the groundwater supply.

Rain gardens can be used in conjunction with porous paved parking areas, infiltration trenches, and filter strips for pretreatment of stormwater runoff.



Benefits and Uses

- Filters contaminants from runoff prior to its discharge to the storm sewer system or streams
- Reduces peak velocity and volume of stormwater runoff delivered to storm sewer system or streams
- Alleviates flooding and erosion downstream
- Inexpensive to install and maintain
- Enhances aesthetics of local landscape
- Recharges groundwater supply
- Applicable to all types of sites (residential/commercial/industrial)
- Can be used to treat runoff from streets, parking lots and driveways
- Provides habitat for wildlife
- Reduces mosquito breeding by removing standing water in yards
- Reduces potential of home flooding

Additional Resources

PA Department of Environmental Protection
www.depweb.state.pa.us - search Pennsylvania Stormwater Best Management Practices Manual

Alliance for the Chesapeake Bay
www.AllianceChesBay.org

Cahill Associates
www.thcahill.com - click on "Technologies" for project examples and general information

Rain Garden Network
www.raingardennetwork.com

Stormwater Manager's Resource Center
www.stormwatercenter.net

General Design Considerations

- Effective for draining areas of less than 5 acres
- Effective for nearly all types of soils and topography; best suited for areas with moderate permeability, more than 0.25 inch per hour
- Allow space between basin bottom and water table and bedrock to prevent groundwater contamination
- Design should include overflow drainage to remove excess stormwater
- Not suitable for receiving runoff with high levels of sediment
- Underdrains should not be used in rain garden design (see *bioretention area* for drainage)
- Recommended side slope is 3:1, or 2:1 in areas where space is limited
- Select native vegetation that is tolerant of varying water conditions (see reverse side)
- Plant depth should be at least 24 inches for herbaceous plants
- Soil should be a loam, loam/sand mix or sandy loam capable of supporting vegetative cover; modify soil with compost if needed
- Use a maximum of 2 to 3 inches of mulch
- Replace mulch annually
- Restrict ponding depth to 6 inches or less
- Pruning and weeding should be performed as necessary
- Rain gardens may require watering during dry periods
- Follow erosion control procedures
- Inspect regularly for clogging, litter, or rills or gullies caused by erosion



Produced by:
Dauphin County Conservation District
1451 Peters Mountain Road Dauphin, PA 17018
www.dauphincd.org p: (717) 921.8100

Native Vegetation

Native vegetation refers to plants, shrubs and trees that have existed in an area before it was settled by Europeans. More than 2,100 native plant species grow in Pennsylvania.

Using native plants is beneficial, as they are acclimated to the local climate and therefore, require less maintenance than introduced species. Native plants also contribute to the preservation of Pennsylvania's plant heritage.

Cultivars are varieties of native plants bred for a particular characteristic (size, color, etc.). Cultivars may be used in place of a native species.

Other Native Plants

Examples of some other types of native plants include:

Flowers

Wild Columbine	Jack-in-the-Pulpit
Wood Geranium	Common Milkweed
Phlox	Sundrops
Common Blue Violet	Partridge-berry
Virginia Bluebell	May-apple
Cardinal Flower	Trillium

Grasses

Virginia Wild Rye	Switch Grass
Indian Grass	Bottlebrush Grass
Lurid Sedge	Big Bluestem

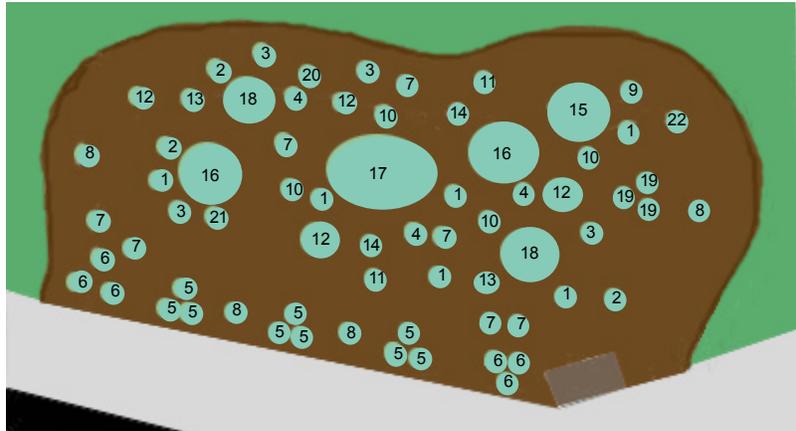
Shrubs

Red Chokeberry	Silky Dogwood
Black Chokeberry	Flowering Dogwood
Winterberry	Wild Plum
Fragrant Sumac	Virginia creeper
Mountain Laurel	Redbud

