ROBBINS PARK
ENVIRONMENTAL EDUCATION CENTER

ECOLOGICAL RESTORATION EDUCATION

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Capstone Studio Spring 2013
T.U. Master of Landscape Architecture Program
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TEMPLE UNIVERSITY

Robbins Park Environmental Education Center

RESTORATION CAPSTONE DESIGN PROJECT

ECOLOGICAL RESTORATION PLAN FOR ROBBINS PARK ENVIRONMENTAL EDUCATION CENTER

May 3, 2013

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Capstone Restoration Design Project – LAN ARCH 9995
Spring 2013
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*All photographs and graphics taken or created by Keith Maung-Douglass unless otherwise noted.

3 Introduction

This document is the summation of a semester long master of landscape architecture and ecological restoration capstone project. The site location for this project was the Robbins Park Environmental Education Center which is located in Ambler, PA. This document contains both the ecological restoration plan and the landscape architectural design plans, which were developed as an attempt to cohesively combine both the natural and human element into a single and uniform design. In this specific situation, the environmental education element of the park was the major influence in the design process. This project is unique in the fact that its success is not fully dependent on the end outcome of the ecological restoration. The majority of the success of this project depends on the added educational value that it adds to the field of ecological restoration, while also stimulating the minds of young children and adults alike. The end goal is not reliant on having a 100% restored ecological system, but rather the end goal is to use this restoration and design process to both enhance the public appeal to the park, while also dramatically increasing the educational value of the restoration efforts that will be undertaken.

This document begins with some background information on the park, as well as some inventory and analysis that was done for this specific site and its surrounding area. Based on the site conditions and the goals of the design process, some design precedents were examined for some guidance and influence on some design ideas for this project. After gathering all of this information, three design concepts were developed and from those three concepts, the best elements that fit the end design goal from each were combined into a single master plan. This master plan then influenced what aspects of ecological restoration and landscape architecture design needed to be further developed to best showcase the design intent. Therefore, what follows is a bunch of detail information and design perspectives to help showcase this intent.

Project Overview

Robbins Park is perfectly situated to become a prime educational and study area for ecological restoration and environmental design. The park already has a well-established educational partnership with the Upper Dublin School District and a staff that is fully on board to both improve on the ecological environment of the park and to stimulate the minds of the public. On top of that, the park also already has an array of existing environmental ecosystems that are just waiting to be improved on and showcased to the public as a means of stimulating environmental stewardship. Robbins Park has a spring fed pond, a first order stream (Rose Valley Creek), a mature forest, a meadow and an array of wetland and floodplain ecosystems. The downside to the park is that some invasive plants species and the overabundance of deer in the area have created an environment that on a whole is lacking a great diversity of native species and is overrun with exotic species that provide little ecological value to the environment. Despite the invasion of exotic invasive plants, the park still have an abundance of wildlife and some well intact ecosystems that just need a little tender love and care to bring them back to the glory that they once were.

A major hindrance on the park is the significant influx of stormwater to the creek system. Development around the park has led to a dramatic increase in the amount of impermeable surfaces and was accompanied by poor environmental planning that led to the direct piping of stormwater into the park's creek system. The additional of all of this water has greatly eroded the stream and has removed the creek bed from its historic ties to the floodplain of the natural system. This has both increased flooding issues downstream, as well as greatly degraded the streambank and creek habitats all along the Rose Valley Creek system. The unnatural addition of stormwater makes restoration efforts to historic conditions impossible, since the current situation of high water

influxes is very different than that of historic conditions. This means that some modifications to the system will have to be installed in order to deal with this human caused problem in a way that will best merge a natural system with some smart engineering efforts to better deal with the issue. Major parts of the restoration plan within this document will deal with trying to correct and deal with the stormwater issue that is a constant burden on the creek system within the park.

Another big component of this restoration effort will be to remove the exotic invasive plants that have nearly overtaken a good portion of the park system. This restoration plan will cater directly to the limited abilities of the park to actually deal with this massive problem. This plan will not treat the removal of invasive plants as a trivial task that can be accomplished in a single year, without any long term maintenance. This plan will take the negatives of this situation and use it towards the advantage of the educational process. Having a limited budget and staff/volunteer work force creates the opportunity to create a long term educational and research restoration plan that will have many more benefits than a typical ecological restoration project. Your typical restoration plan might try and create the perfectly restored ecological system as soon as possible, which is great for that particular environment that they are creating, but the educational benefit is lost in the rushed effort to create that "perfect" system. The gained research knowledge and public awareness comes from long term projects that involve many people and have lots of public exposure over a long period of time. This project hopes to use its negatives for just that benefit. The restoration of Robbins Park will take the public along for the ride and the project will evolve as the restoration efforts evolve. The restoration efforts will also include an extensive monitoring and maintenance plan that will help to provide empirical data to either highlight the benefits of certain aspects of ecological restoration or inspire the need and desire to try something else.

The landscape architectural design part of this project will focus on helping to stimulate interest in visiting the park. The first part of getting people to the park is to enhance the visual statement that the park presents at its entrance. Currently the park is not very visible from its main entrance, which does little to help draw people into the park. The park sign is difficult to see and there is not much of a curb appeal that would stimulate someone's eye to look over at the park and make a decision to stop in. For this reason, one of the major design elements will be to re-design the front entrance and make the park more appealing and increase ease of access. Another element to draw people into the park will be the creation of a natural woodland playground that will both stimulate the desire of children to play, as well as better connect people to nature. On top to these additions, this plan will also include many educational stations throughout the park that will both engage and educate people of all ages.

This document will go into deeper detail about all of the elements mentioned here and more, but before we jump into the many design ideas we must first get you better acquainted with the site. This will help to provide the reader with adequate background information so that they can fully understand the site and all of its unique elements. Once that information is fully explained, the document will lead into the different design and ecological restoration elements that are suggested.

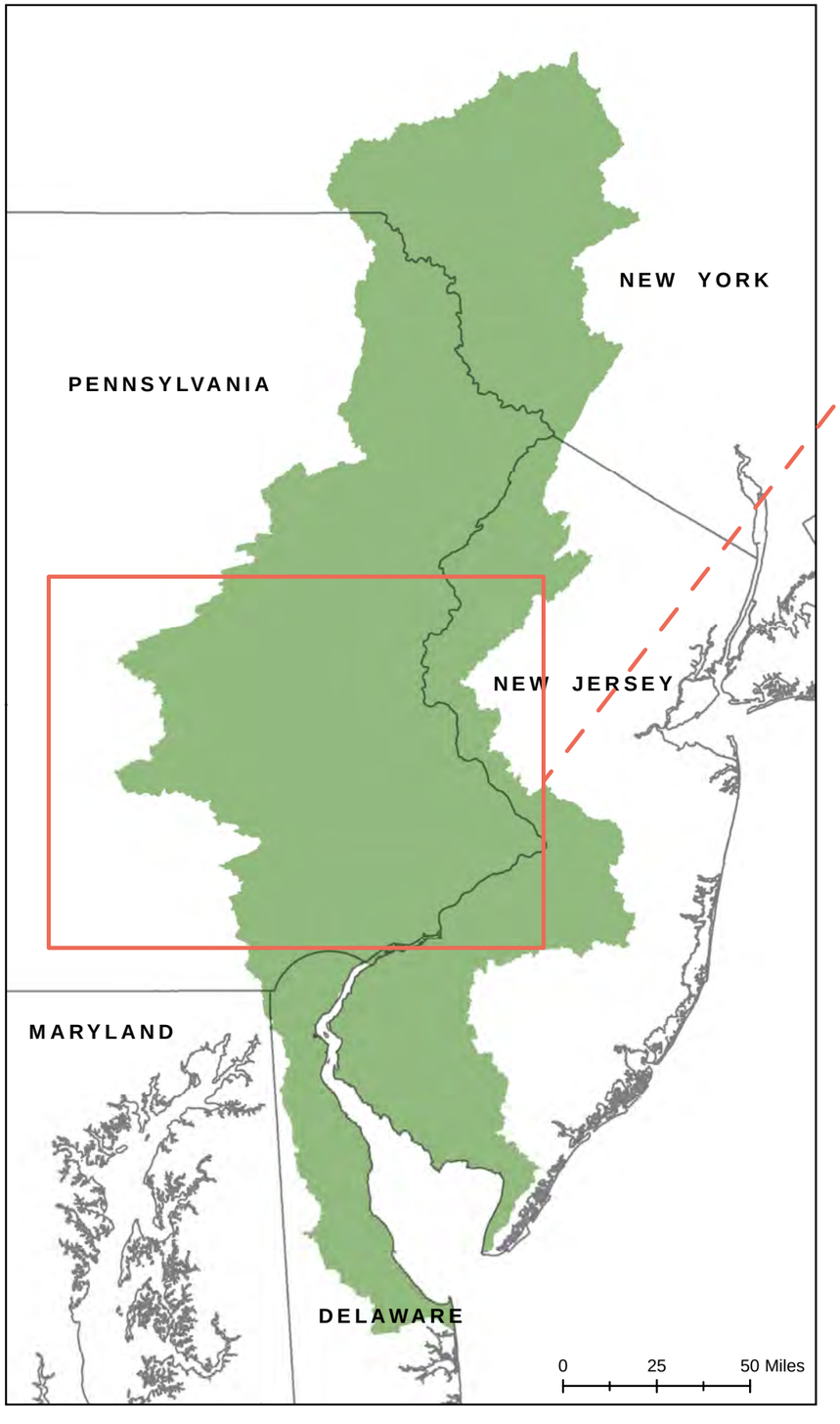
4 Site Inventory and Analysis

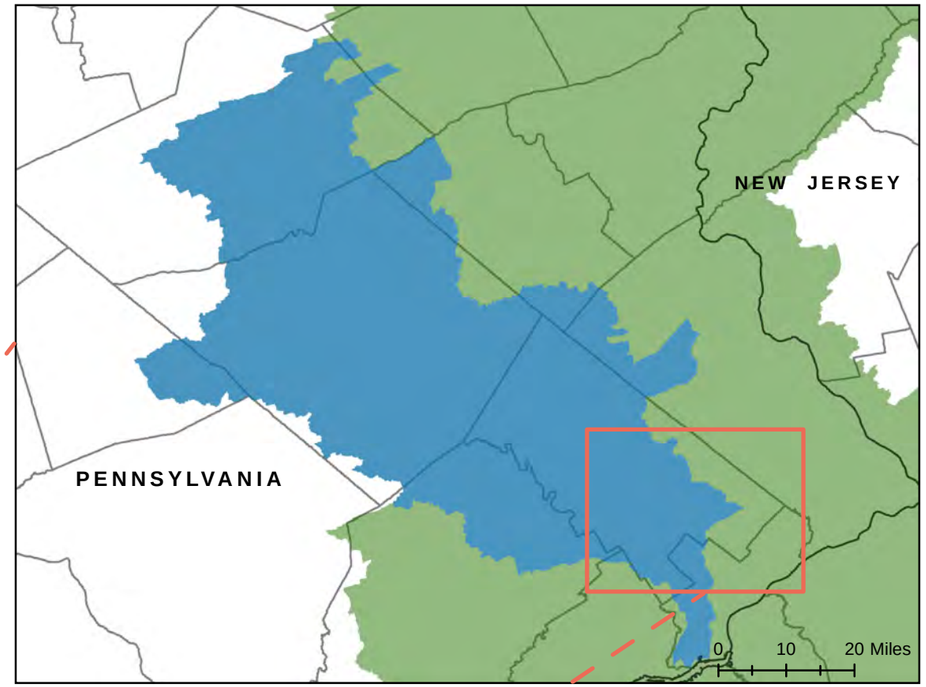
Robbins Park is a 38 acre outdoor environmental education park located in the Upper Dublin Township of Montgomery County, PA. The public park is a joint venture between the Upper Dublin Township and the Upper Dublin School District, combining the need for public space and an outdoor educational facility. The park started in 1975 through a series of land donations from the Cheston and Robbins families with the coordination of Upper Dublin science educators, Dr. William Ritter and Daniel Jaycox. The park supports over 25 different educational activities and programs that are meant to help supplement environmental and outdoor education that coincide with classroom lessons. The park is also open to the general public from sunrise to sunset.

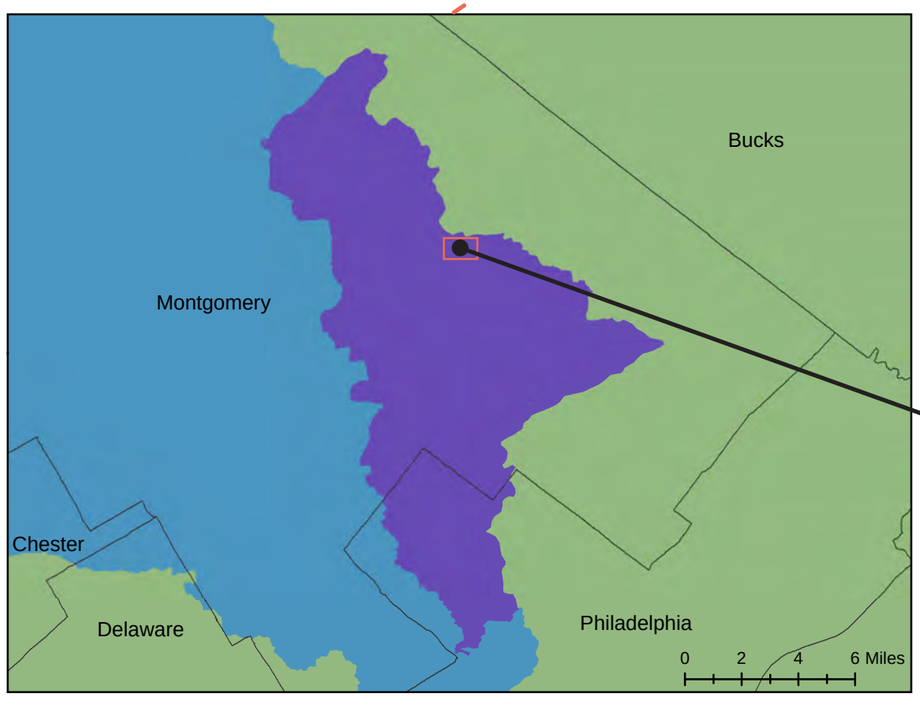
Watershed Context

Robbins Park is entirely within the Rose Valley Creek watershed, which is only a small part of the greater Wissahickon Creek Watershed, which is over 40,500 acres (PWD, 2013). The Wissahickon creek lies along the south eastern side of the Schuylkill River watershed, which is part of the much larger Delaware River Basin (**Figure 1**). **Figure 2** shows the Wissahickon Watershed with all of the waterways highlighted in blue. Robbins Park is the red portion on the north east side of the watershed, which is shown in a blown up map in **Figure 3**. Despite being a small component of the entire watershed, the Robbins Park area is a key component of the head waters for Rose Valley Creek, which contributes a significant amount of water to the downtown Ambler area along the Wissahickon Creek. The Center for Sustainable Communities at Temple University is currently developing a stormwater management plan for the three major watersheds in the Ambler Borough (Meenar et al, 2013). The Rose Valley Creek Watershed is included in this study and hopefully their final document will provide some additional support for the benefits of restoring Robbins Park. More details and updates on this project can be found at http://amblerwatersheds.wordpress.com.

Watershed Context







Legend

- Wissahickon Watershed
- Schuylkill River Watershed
- Delaware River Watershed

Robbins Park and the Rose Valley Creek Watershed Area

N

Figure 1: Robbins Park is within the Rose Valley Creek watershed portion of the Wissahickon Creek watershed. The Wissahickon creek lies along the south eastern side of the Schuylkill River watershed, which is part of the much larger Delaware River Basin. The maps provided here show how Robbins Park is not an isolated system, but is a part of a much larger, complex and important watershed system. Maps created in ArcMap using data from pasda.org.

Wissahickon Watershed

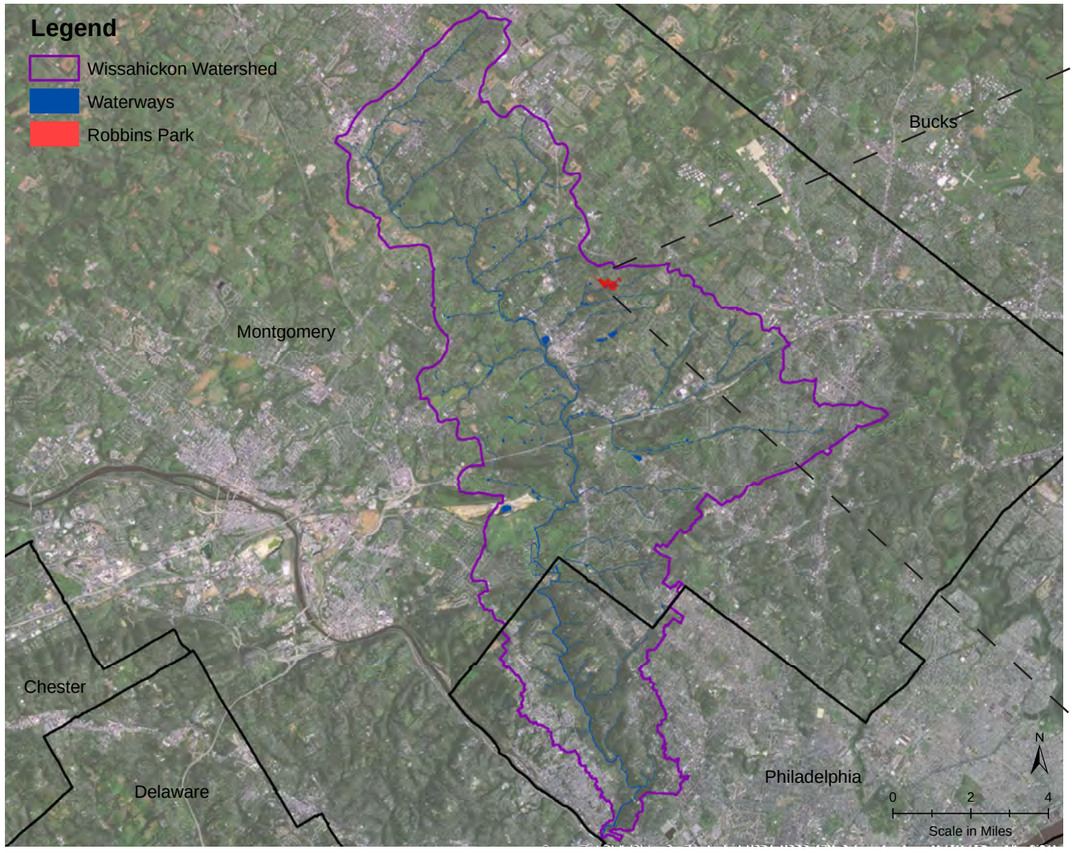


Figure 2: Robbins Park barely appears as a blip on the map for the entire Wissahickon Watershed, but each smaller creek system is an important component of the entire system. Much of the water to the Wissahickon Creek is brought into the system via these smaller feeder creeks and if they are better cared for and improved to better to handle stormwater, then the better off the whole system will be. Base map image from pasda.org.

Park Context

Figure 3: This map shows the boundaries of Robbins Park (dashed lines) as well as some of the surrounding area. Rose Valley Creek flows through the central portion of the park. Base map image from pasda.org.

Geology and Ecoregions

In order to better understand the type of ecosystem that exists in a certain location it is important to understand the geology of the area. The geology has a great impact on the type of ecosystem that will exist in that specific area. Not only does the geology influence elevation, it also is the bases for the soil structure of the location. The different geologic locations across the planet have helped to create different niche areas for very specific ecosystems. These different ecosystems have been broken down into many different levels of specific ecoregions. Geologic and ecoregions (levels III and IV) maps for the south eastern portion of Pennsylvania have been mapped in **Figures 4a-4c**. A direct correlation can be seen between the land areas of different geology and their respective ecoregion designation. Robbins Park lies within the Stockton Formation geologic zone, which gives it a sandstone and siltstone geologic base. The level IV ecoregion of Robbins Park is the Triassic Lowlands, which is a part of the greater Northern Piedmont level III ecoregion. The Triassic Lowlands historically consisted of an Appalachian Oak Forest, which is typically dominated by white and red oaks (Kuchler, 1964). Today, the native forest has been replaced by patches of farms, houses, and woodland, which are interwoven with many roadways. Hickory tree species are more common in this region, whereas red maple and black tupelo are historically less likely to inhabit this area (Farrell and Ware, 1991).

Soils and Slope

Robbins Park contains at least 8 different soil types (LaA, LaB, Bo, CrA, ReA, LeA, AbA, CfA), which are shown in **Figure 5**. To get a better idea of the difference between these different soil types they were then mapped (**Figure 6**) based on their hydrological grouping (how well they infiltrate water), which is delineated into 4 different groups (A, B, C and D). Group A (high sand content) infiltrates water very well, whereas Group D (lots of clay content) is very poor at infiltrating water. Groups B and C fill in the range between Groups A and D. The hydrological grouping of the soil within different regions will be important when considering what type of vegetation should be planted there.

Another important component to understand is the contours of the site and areas that have steep slope. **Figure 7** is a contour map of the site showing 2 foot contours. Understanding the contours of the site will help to understand how water flows, which could be important for many different reasons. From the contour map a slope map (**Figure 8**) was created in order to highlight areas that flat and areas that have steep slopes. This slope map shows that steep slopes only seem to appear along the heavily eroded streambank and along a section in the center portion of the park. Most of the rest of the park is relatively flat.

Vegetation

The 38 acre park site currently consists of approximately 6.0 acres of pasture land (currently being leased out), 1.4 acres of meadow, 2.2 acres of maintained grounds with structures, 0.2 acre pond and about 28.2 acres of forest with about 0.8 acres of wetland along with the Rose Valley Creek running through it. The elevation of the site ranges between 300 and 360 feet, with the highest point being near the pond (northeast corner) and the lowest being the point where Rose Valley Creek exits the property under route 309 (southwest corner). This portion of Rose Valley Creek is the northern of the two extensions. A map showing these distinct areas is shown in **Figure 9**.

The park is surrounded primarily by residential properties with the exception of the Upper Dublin Sports Club to the north and Temple University sports fields to the south (Figure 8). The main entrance to the park is located near the intersection of Butler Pike and Meetinghouse Road. Route 309 runs up the west boundary of the park with Tennis Avenue, Beechman Road and Stout Road bounding the remaining sides, which also provide entry points from each. Another park entry point is at Casals Plaza, which interposes into the park via a small cul-de-sac off of Butler Pike.

Historic Conditions

In order to understand the current conditions of the site it is important to understand a bit of the sites history. Many historic sources have estimated that before European settler came to Pennsylvania the forests covered 90 to 95 percent of Pennsylvania's land area of 28.7 million acres (DeCoster, 1995). Over the centuries efforts have been made to protect our forests, but currently only about 62% of Pennsylvania is now covered by forest (Goodrich et al 2002). The park exists in a region that is historically described as being mostly an Appalachian oak forest (Kuchler, 1964).

Repeated clear-cutting, farming and development of the site makes it difficult to fully grasp the historical conditions. Some efforts have been made to examine how forest systems in this region have changed over time. Mikan et al looked at how repeated cutting and burning of the forests on the Piedmont may have created a successional process creating the dominate tree species we see today. Based on their research, pre-settlement forests of the region were dominated by Q. velutina, Q. alba, Castanea dentata and Carya spp. The repeated cutting, burning and charcoal iron industry practices of creating coppice stands, led to a reduction in shade tolerant species and promoted the recruitment of Q. prinus with an understory of A. rubrum, B. lenta and B. alleghaniensi (Mikan et al 1994).

Looking at the series of aerial photos from this site from 1942, 1958, 1971 and 2010 (**Figures 10a-10d**), one can see that a large mature woodland existed in the southwest portion of the park in 1942, while most of the rest of the current park land was managed land. The current pasture lands at the north-west part of the park were continually maintained, while the rest of the current park land was left to the will of the successional growth with the added feature of human introduced exotic plant species and unmanaged deer populations. The 2010 aerial shows that most of the park has now filled in with woodland and **Figure 11** shows the canopy height of the trees, which further shows the differences in tree height growths between the forested areas based their relative ages. The canopy height map matches up well with the distinction made between the Oak/Beech forest and the degraded forest. The historic forest area has mature trees and very few invasive species when compared to the rest of the wooded areas of the park. Having an established woodland has helped to slow the progression of the invasive plant species.

Geology and Ecoregions

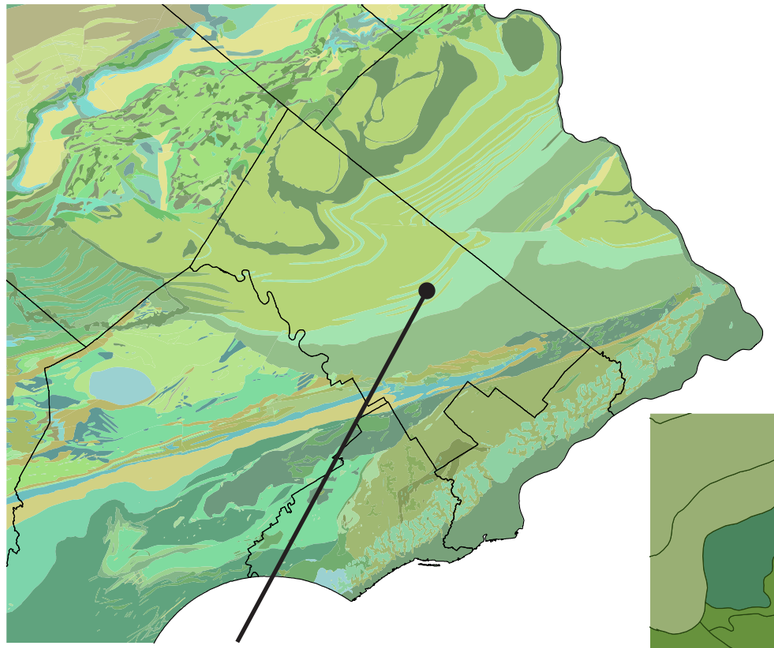


Figure 4a: Geology

Stockton Formation
Sandstone and Siltstone

Figure 4b: Ecoregions Level III

Northern Piedmont
The Northern Piedmont is a transitional region of low rounded hills, irregular plains, and open valleys. It is underlain by a mix of metamorphic, igneous, and sedimentary rocks. Potential historic vegetation would have been predominantly Appalachian oak forest whereas the Piedmont ecoregion would have been dominated mostly by oak-hickory-pine forests (Woods et al).

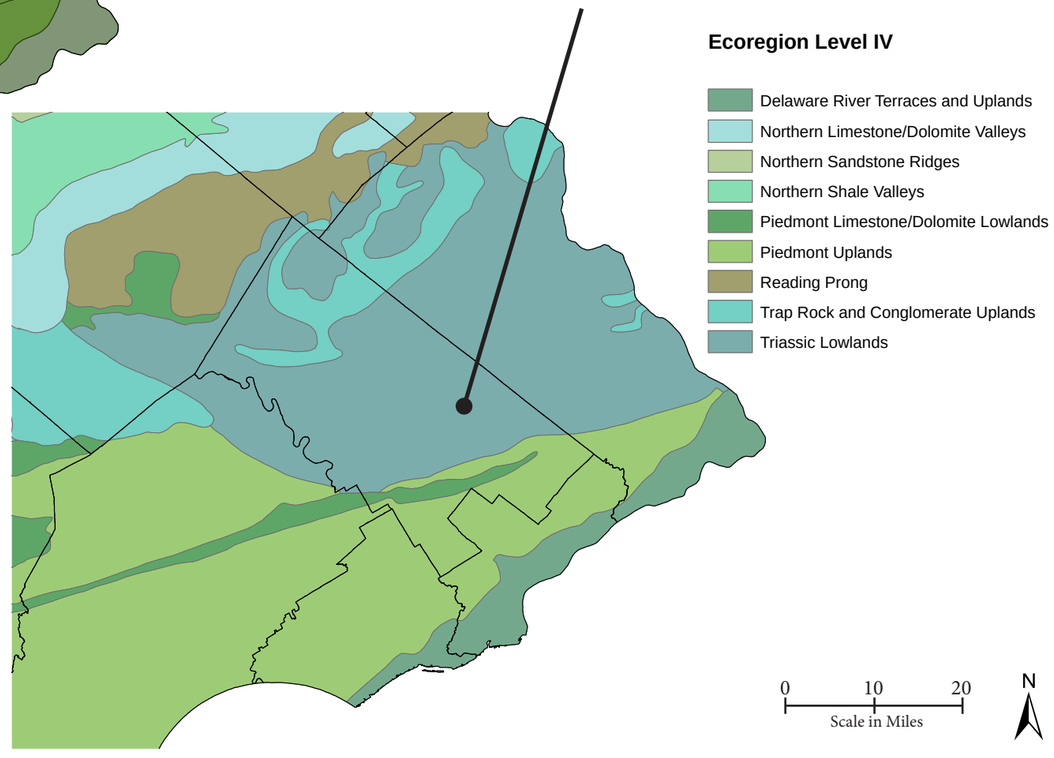


Figure 4c: Ecoregions Level IV

Triassic Lowlands
The Triassic Lowlands is typically characterized by having wide undulating ridges, broad nearly level valleys and limited local relief.
The soils were derived from Triassic sandstone, shale, siltstone, and argillite of the Brunswick, Stockton, Lockatong, Gettysburg, and New Oxford formations (Woods et al).

The Triassic Lowlands historically consisted of an Appalachian Oak Forest, which is typically dominated by white and red oaks (Kuchler, 1964). Today, the native forest has been replaced by patches of farms, houses, and woodland, which are interlaced with many roadways. Hickory species are more common in the Triassic Lowlands because the soil is less acidic and more calcium and magnesium rich, which the hickory species prefer, but (Farrell and Ware, 1991). Red maple (Acer rubrum) and black tupelo (Nyssa sylvatica) are historically less abundant (Farrell and Ware, 1991).

*Maps created in ArcMap using data from pasda.org.

Soils Map

Figure 5: A map showing the many different soil types that appear within the park and its surroundings. Mapped in ArcMap using data from the NRCS.