Trees

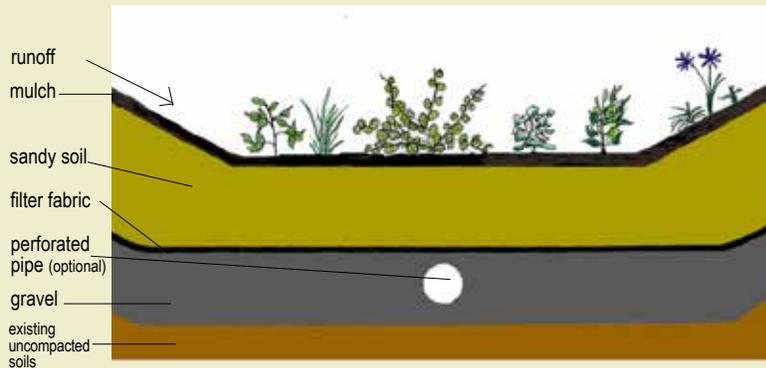
Red Maple	Sugar Maple
Tulip Poplar	Eastern White Pine
American Beech	Sycamore
Swamp White Oak	Chestnut Oak
White Oak	Red Oak
Black Birch	Yellow Birch

Native Vegetation planted in the BMP Tour Rain Garden



Key	Flowers/Shrubs	Latin Name	Flowering time
1	Foxglove Beardtongue	<i>Penstemon digitalis</i>	May-July
2	Swamp Sunflower	<i>Helianthus angustifolium</i>	Aug-Oct
3	Swamp Milkweed	<i>Asclepias incarnata</i>	July-Oct
4	Dogtooth Daisy/Sneezeweed	<i>Helenium autumnale</i>	Aug-Nov
5	Mouse-eared tickseed cultivar	<i>Coreopsis auriculata</i> 'Nana'	May-Sept
6	Black-eyed Susan cultivar	<i>Rudbeckia speciosa</i> 'Goldsturm'	Aug-Oct
7	Marsh Blazing Star	<i>Liatris spicata</i>	July-Sept
8	Stout Blue-eyed Grass	<i>Sisyrinchium angustifolium</i>	May-July
9	Evening primrose cultivar	<i>Oenothera fruiticosa</i> 'Lemondrops'	May-Aug
10	New England Aster	<i>Aster novi-angliae</i>	Aug-Oct
11	New England Aster cultivar	<i>Aster novi-angliae</i> 'Purple Dome'	Aug-Oct
12	Spiderwort cultivar	<i>Tradescantia ohioensis</i> 'Mrs. Loewer'	June-July
13	Simler's Joy/Blue Vervain	<i>Verbena hastata</i>	June-Oct
14	Boneset	<i>Eupatorium perfoliatum</i>	July-Sept
15	Elderberry	<i>Sambucus canadensis</i>	June
16	Virginia Sweet Spire cultivar	<i>Itea virginica</i> 'Henry's Garnet'	June-July
17	Red Osier Dogwood	<i>Cornus sericea</i>	June-July
18	Summer Sweet cultivar	<i>Clethra alnifolia</i> 'Ruby Spice'	July-Sept
19	Goldenrod cultivar	<i>Solidago sphacelata</i> 'Golden Fleece'	Aug-Oct
20	Great Blue Lobelia	<i>Lobelia siphilitica</i>	Aug-Oct
21	Eastern Joe-pye Weed	<i>Eupatorium dubium</i>	June-Sept
22	Narrow-leaf Echinacea	<i>Echinacea angustifolia</i>	June-Aug

A Closer Look at the Layers of a Rain Garden





Bluebird Nesting Boxes

INSTALLATION GUIDELINES

Time: It is best to erect the box by the first week of March. Male bluebirds will begin box selection as early as mid-March.

Location: Open mowed fields
120 feet from wooded edge
Boxes 100 yards apart
One box per acre

Placement: Face hole away from prevailing wind
Entrance hole 4–6 feet above the ground
Place within 50 feet of a perch (natural or manmade)

POTENTIAL COMPETITORS

Several other bird species may attempt to utilize your bluebird nesting box. The following will assist you in identifying the species.

Tree Swallow

nesting material: dry grass with feathers
eggs: pure white

Chickadee

nesting material: moss and hair
eggs: dull white with brown spots

House Wren

nesting material: small twigs
eggs: red and brown spots

House Sparrow

nesting material: dried plants with feathers
eggs: dull white with olive spots

NESTING INFORMATION

Dry grasses are the materials most commonly used by bluebirds. Although when made near evergreens, pine needles may be used. Nest building begins in early April. It takes five to fourteen days for bluebirds to complete a nest.

A single egg is laid each day. The eggs are approximately $\frac{3}{4}$ " by $\frac{2}{3}$ " and are normally clear blue. The female incubates the eggs for about 14 days. After hatching, the young will leave the nest in approximately 17 days.

After the young have fledged, remove the used nesting material. Bluebirds nest two to three times a season, building a new nest each time.

Monitor the nesting boxes once a week, between early April and late August.



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Natural Lands Trust ~ Hildacy Farm ~ 1031 Palmers Mill Road ~ Media, PA 19063 ~ 610-353-5587 ~ www.natlands.org

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