Soil Hydrologic Group Map

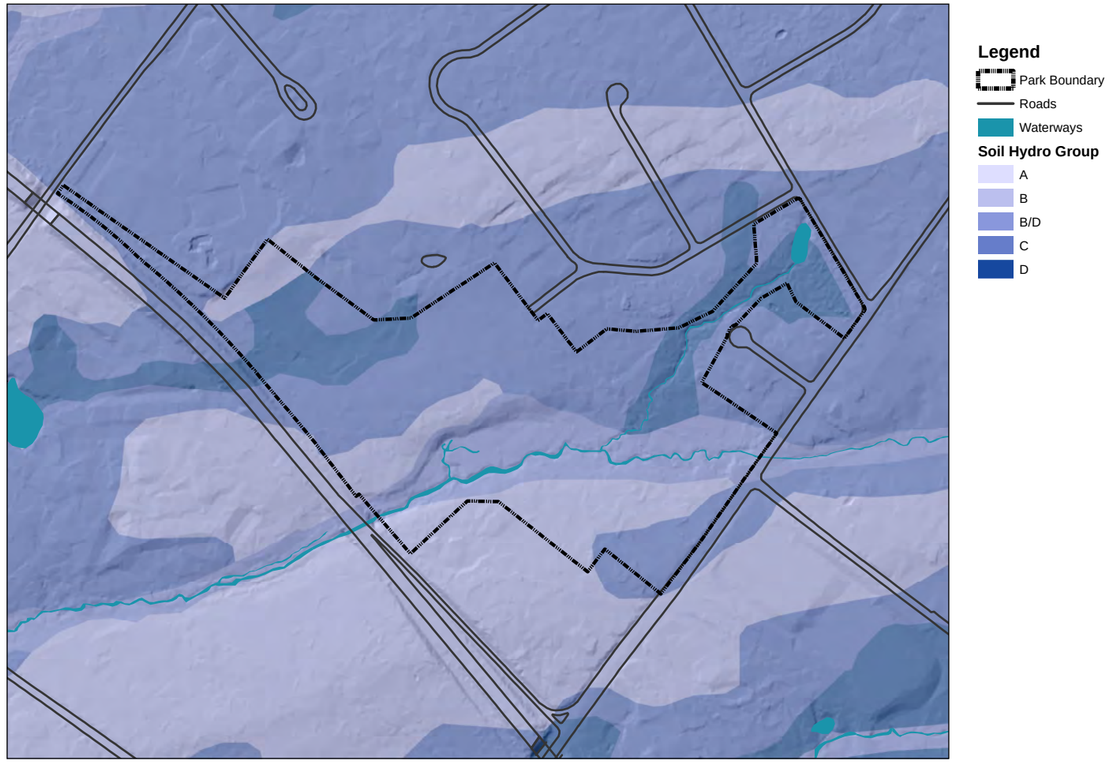


Figure 6: A map showing the soil types based on its hydrological grouping. Mapped in ArcMap using data from the NRCS.

Contour Map

Legend

- 2’ Contours
- 10’ Contours
- Park Boundary
- Road Boundary
- Waterways
- Buildings

0 300 600

Scale in Feet

Figure 7: Map showing the 2 foot contours of the site and surrounding area as well as the names of the streams within the park. The data was provided by the PAMAP project and downloaded from pasda.org.

Slope Map

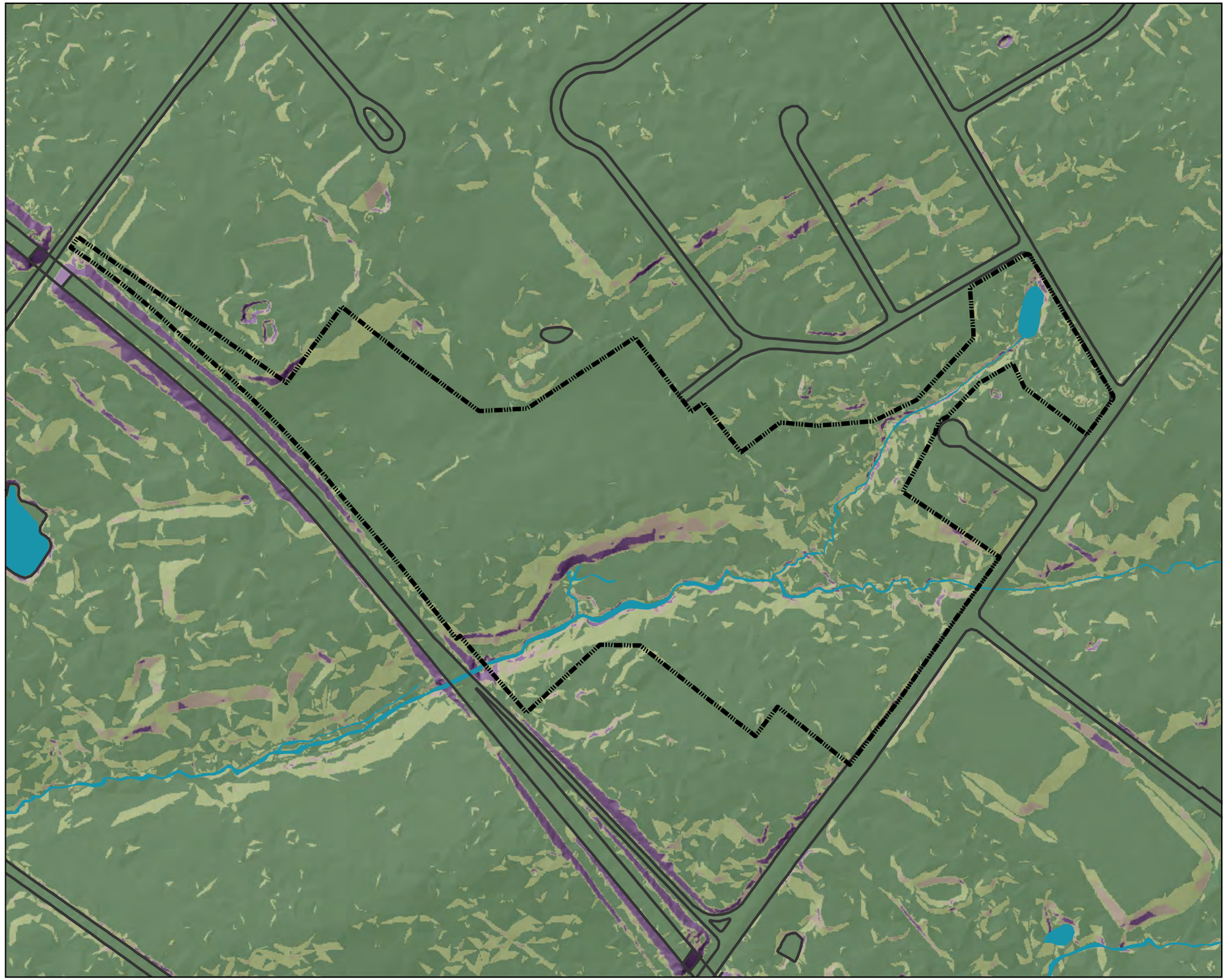


Figure 8: Map showing slopes of land features for the site and its surrounding. Map created in ArcMap using data from pasda.org.

Land Inventory

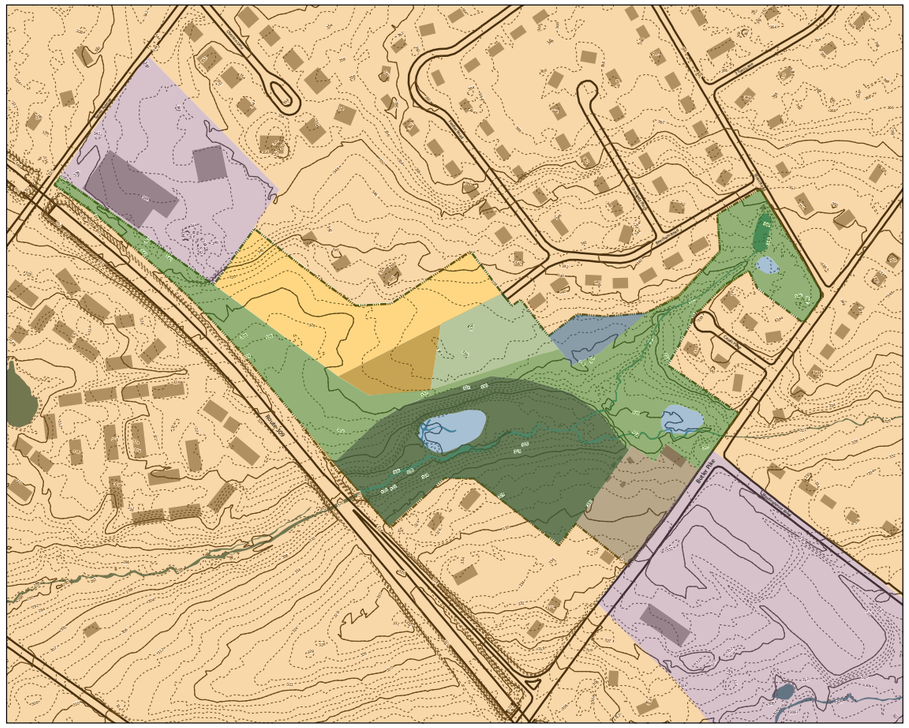


Figure 9: Robbins Park is surrounded by mostly residential properties, but does share some borders with some recreational/institutional land. This means that the natural ecosystems of the park are self contained within its own boundaries and do not flow into bordering natural ecosystems. The one exception is the private lot to the south west of the park. This is a large wooded lot and is separated from the park by route 309, with the only wildlife connection point being through a culvert under the road. The different vegetation types are shown on this map and color coded as shown in the map legend.

Forest Canopy

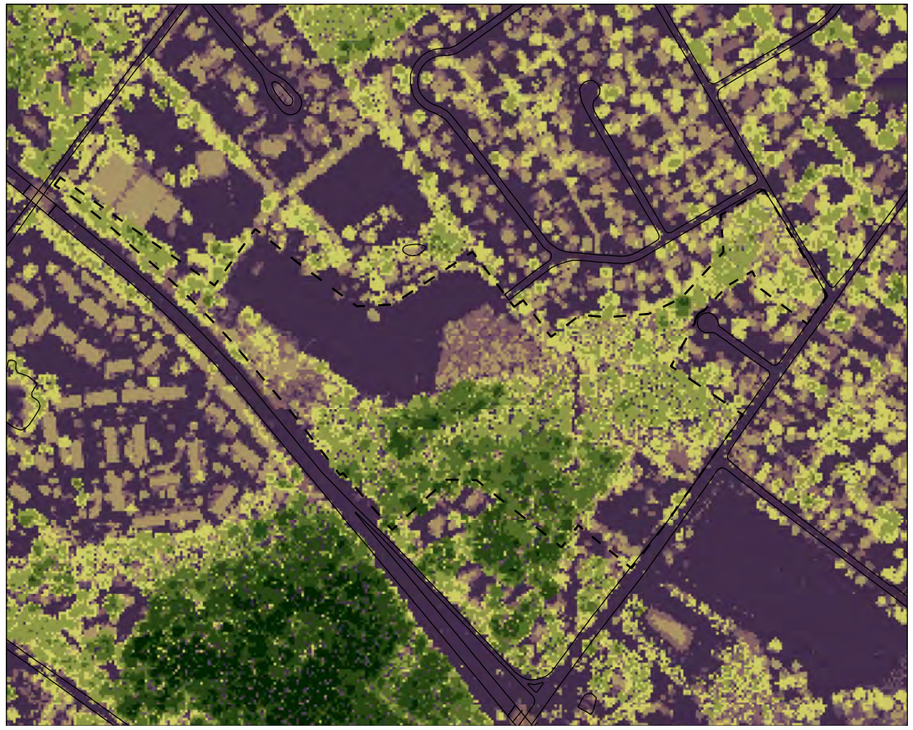
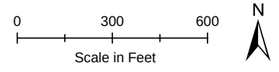


Figure 11: Map showing the tree canopy height within Robbins Park and in the surrounding area. The darker green indicates the much taller and mature trees, which mainly exist in the south portion of the park. There are a few tall trees along the stream leading from the pond and a stand of sycamores along the narrow band at the north west entrance to the park. The private lot to the south west of the park has significantly more large trees as indicated by the much larger patch of dark green. Map created in ArcMap using LiDAR data from PAMAP.



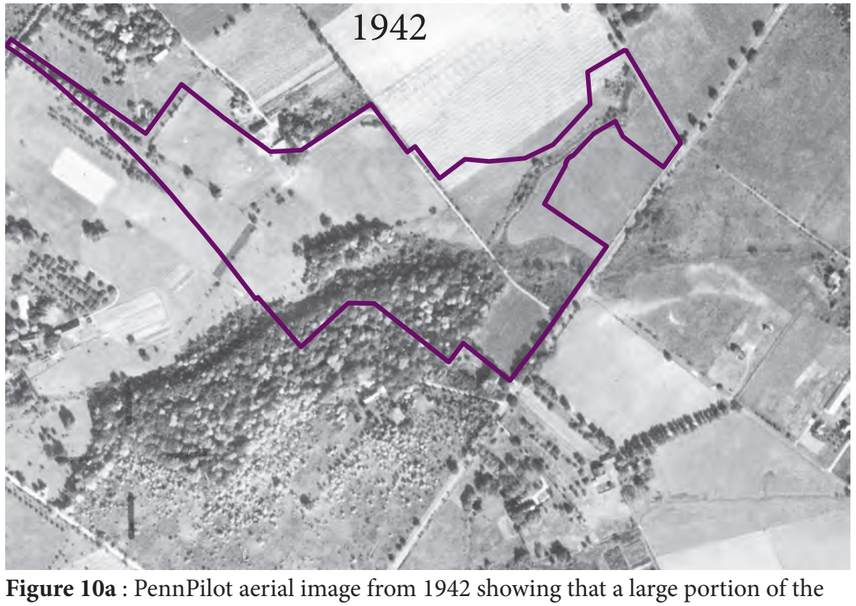


Figure 10a : PennPilot aerial image from 1942 showing that a large portion of the park was once cleared. There is a patch of forest at the south end of the park and some vegetation along the stream.

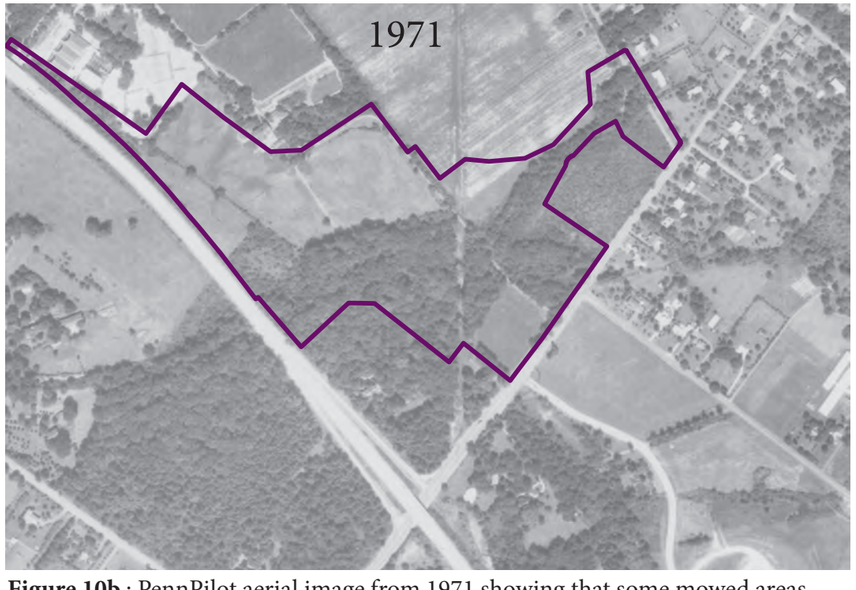


Figure 10b : PennPilot aerial image from 1971 showing that some mowed areas have been allowed to be re-vegetated, especially along the north east side of the park.

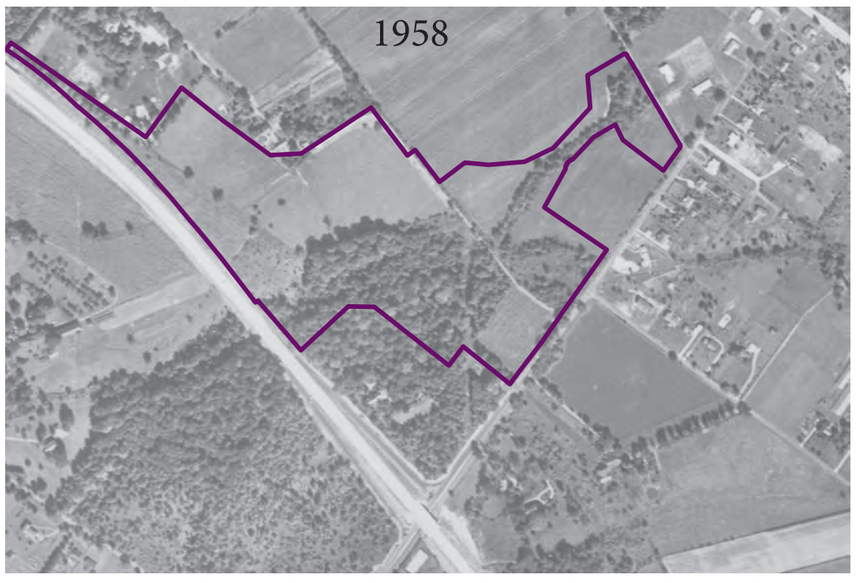


Figure 10c : PennPilot aerial image from 1958 showing the recently created route 309 along the west boundary of the park. The vegetation has not changed much from 1942, but has filled in some. This aerial also shows the construction of residential housing.

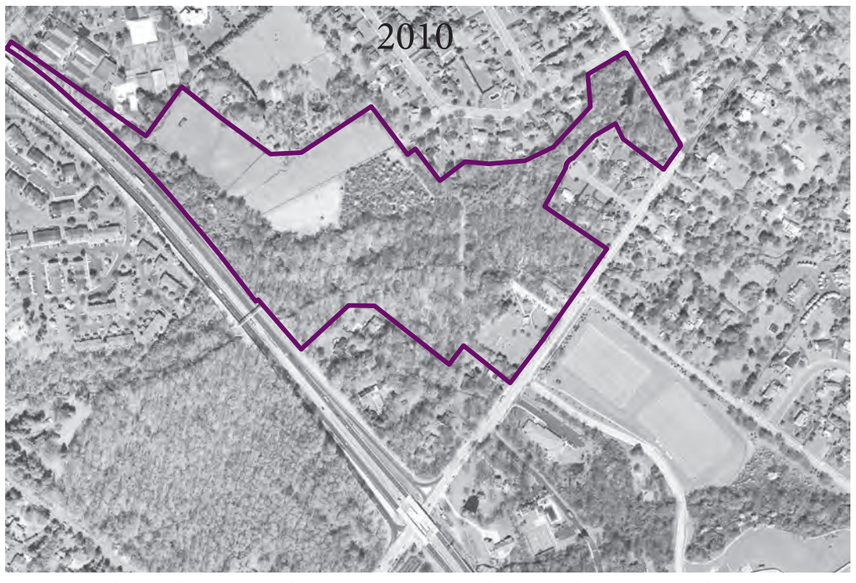
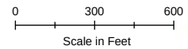


Figure 10d : Pasda.org aerial image from 2010 showing that more of the park is vegetated and that much more of the surrounding area has been developed with residential properties.



Waterways

Robbins Park has about 2,875 linear feet of stream flowing through the park. This includes Rose Valley Creek, as well as the unnamed stream flowing from the pond. The pond is about 9,000 sq feet and has about 375 linear feet of shoreline. The pond is a man made structure and is fed by a ground water spring which flows from underneath a historic spring house (**Figure 12**). The water leaves the pond from a concrete spillway and flows down to connect with Rose Valley Creek (**Figure 13**). Before it meets up with Rose Valley Creek there are two stormwater outfalls that dump stormwater into the creek. These two outfalls are pictures in **Figures 14 and 15**. The second outfall shown in **Figure 15** seems to get a much higher flow rate as compared to the first outfall. Flow meters or weirs would need to be installed to analyze and compare these outflows to get some accurate data.

Figure 16 shows the stormwater infrastructure for the park and the all of the area that eventually drains into the park. There is over 205 acres of land area upland of the park that drains into the waterways that enter the park. Much of this water is piped directly from private residents and roadways and into Rose Valley Creek. Most of the area within the Rose Valley Watershed that upstream of the park is residential and not a lot is done to help infiltrate the water. Much of the land is compacted lawn, roofs and impervious asphalts that shed storm-water very quickly. This is compacted by the concentration of the stormwater via all the stormwater pipes that collect the water from the roadways. This can clearly be seen in **Figure 15** by the designation of the red lines. The Rose Valley Preserve (shown in green north of Robbins Park) does provide some potential public land space for stormwater infiltration, but currently does very little as it is also channelized and not connected to the flood-plain.

Figure 12: Historic spring house that feeds the pond.

Figure 13: Man-made structure damming up the pond.

Figure 14: Brick headwall stormwater outfall.

Figure 15: Second stormwater outfall.

Current Conditions

Pasture and Meadow

The 6.0 acres of pasture land is currently being leased and is used for the grazing of a variety of different farm animals. Upon the end of the lease there is the potential opportunity to regain this portion of land to in-corporate it into the public portion of the park. The portion of land is currently bound with a split rail fence and the constant animal grazing has kept the vegetation low. This portion of land also contains a small barn shed at the northern most of end of the pasture. The current meadow (**Figure 17**) is mowed once a year and consists mostly of poison ivy and invasive species like wine berry and multifora rose. A few common natives are found within the meadow (milkweed, goldenrod, little bluestem), but nothing valuable enough to justify protecting in any way during any restoration process. The current trail system only circles around the meadow, which offers little interaction with the meadow environment (**Figure 21**).

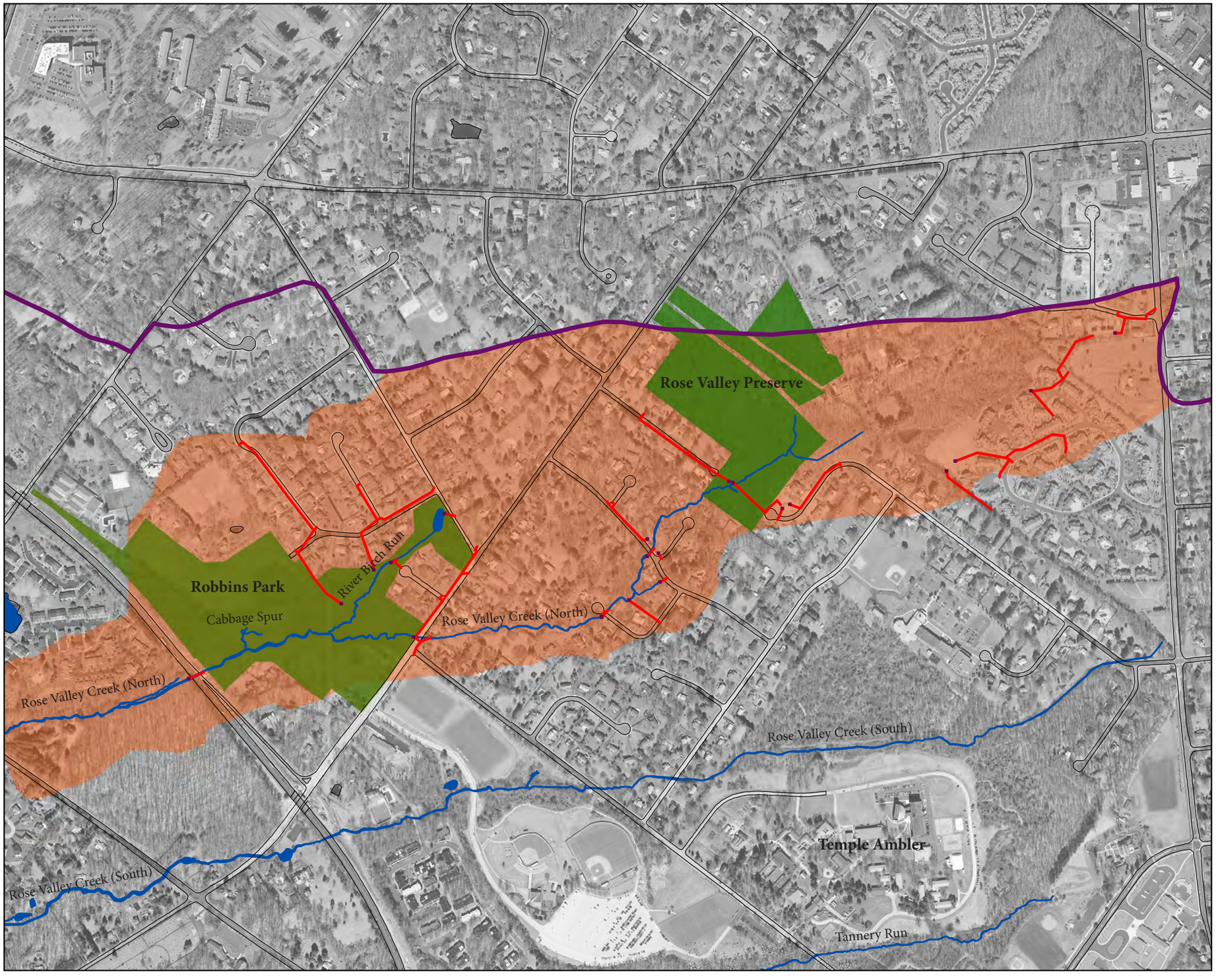
Forested Areas

The forested portion of the site can be subdivided into 4 distinct types or conditions. These distinct for-est regions have been designated as; beech/oak forest, wetland forest, degraded forest and young forest and are shown on the map in **Figure 9**. Distinction between some of these classified regions can also be observed based on the canopy height of the trees as shown in **Figure 11**.

The mature forest **(Figure 18**) consists mainly of American Beech, Red and White Oak and Tulip Popular with an under-story of Spicebush and American Hornbeam. The herbaceous layer is sparse, but does include trout lily, may apples and a variety of ferns. A complete plant list can be found in appendix A. Exotic invasive plants are present in this region, but are in no way taking over.

The wetland/floodplain forest regions (**Figure 19**) have a low density of trees, consisting mainly of red maple, sycamore and sweet gum. Spice bush, silky dogwood and false indigo-bush make up the shrub layer with

Stormwater



Legend

- Wissahickon Watershed
- Stormwater Outlets
- Stormwater Inlets
- Stormwater Pipe
- Roads
- Waterways
- Upper Dublin Land
- Robbins Park Watersheds

Figure 16: Within the park flows the northern branch of Rose Valley Creek. In addition to Rose Valley Creek there is a small stream flowing from the spring fed pond at the north east corner of the pond. This unnamed stream also get additional water inputs from three stormwater outfall pipes before it meets up with Rose Valley Creek. There is also a significant water input coming from the spring seep within the center of the park (Figure 6).
Most of the stream banks and stream bed within the park are heavily eroded and channelized, causing a lowering of the water table and unstable banks. The worst conditions are downstream of the stream merger as shown in the images in Figure 7. Most of this erosion is from many decades of stormwater runoff from surrounding impervious/low permeable surfaces as well as flow from stormwater piped directly into the stream. Historically these streams would have almost never seen these high of stormwater flows, so the banks and stream beds have given way and will continue to do so without human intervention. Data from pasda.org and Upper Dublin Township

0 600 1,200
Scale in Feet

N

ferns, skunk cabbage and a variety of sedges and rushes making up the herb layer. Invasive plants like lesser celandine and Japanese stilt grass are common in these regions.

The degraded forest is heavily infested with exotic invasive species. Some of the most prevalent are the Amur bush honeysuckle, border privet, Norway maple, garlic mustard, oriental bittersweet, Japanese vine honeysuckle, lesser celandine and the princess tree. The forest under-story and herbaceous layer is almost exclusively exotic invasive species and will require an extensive removal plan, which will require a long term management plan. The canopy mostly consists of younger black walnut, black locust, Norway maple, Ash and silver maple trees. Spicebush can be found throughout, but is heavily choked out by the amur honeysuckle and border privet. A complete plant list is shown in appendix A.

The young forest (**Figure 20**)is a small portion of a succession forest on the eastern border of the meadow. This piece of land has been used as an education tool to showcase how a forest develops over time. Despite the many educational benefits of this approach, the presence of many exotic invasive species has done a decent job of making their claim on this portion of land. Some natives have been able to stake their claim as well, so not all is lost with this educational area.

Figure 17: Meadow

Figure 18: Large mature oak tree

Figure 19: Forested wetland

Figure 20: Trail through the succession forest

Trails

The current trail system (**Figure 21**) has too many trails, making a walk around the park unnecessarily confusing with very little added benefit. The trails are mostly simple wood chipped trails as shown in **Figure 19**. Wood chips is adequate for most of the park, but there are some areas where the wood chips get washed away and may require some redesign to control water flow.

Wildlife

Some examples of the different wildlife that have been seen at the park is shown in **Figure 22**. These are just a few of the animals that were spotted by myself, a full animal survey would have to be conducted in order to get a full list of all of the animals that live in and visit the park. This shows that the park is already a popular place for a variety of animals and the restoration of the park would hope to build on this diversity.

Exotic Invasive Plants

Some parts of Robbins Park are over run with exotic invasive plants and will require a lot of work to remove. A list of some of the most common exotic invasive plants that have already been identified is shown in **Figure 23.** There is a good chance that there are few more exotic invasive species at the park that have not been yet identified on this list. A more extensive survey would have to be conducted to get a complete list. The major problem species for this park are *Ranunculus ficaria, Rosa multiflora, Lonicera maackii,* and *Ligustrum obtusifolium*. *R. ficaria* covers much of the degraded forest floor in a thick mat and will be the most difficult species to deal with. The other three species make up about 90% of the understory for the degraded forest area, but can be dealt with more easily using a few different techniques which will be discussed later. Gardens surrounding the education center building were not yet surveyed for a list of invasive species and may be a potential seed source for the rest of the park.

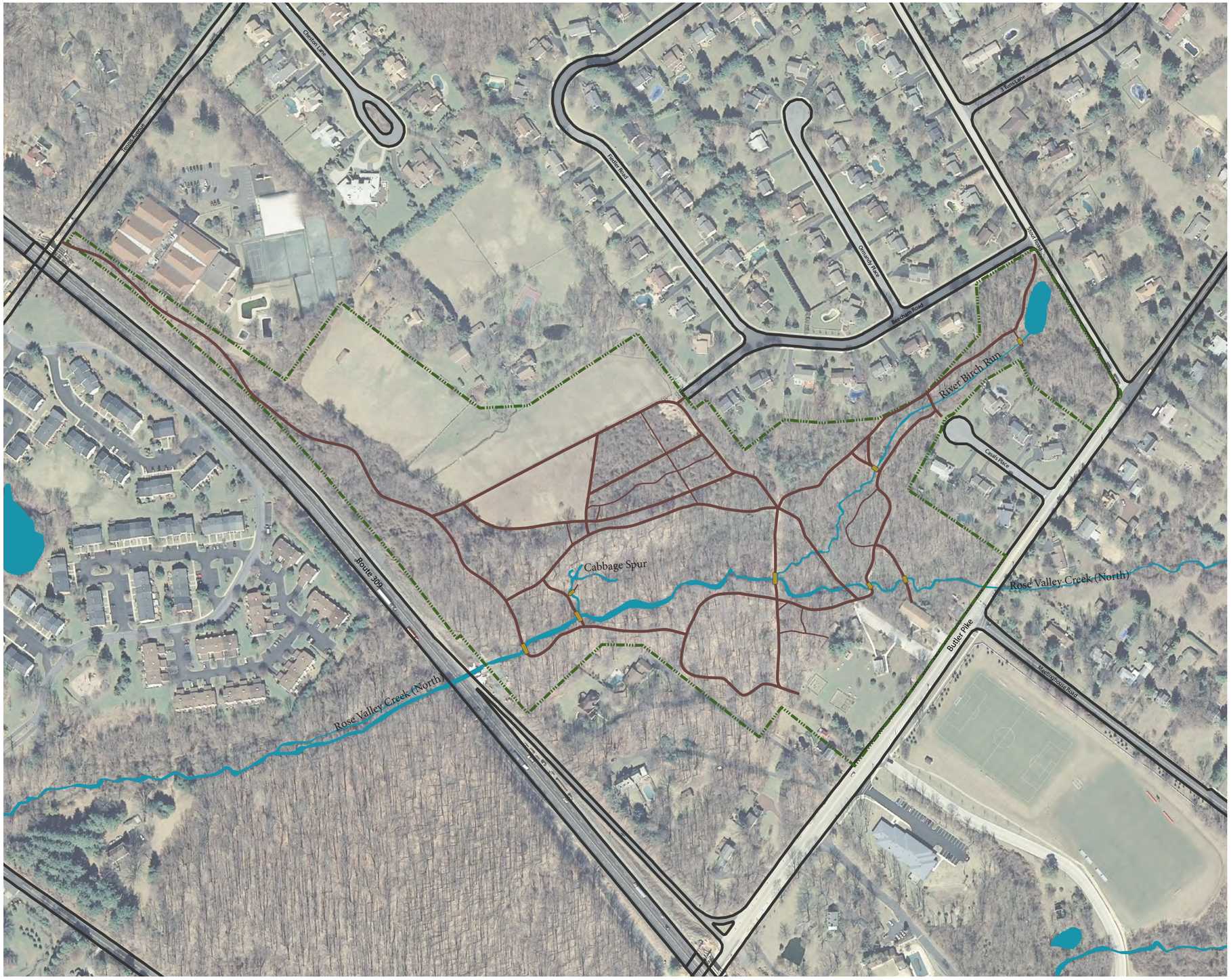
Site Constraints

Some of the important site constraints are highlighted on the map in **Figure 24**. The accompanying photo and information for each constraint is shown in **Figure 25**.

Site Opportunities

Based on some of the constraints shown in **Figures 24** and **25** and some other things at the park, a map similar map was created to showcase the important site opportunities. This map is shown in **Figure 25** and the accompanying photo and information for each constraint is shown in **Figure 26**.

Park Trails



Legend

- Trails
- Park Boundary
- Road Boundary
- Waterways
- Bridges

Figure 21: A map showing the current trails and stream crossings at Robbins Park. Some of the trails have no unique destination or added experience, so could be removed or redirected to improve the park experience, while limited damage to the ecosystems. Base map image from pasda.org.

0 300 600

Scale in Feet

N

Wildlife

EasternRed-backed Salamander (*Plethodon cinereus*)

Figure 22: List of some of the wildlife species that have been seen on different site visits along with some photographs.

Mammals	**Birds**	**Reptiles**	**Amphibians**	**Fish**
Gray Squirrel	Mallard Duck	Garter Snake	Red-backed Salamander	Dace
White Tail Deer	Red-tailed Hawk	Common Snapping turtle	Bull Frog	Chub
Raccoon	Green Heron	Common Water Snake	Green Frog	
Red Fox	Great Blue Heron	Red Ear Slider		
Bats	Red-bellied Woodpecker	Eastern Painted Turtle		
	Blue Jay			
	American Robin			
	Northern Cardinal			

Eastern Painted Turtle (*Chrysemys picta*)

Garter Snake (*Thamnophis sirtalis*)

Bull Frog (*Rana catesbeiana*)

Bat Box

Water Snake (*Nerodia sipedon*)

Red-eared Slider Turtle (*Trachemys scriptaelegans*)

Mallard Ducks (*Anas platyrhynchos*)

White-tailed Deer (*Odocoileus virginianus*)

Salamander in Aquatic Stage

Exotic Invasive Plants

Lesser celandine covering the edges of the Snake Alley trail within Robbins Park. Lesser celandine is a present in almost all parts of the park. Picture taken in late March 2012.

Dense mats of Lesser periwinkle are making there way into the park from neighbors backyards. Picture taken in late March 2012.

Common Name	Scientific Name
Hydrilla	Hydrilla verticillata
Bamboo	Unknown
Canada thistle	Cirsium arvense
Common reed	Phragmites australis
Crown vetch	Coronilla varia
Garlic-mustard	Alliaria petiolata
Goutweed	Aegopodium podagraria
Japanese stilt grass	Microstegium vimineum
Lesser celandine	Ranunculus ficaria
Orange day-lily	Hemerocallis fulva
Star-of-Bethlehem	Ornithogalum umbellatum
Tall fescue	Festuca elatior
Wild parsnip	Pastinaca sativa
Amur honeysuckle	Lonicera maackii
Border privet	Ligustrum obtusifolium
Japanese barberry	Berberis thunbergii
Japanese spiraea	Spiraea japonica
Jetbead	Rhodotypos scandens
Multiflora rose	Rosa multiflora
Wineberry	Rubus phoenicolasius
Winged euonymous	Euonymus alatus
Callery pear	Pyrus calleryana
European bird cherry	Prunus padus
Japanese angelica-tree	Aralia elata
Norway maple	Acer platanoides
Princess Tree	Paulownia tomentosa
Siberian elm	Ulmus pumila
Tree-of-heaven	Ailanthus altissima
White Mulberry	Morus alba
English ivy	Hedera helix
Japanese honeysuckle	Lonicera japonica
Lesser periwinkle	Vinca minor
Mile-a-minute weed	Polygonum perfoliatum
Oriental bittersweet	Celastrus orbiculatus

Entry to the Snake Alley trail showing the dense thicket of exotic invasive privet and bush honeysuckle. Picture taken in February 2013.

A Callery pear tree, in bloom, growing along the edge of the meadow that borders the succession woodland. Picture taken in late March 2012.

Figure 23: A list of invasive species that have been recently spotted at Robbins Park. Photographs highlight some of the problem species.

Site Constraints

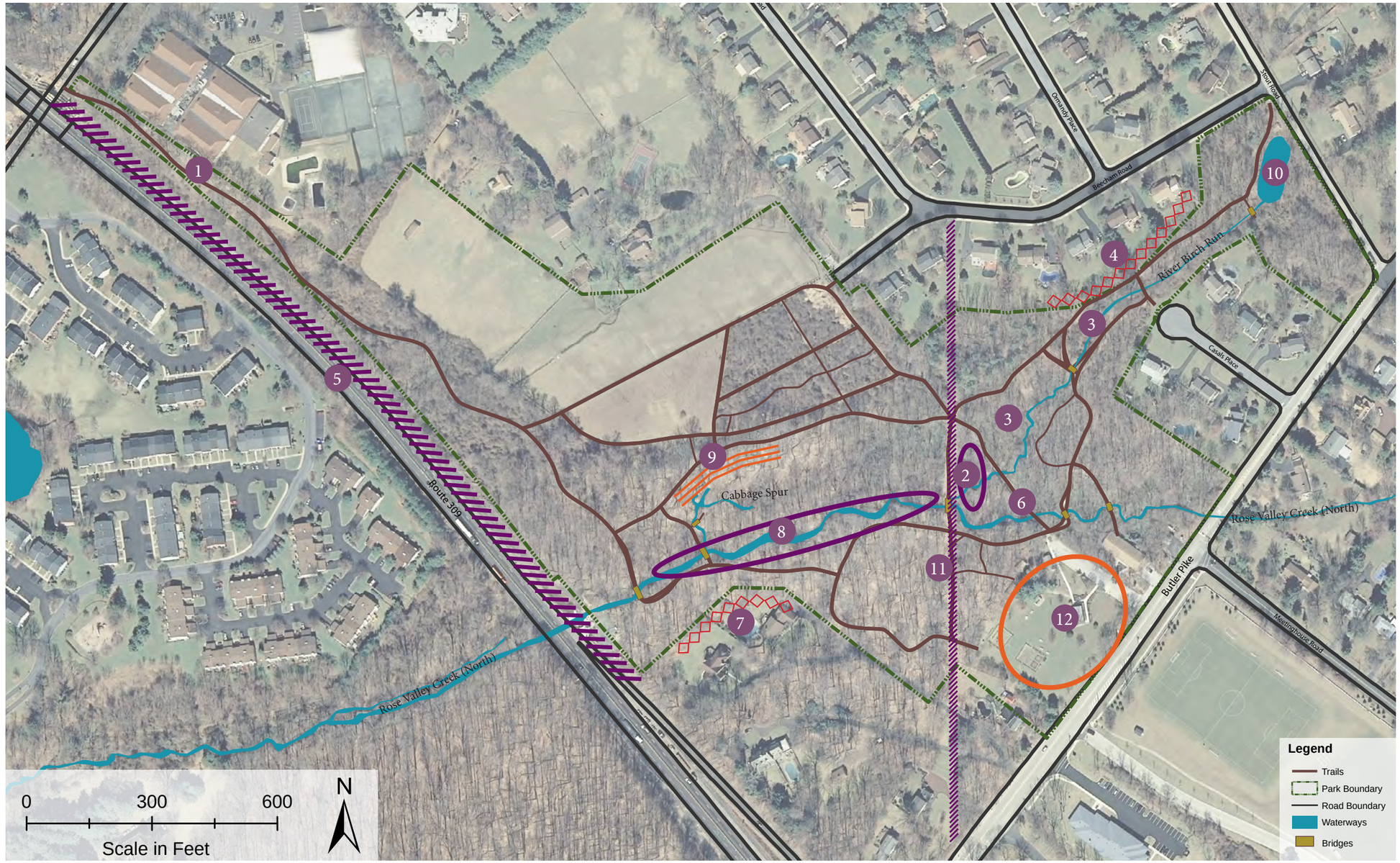


Figure 24: A map highlighting some of the important site constraints that exist at Robbins Park. Each numbered location is explained on Page 19 with an accompanying image. Base map image from pasda.org.

Site Constraints

1

Trash and Debris- Lots of trash and debris has piled up from dumping off of 309 and from the sports club.

2

Phragmites - A stand of Phragmites that needs to be controlled before it spreads throughout the park.

3

Stormwater Outfalls - Stormwater from the neighborhoods are piped directly into the creek.

4

Bordering Properties - Neighboring properties are very visible from trail. Also an entry point for invasive species.

5

Route 309 Visible and Audible - Try to block view and reduce noise pollution.

6

Culvert - This culvert concentrates the stormwater flow and increases erosion.

7

Bordering Properties - Visible from the park, but tend to blend better into the parks natural setting.

8

Streambank Erosion - Rose Valley Creek is heavily eroded in this portion of the park.

9

Steep Slope - Avoid putting any trails or structures on this slope. Might be good to highlight different plant community.

10

Invasive Aquatic Species - The source of many invasive plant and fish species for downstream areas.

11

Gas Pipeline - A gas pipeline runs through the center of the park. A cleared right-of-way needs to be maintained

12

Main Education Work Area - Educational components require a mowed clearing for different activities.

Figure 25: Images and descriptions of the different site constraints as shown on the map in **Figure 24**.

Site Opportunities

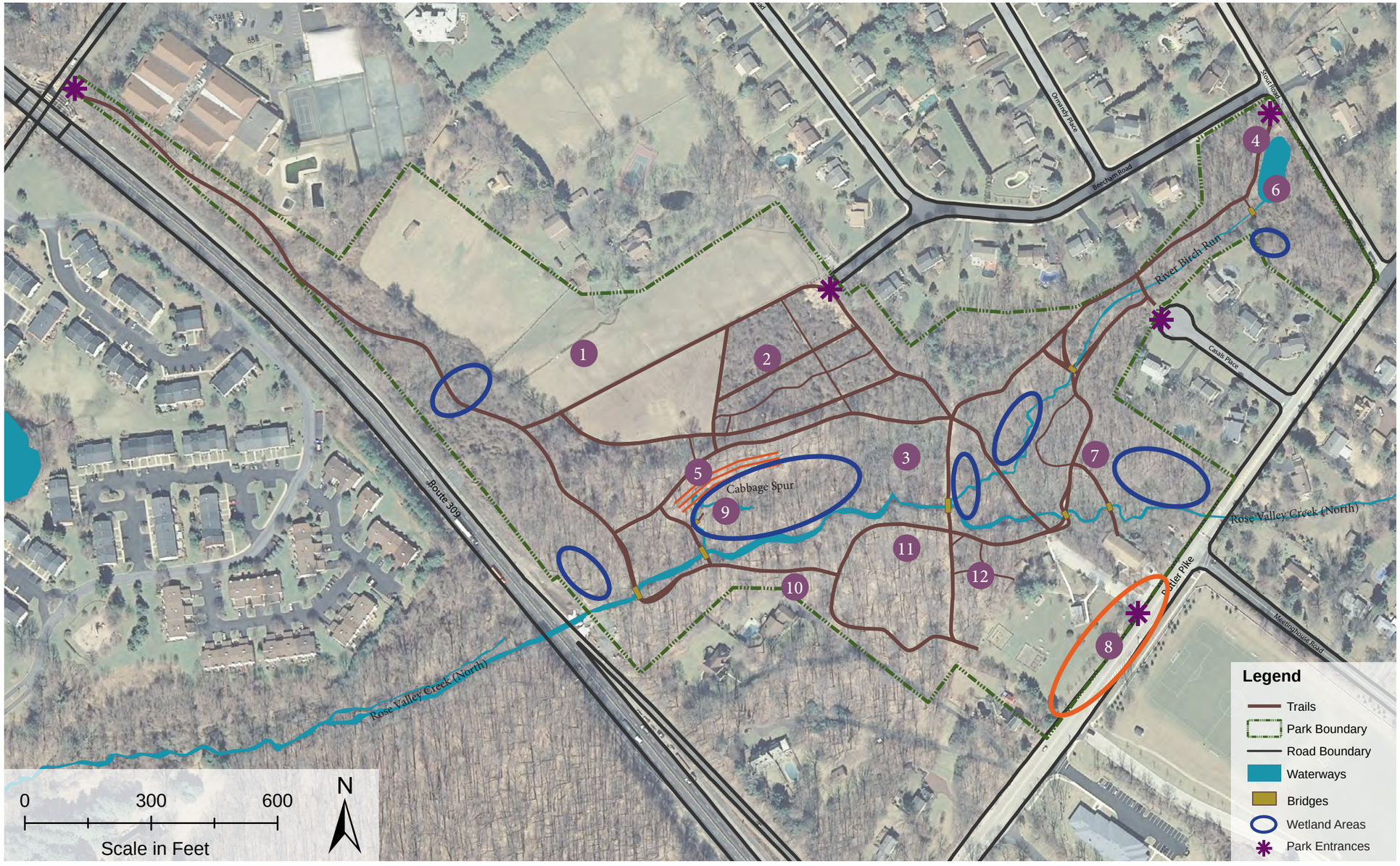


Figure 26: A map highlighting some of the important site opportunities that exist at Robbins Park. Each numbered location is explained on Page 19 with an accompanying image. Base map image from pasda.org.

Site Opportunities

1

Flat Open Space- This area is an open slate and can be used for many different things.

2

Succession Forest - A young stand of trees offers the ability to showcase how forests develop.

3

Interactive Elements - Different educational elements around the park offer a great way for people to interact with wildlife.

4

Spring House - The historic spring house is in decent shape. Could be restored and used as an education tool.

5

Floodplain Overlook - This hill provides a nice overlook of the floodplain and seep wetland area.

6

The Pond - The pond provides a great place to see wildlife like turtles, snakes, frogs and birds.

7

Camp Fire Area - The current camp fire area is functional, but has the potential to be enhanced.

8

Main Entrance - The current main entrance lacks curb appeal, but has lots of potential.

9

Seep Wetland - This natural seep area stays wet all year and already has a nice skunk cabbage community.

10

Fallen Beech Tree - An uprooted tree provides a good place to educate people on the life cycle of a forest.

11

Native Wildflowers - Within the mature forest there are a few native wildflower species that still can be found.

12

Forest Clearing - This clearing has lots of potential for many different uses. A woodland playground would be perfect here.

Figure 27: Images and descriptions of the different site opportunities as shown on the map in **Figure 26**.

Panoramic Views

Figure 28: Panorama image of the wetland seep area in the center of the park.

Figure 29: Panorama image of the current meadow at the park.

25 Design Precedents

In order to get some inspiration for the design of the Robbins Park ecological restoration plan, some precedents were examined. The area of focus for the Robbins Park restoration plan is to be education so two places that had a strong educational component were examined for inspiration. These two places were Black Rock Sanctuary and Morris Arboretum and were both visited to get the full experience that they offered. In order to get some inspiration about the restoration process for the park some streambank restoration and sill installations were examined that were installed by Munro Ecological Services as well as the Temple University Restoration Workshop class. Larry Weaner Landscape Associates' Manual for Seeded Native Wildflower Meadows as well as some of their meadow restoration projects were used for inspiration and methodology for the design and planting of the meadow within Robbins Park.

Black Rock Sanctuary

Black Rock Sanctuary is a 119 acre park located along the Schuylkill River in Phoenixville, PA. The park contains a 0.8 mile ADA-accessible interpretive trail which help to educate and connect people to the many natural habitats that are showcased within the park. Some of the interactive displays were used as inspiration for what could be implemented at Robbins Park. Some examples of these displays are shown in **Figures 30 & 31**. Black Rock also provided visitors with many viewing scopes that allowed them to view parts of the park at a safe distance, so as to not disturb the wildlife. These viewing scopes were also ADA-accessible and an example is shown in **Figure 32**.

Figure 30: Interactive flip-book showing the different seasons of a vernal pool.

Figure 31: Interactive water flow sign that lets visitors trace their finger over different paths to understand the importance of a meandering design for infiltration.

Figure 32: ADA-accessible viewing scope that allows visitors to view the meadow from a distance.

Figure 33: Birds nest tree house at Morris Arboretum.

Morris Arboretum

Morris Arboretum was visited in oder to get inspiration for a elevated bird nest style lookout that was recently installed there. An image of this is shown in **Figure 33**. While there ,a few other things sparked some inspiration, which included some interestingly designed signs and a stream crossing (**Figures 34 & 35**). The shape of these signs is both educational and stimulating to the eye. The stream crossing is a safe way to allow visitors to cross a stream while feeling more connected to the moving water below, without getting their feet wet.

Figure 34: One in a series of signs showing the growth of an acorn into an oak tree.

Figure 35: A rock stream crossing that allows visitors to feel more connected to the stream as they cross.

Figure 36: Image of a meadow created by Larry Weaner Landscape Associates for a private client in New Canaan, CT. Photo by LWLA.

Larry Weaner Landscape Associates

Larry Weaner Landscape Associates is located in Glenside, PA and has over thirty 30 years of experience in the creation of wildflower meadows. They have many nationally recognized projects the feature very lush and diverse native meadows. His manual on planting native meadows is a great guide on how to successfully create a low maintenance native meadow that will be able to fend off many exotic invaders. His design approach is to create a planting palate that will fill all niches of a meadow ecosystem year round. This means breaking down the meadow into different layers above and below ground as well as having seasonal growth that will fill laterally and vertically in a way that will not leave empty places for invading plants to take advantage of. Two examples of some of their meadows are shown in **Figures 36 & 37**.

Figure 37: Image of a meadow created by Larry Weaner Landscape Associates at Strasburg Community Park in Stasburg, PA. Photo by LWLA.

Munro Ecological Services

Stream restoration work done by John Munro of Munro Ecological Services is the major design inspiration for most of the stream restoration for Robbins Park. His years of practical stream restoration experience has refined the techniques down to very simple designs that both function structurally and ecologically. This is evident in both of the images provided in **Figures 38 & 39**. The wooden log sill functions to help raise the water table in an incised stream and also helps give the designer the ability to direct the flow of water away from eroded banks downstream of the sill log. This same function can be seen in rock and concrete structures, but they lack natural and ecological benefit of a log structure. The same is true for the streambank restoration seen in **Figure 39**. Other streambank stabilization techniques usually involves rock and concrete structures that greatly limit the ability for plants and animals to exist harmoniously with the structure. The streambank stabilization in **Figure 39** shows how plants can easily grow within the structure.

Robbins Creek has a lot of streambank in need of stabilization and the stream is very deeply incised in some areas, so the use of these types of structures would be very useful for this project. Having the structures blend naturally into the ecosystem is also very important, so these designs would be perfect for this task.

Figure 38: Creek sill design by John Munro of Munro Ecological Services installed at Pennsburg Nature Preserve.

Figure 39: Streambank restoration on Tannery Run, Ambler, PA.

In order to organize the different design ideas for the site, three concept plans were created. Creating many different concept plans helps to flesh out the many different ideas into a more structured plan so that they can be further analyzed and studied for what works best with the end goal of the design intent. The three main concepts ideas created for this project are titled; Restoration Wilderness, Wetland World and Restoration Education. Each concept has an overlying concept that directs the design of the entire site. Each of these different concepts are further explained below.

Restoration Wilderness

Restoration wilderness is all about experiencing the wilderness in its native state with minimal disturbance into that space. The number of trails and access to specific areas is reduced to minimize human interference within the protected wildlife areas. The park visitors will be provided with specific viewing areas that will give them the best perspective of the different ecosystems within the park, but will keep them at a distance in order to minimize contact with the native plant and animal life. Deer fence would be place around the entire site in order to keep deer out while the restored areas have a chance to completely grow back to a healthy restored state.

The current pond would be restored to a natural wetland seep by removing the concrete dam structure of the pond and the spring house . This would allow the spring seep to drain naturally across the land and will not be unnaturally backed up. No access will be allowed into the floodplain and wet shrub-land areas of the park in order keep them as fully protected ecosystems. Trail access through the meadow will be minimized in order to create a large area with no human access so that birds and other wildlife can be undisturbed by visitors tot he park. Viewing areas will allow visitors to view these ecosystems from distance with viewing scopes or personal binoculars. Some other features of this concept include the creation of a native nursery that will be used to grow native plants to be placed within the park. A native demonstration garden will be built near the main entrance to showcase some of the important ecosystems found within the park. A concept plan for Restoration Wilderness is shown in **Figure 40**.

Wetland World

Wetland World will focus on the different wetland habitats currently within the park and will also create some other new wetland habitats in order to showcase the many different types of wetlands within the region. The current wetland habitats will be greatly enhanced by adding new plantings and fixing any human caused modifications that are degrading their natural function. Other areas of the park will be used to create some wetland systems that current do not naturally exist within the park. One such creation would be a series of stormwater wetlands that would help to infiltrate and filter the stormwater naturally. This will help reduce the stormwater load to the creek, while also creating new wetlands for visitors to experience. The existing trails will be modified to allow the best experience of each wetland ecosystem. The three bay wetland ecosystem system will sequence from a salt tolerant ecosystem to a totally fresh water system. Road salt runoff will be allowed to be collected in the salt ecosystem, which will slowly filter into the in-between system and then finally the totally fresh system. This will allow for the creation of three very unique wetland environments.

Some other key features will be a meadow wetland, an acidic bog and a forested wetland ecosystem. The front entrance area of the park will also follow the water theme, by having a water and rock display garden, a rain garden and a wetland themed playground area. A concept plan for Water World is shown in **Figure 41**.

Restoration Education

Restoration Education will focus on providing informative and interactive education stations and study areas throughout the park. Different locations of the park will be utilized based on their unique natural features as well as for their potential for restoration demonstration. The end goal is to educate, not total ecological restoration. Some main focus areas would be stream restoration, forest growth succession, a plant ID trail and an in-stream creek crossing. The identification and education on exotic invasive plants will be a big component in order to expand the knowledge of the importance of ecological restoration. This plan will also feature a natural woodland playground that will help connect children to nature while also entertaining them. The front entrance will be changed in order to better suit school bus traffic since the education component will be the main attraction to the park. A concept plan for this design idea is shown in **Figure 42**.

Restoration Wilderness

Design Concept - Restoration wilderness is all about experiencing the wilderness in its native state with minimal disturbance. The number of trails is reduced to minimize access to protected areas. The park visitor will be provided with specific viewing areas that will give them the best perspective of the different ecosystems within the park

Restored Seep - The pond headwall and spring house are removed and site reshaped and planted to a natural seep ecosystem.

Seep Viewing Platform

Meadow Viewing Deck - A raised deck that will allow visitors to observe birds and other wildlife within the meadow.

Restored Native Warm Season Meadow

Plant Salvage - Existing succession forest removed and healthy native stock salvaged for others places on site.

Floodplain Overlook - This hill provides a nice overlook of the floodplain and seep wetland area.

Protected Shrub Wetland - No access will be allowed to this wildlife enhancement area.

Seep Wetland - Boardwalk and viewing platform to bring people into the natural seep wetland ecosystem.

Main Entrance - Main building and entrance maintained. Classroom area used as a nature center.

Stream Crossings - Allows the park goer to experience the stream without disrupting its ecosystem.

Demonstration Garden - This garden will be used to showcase some different ecosystems within the park and provide some curb appeal.

Floodplain Forrest - No access to the protected floodplain forest ecosystem.

Mature Beech-Oak Forest Walk - The visitor will wind through the mature forest and experience the life cycle of a healthy forest.

Elevated Creek View - This raised path provides a nice view down into a plunge pool full of creek fish.

Greenhouse - A greenhouse structure will be used to grow native stock for the site.

Native Plant Nursery

N

0 300

Scale in feet

Figure 40: Concept plan for restoration wilderness.

Wetland World

Design Concept - Wetland World will greatly enhance the wetland ecosystems within the park and allow the visitors to fully experience each one. A variety of different of native wetland ecosystems will be created and restored within the park. The existing trails will be modified to allow the best experience of each wetland ecosystem.

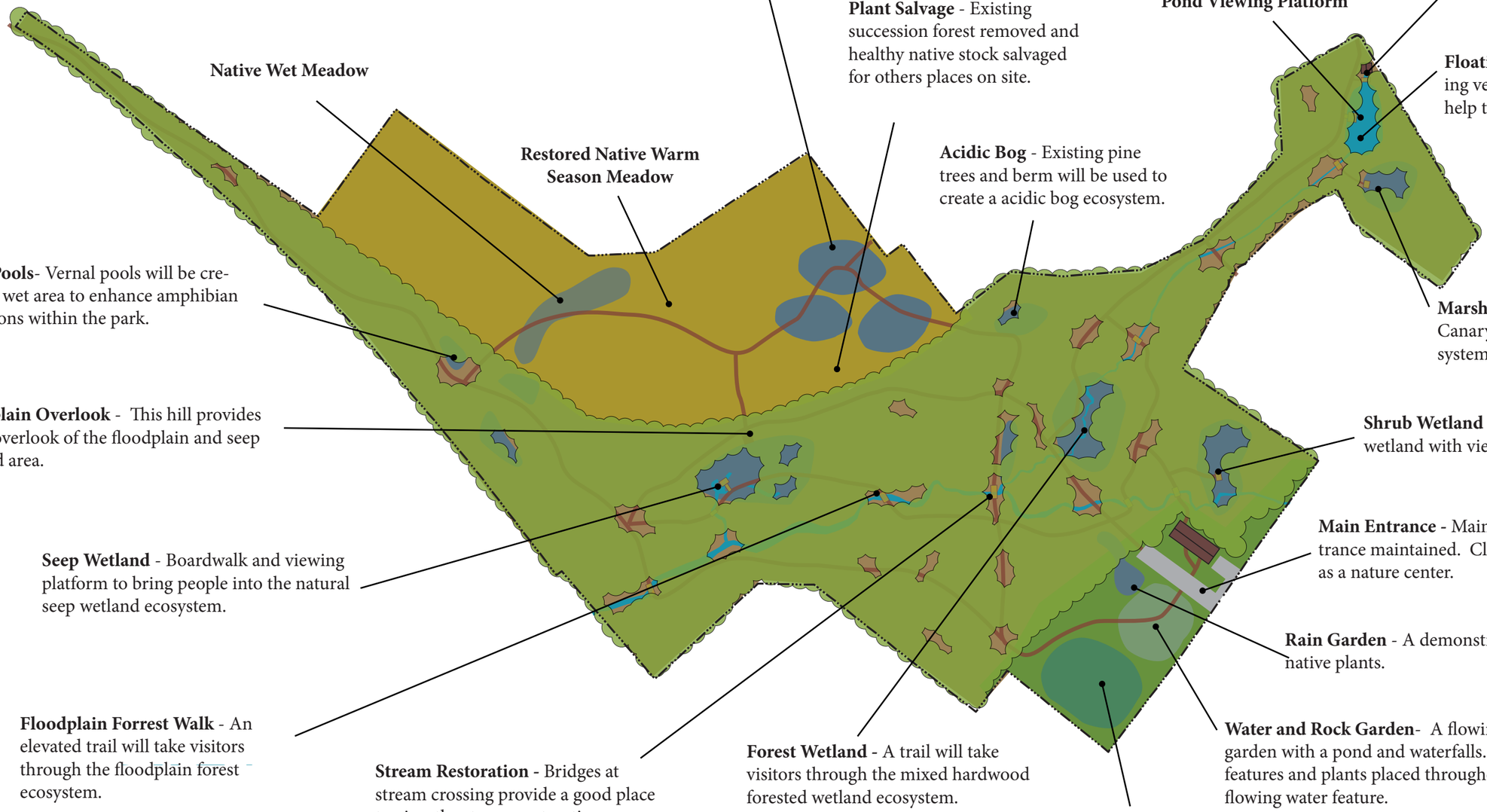


Figure 41: Concept plan for Water World.

Restoration Education

Design Concept - Restoration Education will focus on providing informative and interactive education stations and study areas throughout the park. Different locations of the park will be utilized based on their unique natural features as well as for their potential for restoration demonstration. The end goal is to educate, not total ecological restoration.

Invasive Species Containment

New Forest - A portion of the current pasture will be planted with native tree saplings in order to show the beginning of the succession from meadow to forest.

Restored Spring House - The spring house will be restored and used to educated visitors on the cycle of water and how it effects humans and wildlife. Children can reenact how people use to get water before plumbing.

Pond - A great education tool to teach about reptiles and fish. Interactive tadpole-frog display. Floating turtle log.

Pond Viewing Platform

Restored Native Warm Season Meadow

Succession Tower - This tower will allow visitors to view the tree canopies of the forests in different stages.

Succession Forest - The current succession forest will be restored in order to remove invasive species. No new plantings will be done.

Acidic Bog - Interactive bog allows children to help in the making of the "bog tea" by adding pine needles and park to the leech pit.

Vernal Pools- Vernal pools will be used to teach people about amphibians. An interactive display will be used to showcase some of the parks native amphibians.

Fire Circle - A stone fire pit will be constructed with semi-circle seating for camp fires and outdoor classroom lessons. Can also be used to teach about how people use to cook over fire.

Floodplain Overlook - This hill provides a nice overlook of the floodplain and seep wetland area. A see-through display can show what the floodplain would like during a big storm.

Main Parking- The parking lot is made smaller to better suit the parks user base.

Seep Walk - A boardwalk will take visitors through the seep wetland and then up the steep bank to the meadow. A great place to educate people on how geology effects the landscape.

Habitat Garden - A native garden highlighting some of the local ecosystems in the park.

Deer Fence

Bus Drop-off- A new parking lot design allows for buses to easily drop off students.

Stream Crossing - An in-stream crossing will allow people to get into the water and fully experience the stream and stream restoration.

Plant ID Trail- An ADA trail that will have number tags on specific plants that will go along with a paper booklet or a digital application that allows people to try to ID plants.

Woodland Playground - A natural feature playground under the tree canopy that will allow children to play within a natural system. Bird's nest tree house, climbable mushrooms, rocks and logs.

Plant Nursery - The current mowed lawn will be replaced with a native plant nursery.

N

0 300

Scale in feet

Figure 42: Concept plan for Restoration Education.

Design ideas from the three previous concept plans were picked over and combined into a single plan. This plan is illustrated in **Figure 48** and has some descriptive text on **Figure 49** that lists some of the specific areas and design concepts. A larger version of this illustrative plan is also included as an external fold out document and is included in the folder at the end of this booklet.

The overall concept of this plan is to focus on the educational benefits that a park undergoing ecological can contribute. Each restoration effort will be tied directly to an educational component, whether it be by the simple addition of an educational sign, an interactive display, a full scale lesson plan or by direct involvement in the restoration process. The main focus areas of the park will be the creation of a much larger native wildflower meadow, a forest succession area, the pond with a reed bed system, a series of stormwater flow control wetlands stream restoration and a redesign of the front entrance area. Some other areas of focus are the creation of a woodland playground, a mushroom themed sitting and exploring area, an acidic bog and some vernal pools. A more complete list of the design ideas are listed in **Figure 49** and shown on the Illustrative map in **Figure 48**.

Master Plan Details

Trail System

The trail system for this design was modified in order to remove trails that were not necessary and to add some trails that would bring visitors to the newly created features within the park. The new trail layout is shown in **Figure 45**. All of the woodland trails will be simple wood chip trails except for the main loop trail, which will be a paved trail (shown as purple in **Figure 45**). The meadow trail will be a simple mowed path. Trails that go over wetlands areas will be boardwalk (**Figure 64**) and areas of the trail subjected to cross flooding will have drain headwalls installed (**Figure 61 & 62**) to prevent trail erosion. The redesigned trail system will maintain all five of the current park entrance points in order to provide adequate access to the park from the surrounding areas.

Educational Areas

Some of the main added educational areas within the park will be a vernal pool interactive display, a stream oxbow viewing area, a forest life cycle zone, a mushroom themed sitting and identification area, as well as a stream crossing that will contain creek life impressions in the stone. The vernal pool will area (# 6) will contain a viewing platform that will give visitors a good view of functioning vernal pools. The platform will contain signs depicting the vernal pools at different times of the year and will provide educational information about this process and its importance for the life cycle of different native amphibian species. Also included in this display will be brass sculptures of the varies life cycle stages of the amphibians that would inhabit the vernal pool area. These statues can be touched and examined by visitors in order to gain appreciation for the different metamorphic stages.

The stream oxbow viewing area (#7) will provide an educational sign, as well as a view of the natural oxbow that formed in Rose Valley Creek (**Figure 43**). This sign will talk about the natural evolution of streams and rivers and how human development has altered these natural systems. Nearby the stream oxbow (# 12) will be a stream crossing that will allow visitors to walk over stones just inches from the moving water below. The stones will have many different creek plant and animal life forms imprinted on them. This will allow the visitors to connect both with the water of the creek and its many life forms without getting wet or disrupting the natural ecosystem. An example of these stone imprints from Morris Arboretum is shown in **Figure 44**.

Another natural feature of the park that will be showcased is the many trees that have fallen over the years. Within a small area of the park (#8) there is a large tree that fell during Hurricane Sandy (**Figure 45**), as well as a few other fallen trees that are in various stages of the natural decay process. A view signs in this area will lead visitors to a few different locations to showcase the different stages of a trees life; from a young seedling, all the way to remnant dirt mound.

Relating to the life cycle of a tree is the life cycle or succession of a forest system. This natural process will be a major component of the park and will be discussed in more detail in the restoration section of this booklet. In order to best showcase this forest succession process to the visitors, they will be provided with an elevated viewing area (#10) that will give them a full panoramic view of the different stages of forest succession. The

Figure 43: Natural oxbow in Rose Valley Creek.

viewing deck will be designed to mimic the structure of a birds nest, hence giving the viewer a birds eye view of the succession process. Panoramic viewing scopes will be provided and will contain a flip up viewing switch that will allow the user to cycle through different images of the portion of forest that are looking at different stages of its real-time growth and seasonal changes. These images will be taken periodically over the course of many years and will be continually added to the viewing scopes as image overlays. This will allow the user to flip between a real world view and a historic image view to compare the changes. An illustrative image of this viewing platform is shown later in the illustrative perspectives section of this booklet.

Another educational feature of this design will be an educational seating area that will have a fungi theme. It will be called Mushroom Cove and is shown as #11 on **Figure**. Mushroom cove will be a small area off of the trail that will have mushroom shaped stools carved out of wood and painted. The stools will be various shapes and sizes for sitting and climbing by people of all shapes and sizes (**Figure 46**). Bordering the sitting area will be many different rotting logs and seeded mushroom habitats that will contain a variety of mushroom species (**Figure 47**). Many of these logs will be collected from on-site and moved to this location. Other mushroom specimens will be collected from nearby locations to help inoculate this area with the spores of new mushroom species. Educational signs will be provided to help teach people about fungi.

Gardens

This design also includes 5 different display and user based garden areas. The front entrance will have a native display garden (#21 on the **Figure 43**) which will contain many elements of the natural park ecosystem. Some of these elements include native plant ecosystems/plant groupings, decaying logs and a recirculating stream and pond system complete with demonstration size sills. The front area will also contain a research and display meadow garden (#23), which will be used to both research and showcase different meadow planting designs. The vegetable garden plot (#22) will contain both a traditional vegetable garden section as well as a native edibles section. This garden will be maintained and used as an education tool by the different school children groups that come to park. Before entering the main gate of the of the park, visitors will pass by a three bay rain garden system (#24) that will collect rain water from the front field and parking lot areas. This rain garden system will be planted with a variety of native plants and will help to slowly infiltrate stormwater back into the ground water. Within the park will be a native wetland plant ID garden (#25), which will contain a variety of native wetland plants along with their appropriate ID tag.

Figure 44: Plant and animal impression in stone at Morris Arboretum.

Additional Features

Some additional design features suggested by this plan is a new educational building and greenhouse, a new parking lot with a bus drop-off and a woodland playground. The new educational building will provide more classroom space that can better enhance the educational activities that can be provided at the park. A nice addition to the new education building would be a lab space with microscopes, stream tables and other education equipment that could greatly enhance the science education at the park. This new building could also contain a native green roof and a greenhouse (#14 & 15). The greenhouse could be used for eduction and for growing and propagating plants for the park. The new parking lot design (#20) will make bus access much easier and safer for when large school groups are being dropped off at the park. The woodland playground (#35) will utilize natural materials, many of which could be salvaged from the park, to create a fun place for children and climb and play within nature. An illustrative concept of this woodland playground idea is shown later in the illustrative perspectives section of this booklet..

Figure 45: Uprooted American beech tree that fell during Hurricane Sandy in 2012.

Figure 46 - An illustrative concept of what the Mushroom Cove seating may look like.

Figure 47 - Some examples of different mushroom species found around the park.

Illustrative Plan

Invasive Species Containment Cell - These type of cells will be used to showcase specific invasive species for educational purposes, while containing them to a specific area that can be easily managed.

Stone Imprint Creek Crossing - Imprints of different creek life forms will be etched into a stone slabs and these stones will be strategically placed within the stream to allow for easy crossing, while not significantly disrupting the streams flow. These imprints will educated people about the different life forms that live in the creek in a way that will directly connect them to the water.

Figure 48: Illustrative plan for Robbins Park

Illustrative Plan Components

Entrances

1. Butler Pike Entrance
2. Casals Place Entrance
3. Stout Road Entrance
4. Beechman Road Entrance
5. Tennis Avenue Entrance

Educational Areas

6. Vernal Pools
7. Stream Oxbow
8. Forest Life Cycle
9. Interactive Animal Tracks
10. Forest Succession Viewing Nest
11. Mushroom Cove
12. Creek Life Stone Impression Crossing

Structures

13. Park Offices and Pavilion
14. New Education Building with Green Roof
15. Native Plant Greenhouse
16. Maintenance Shed
17. Restored Spring House
18. Deer Fence
19. Stormwater Flow Control
20. Parking Lot with Bus Drop-off

Gardens

21. Display Garden with Recirculating Pond
22. Vegetable Garden
23. Research Meadow Garden
24. Rain Garden
25. Wetland Display and ID Garden

Vegetation Areas

26. Skunk Cabbage Seep Wetland
27. Beech - Maple Forest
28. Native Meadow
29. Alder-Dogwood Shrub Wetland
30. Mixed Hardwood Forested Stormwater Wetlands
31. Pine-Leatherleaf -Cranberry Bog
32. Early Stage Forest Succession
33. Middle Stage Forest Succession

Additional Features

34. Green Space
35. Woodland Playground
36. Recirculating Reed Bed
37. Semi-restored “Creepy” Pond

Figure 49: The different components highlighted on the illustrative plan for Robbins Park

36 Restoration Design

This restoration project will not only maintain the environmental education aspect of the park, but will greatly enhance the educational value of the park by incorporating the restoration process into educational programs and interactive displays. Robbins Park will be a restoration learning center and playground for kids and adults of all ages and educational backgrounds. Incorporating the educational aspect into the restoration process will also help to educate and stimulate the interest in the park and in ecological restoration in general. This will help to foster a feeling of ownership of the park and a help to stimulate a desire to volunteer time to help in the restoration process. Another important component of the restoration education will be to educate the residents that live in the area surrounding the park. A partnership will have to be made with these residents to try and help them understand that what they do in their yards can directly effect the park in both positive and negative ways. Educational material will be made available at the park , as well as online, which will highlight things like; which plants are good and bad for the local environment, how to reduce stormwater runoff by using rain barrels, non-impervious material and creating rain gardens, the negative effects of dumping yard waste in the forest and much more.

Restoration Goals

The restoration process of the park will happen in many stages and over many years The main objectives of the ecological restoration are laid out in the following list of goals:

- Restore as much of the park as possible while still maintaining park access and an full education experience.
- Provide interactive displays and playgrounds to help stimulate peoples interest in nature and the benefits of ecological restoration.
- Attract new native bird and insect species by increasing plant diversity and improving habitats.
- Re-connect Rose Valley Creek to the existing floodplain.
- Reduce stormwater flows coming into the park and spread the flows out within the park to better infiltrate.
- Restore the stream banks that have been heavily damaged from decades of erosion.
- Balance allowing human access to the park while maintaining a healthy and wild ecosystem.
- Clean and filter out excess nutrients and other pollutants from the pond and stream systems.
- Create a native plant nursery on site to help to propagate native species to plant on-site and elsewhere in the county.
- Create a fully restored native wildflower and grass meadow that can be easily be maintained and resist invasion from exotic plants.
- Successfully showcase how a natural forest system would go through succession without the presence of exotic plant species and an over abundance of deer.
- Create a park that can used to gather important data on the restoration process.

Waterways

The waterway system for this design is also shown in **Figure 51**. The isolated water features are the pine-leatherleaf -cranberry bog (#29 on **Figure 48**), the wetland plant ID garden (#25) and the vernal pool system (#6). **Figure 52** contains hydrological sections of the entire creek system and includes the sill modifications and how they will change the water level dynamics. All of the other features are in some way connected into the creek system. Starting at the pond a recirculating reed bed system will be installed in order to help filter the nutrients out of the water. After existing the pond the water flows down River Birch Run and is spread out into a series of wetland systems that will be created by installing sill logs and allowing the water to backup on the existing flat topography. This will help to better spread out stormwater and allow it to infiltrate, reducing the burden on the heavily incised down stream areas when River Birch Run meets up Rose Valley Creek. A stormwater flow control structure (**Figures 56 & 57**) will also be installed (#19) after the three wetland systems in order to give more control of the water flow and allow for a larger flooding area during large storms.

Rose Valley Creek begins its journey in the park after exiting a culvert that passes the creek under Butler Pike. This creek gets a lot of stormwater runoff before entering the park, so another wetland flooding area will be created by adding a sill and allowing the water to fill up over the large flat area behind the sill. Once Rose Valley Creek and River Birch Run merge the flow volume is dramatically increased to the lower portion of Rose Valley

Creek. This increase in water volume has caused the most damage in this portion of the creek (**Figure 50**), so most of the sill installations and streambank restoration work will be done in this portion of the creek. The main concept here is to use the smaller upper creek systems to spread out the stormwater flow and infiltrate as much water as possible in order to reduce to load on the lower portion of Rose Valley Creek. Over time the lower portion of the creek can be returned to its natural flood plain once again and also provide the same benefit of spreading out the water volume over a large area for better infiltration.

Figure 50: Image showing the deep incision into the creek bed and the heavy streambank damage caused by years of uncontrolled stormwater flows.

Sills and Streambank Restoration

Figures 51 & 52 show the placement of the 13 sills that will be installed in the creek system of the park. Schematic diagrams of these sill and stormwater structures can be found in the Restoration Schematics section of this booklet. Streambank work will be mainly focused on the entire section of the lower portion of Rose Valley Creek after the merger point with River Birch Run. The upper two creeks do not have extensive streambank damage, but some streambank repair might be needed and be judged following the creation of the flooded wetland systems. A schematic of the streambank stabilization design can also be found in the Restoration Schematics section of this booklet.

Grading

A grading plan is not provided within this document because there will not be any dramatic changes to the existing topography. Any modifications will be done on the micro-scale in very specific locations, so relying on a grading plan built from a contour map may not be the best option. Grading of these locations will be done on the fly while on-site in order to best grasp the minor changes within the landscape. A contour map will be used to gain an overall understand of the structure and slopes of the surrounding landforms in order to understand water flow dynamics.

Recirculating Reed Bed

A recirculating reed bed system will be installed at the pond (#36 & 37). This reed bed system will contain two bays and will be vegetated with *Scirpus polyphyllus, Scirpus atrovirens, Carex gynandra, Carex lupulina and Iris versicolor*. The vegetation will be cut twice a year and the plant material with be composted away from the pond and stream in order to remove the nutrients from the system. The reed bed will mimic a more natural design, but will be totally manufactured, having a plastic liner, a sand planting substrate, and water will be pumped from the pond using solar power. Schematics of the reed bed design are shown in the Restoration Schematics section of this booklet. The main concept is to use solar panels that are wired into a DC electric submersible pump and water up to the top of the reed bed and allow the water to slowly filter through the sand and plant material. The water will be piped using a 4" hose and the water will be dispersed over a layered rock water fall system at the top of the reed bed in order to spread the flow out into the bed without causing any erosion channels. Since the power source is solar powered the system will only run during the day, which is not a huge loss since much of the plant production happens during the day. The sand media also provides a place for microbial colonies to grow, which will also aid in the breakdown of nutrients and some other pollutants. The sand media will have to replaced when the systems begins to become so filled with sediments that it no longer functions correctly. This sand material will have to disposed of off site. There is no reason to suspect that there is are any toxic materials in the creek or pond system, so no hazardous waste disposal will be needed.

Native Wildflower Meadow

The native wildflower meadow will be created using the methods explained in Larry Weaner Landscape Associates' Manual for Seeded Native Wildflower Meadows. In order to accomplish this the existing meadow and pasture land will be treated with a blanket glyphosate herbicide treatment in early summer of the first year. Two weeks later the meadow will be mowed at 4-6" to remove dead material. Let surviving material grow during the summer and respray towards the end of the summer and repeat mowing two after. Seed with winter wheat (Triticum) and mow as needed to keep it from seeding. In the following spring, spot spray any exotic invasive plants, mow the cover crop. Beginning seeding in April using a no-till drill seeder. Follow the seeding mixes and planting diagram depicted in the Planting Plan section of this document.

The first two years will be the most important in order to get the native plants well established and will require monthly mowing to 6" and spot spraying in order to keep the invasive plants from seeding and in order to get adequate sun to the young developing native species. Once the meadow is established mowing will only be required once or twice a year depending on aesthetic desire.

Site Design Schematic

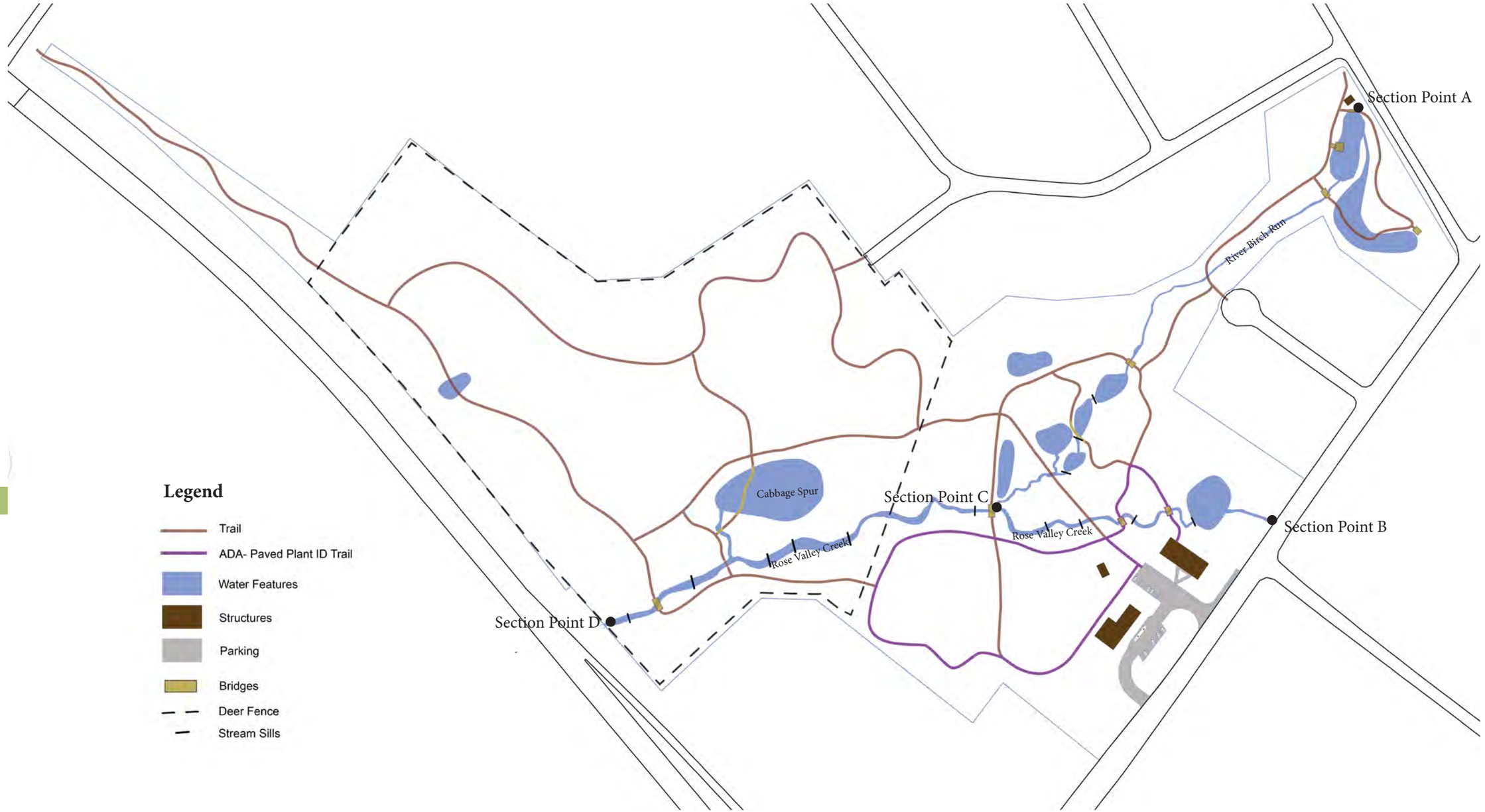


Figure 51: Schematic of proposed trails and waterways for the new design.

Stream Hydrological Sections

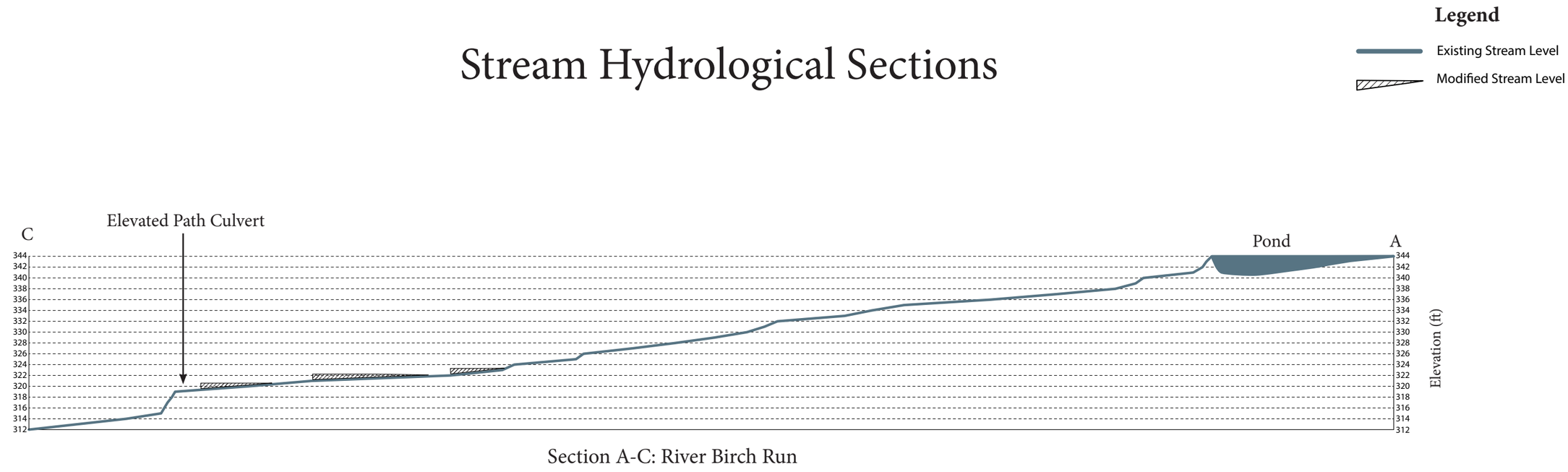


Figure 52: Hydrological sections of River Birch Run and both the upper and lower section of Rose Valley Creek.

Invasive Species Removal From Forest

In order to restore the forest system of the park, a lot of exotic invasive species removal needs to be done. A "cut and paint" strategy will be the primary method for invasive plant removal so that minimal herbicide will be used on the site. Manual removal will be the second common removal strategy for plants that make sense for this method. Spraying herbicide will only be used in very specific situations and the only herbicide compound that will be allowed will be glyphosate based herbicides. The specifics of the invasive removal techniques are outlined in the Appendix section of this document. Some remnants of various exotic invasive species will be retained in a contained manner in order to utilize them for educational purposes.

Invasive Flora Removal Techniques

Herbicide

Only individuals trained to both identify native and invasive plants species and properly use the herbicide and herbicide equipment will be allowed to apply herbicide. The only type of herbicide that will be used will be systemic herbicide. The use of a systemic herbicide will ensure that the roots of the invasive plant will also be killed and not just the leaves. The systemic herbicide for this site must be a glyphosate based solution, which may come with surfactants or not. The brand is not important, but the most common brand version of glyphosate with surfactants is Roundup by Monsanto Corp and Rodeo by Dow for the non-surfactant based herbicides. A surfactant based herbicide can never be used within 10 feet of a wetland or on a plant within 10 feet of a stream. Only a non-surfactant based glyphosate can be used in these cases and only by a person with a permit to do so.

Glyphosate based herbicides are the most commonly used systemic herbicides and will be the chemical of choice for this removal and management plan (Franz, 1997). Other types of herbicides will not be allowed unless they go through an approval process. Herbicides should be used as sparingly as possible to minimize adverse effects on native species. Plants can also become resistant to glyphosate over time, so repeated use over a long period of time could produce resistant invasive plants (Shaner, 2000). Herbicide can be applied in two ways for this site: cut and paint or by using a backpack sprayer. These techniques are discussed further below.

Cut and Paint

The cut and paint method will be used on large woody material. This method will consist of cutting the plant material as close to the ground as possible and immediately (ideally within 2 minutes, unless safety is a concern) apply a 20% Glyphosate herbicide with a paint brush around the entire cambium layer of the stem material (**Figure 53**). Cutting the plant at a steep angle (Figure 5) will increase the cambium surface area, which will allow for more of the glyphosate to be absorbed. Adding a color dye to the 20% glyphosate solution will help to see where it has been applied. This will avoid missing an application and duplicate applications.

Spraying

A solution of glyphosate may be applied to herbaceous plant material by using an approved backpack sprayer **(Figure 54)**. The concentration of the glyphosate may vary between 0.5 % and 5% depending on the

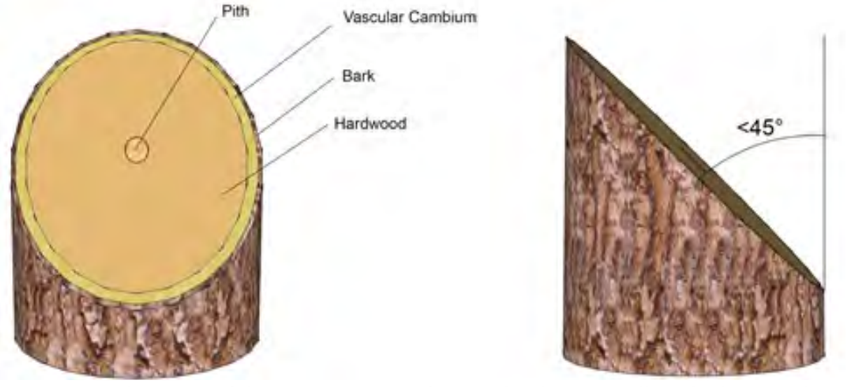


Figure 53: Schematic of the cross section of a woody plant as well as the best angle to cut a woody plant for herbicide application.

species that it is being applied to. Cations in hard water can reduce the effectiveness of glyphosate by binding to it (Nalewaja, 1994), so if hard water is an issue ammonium sulfate can be added to stop the hard water cations from biding to the glyphosate compound. A diluted solution of glyphosate should be mixed the day of the application and all of the product should be used that day and not stored in the backpack. Microbial activity in the water can breakdown the glyphosate (Carlisle et all, 1988) and reduce its effectiveness and general safety practices of cleaning the back pack each day will help reduce contamination of unwanted areas and help maintain the equipment.

Mowing

Mowing can used to remove portions of invasive plants before they seed, thus stopping their ability to spread. This works especially well when a plant is an annual or biannual. Mowing should be down when the material is dry and should never be mowed less than 6 inches high, so that the native species are not destroyed. Mowing can be used in combination with burning and spraying to help promote the growth of natives and reduce the ability of the invasive to reproduce.

Pulling/Physical Removal

Physical pulling or digging up of invasive material is ideal if done in a manner to fully remove the root material. It is much more time consuming and labor intensive, but ensures that the material is removed from the site and reduces the need to spray chemicals on the site. Physical removal could include things like pulling up plants by hand, digging them up with a shovel or using specialty tools like a weed wrench (**Figure 55**). Physical removal should not be done if plant currently has seeds, as the seeds will be dispersed over a large area, negating the removal effort.

Figure 54: Image of a typical backpack sprayer.

Figure 55: Image of a typical weed wrench.

Burning

Burning can be used as an effected method of removing burn intolerant invasive species, while maintaining the native burn tolerant species. Burning should only be done with the approval and supervision of the local fire department and with the proper permits. Burning is best done when the material is dry and with minimal wind. Weather should be monitored very closely before starting a burn. The use of proper fire breaks is also vital and should be approved by the local fire marshal.

Invasive Species

Plants

A list of known invasive plants for the sight is listed in **Figure 23**. This list includes the major invasive plant threats to this ecosystem, but is not all inclusive. If other invasive plants are identified by a qualified person, then they may also be removed. The removal method and estimated time frame for the removal of each species is also listed in the Appendix section of this document. The exact time frame of the removal process may vary each year depending on the changing of the seasons that year. Care should be taken to monitor each plant invasive plant and its neighboring native plants to figure out the best time to take action when herbicides are involved. Timing a spray before natives are leafed out is ideal, but not always possible. Spraying before a plant flowers is also ideal in order to reduce seed production.

Animals

The only known invasive animals that action could be taken on are the native deer and the exotic earthworms. There are some exotic birds, but special permitting and lack of selective capture techniques makes worrying about invasive birds too difficult for this site. The best way to deal with the deer is the use of a deer enclosure fence that will keep the deer out of the site. Deer are unregulated because they now longer have a natural predator besides humans. Some hunting in the area could help reduce the local population, but hunting is not permitted within this park because of use by school groups. A deer fence around the entire property with gates at the main entrances will help to keep the deer from eating the native species.

Invasive Removal Plan of Action

Robbins Park is heavily used year round by the public and school groups. For this reason the removal of invasive species will not be done on a large scale all at once. Sections of the park will be done at a time and native plants will be planted and established before another nearby section is cleared. This will help to reduce the barren effect that removing invasive species will cause. Larger stock native species will be planted very heavily along the edges of the park after removal of invasive is finished. The use of native evergreen species will also be higher along these edges. This will help to create a vegetation barrier from new introductions as well as give the park a more secluded feel from the nearby neighborhoods and roads.

Timeline

Meadow Restoration

The pasture and meadow area could be done in the first year. They are already open spaces, so heavy debris will not have to be removed. The previously stated meadow restoration plan will be followed for this area.

Mature Beech/Oak Forest

This entire area could be done in the first year of the restoration process. The site could be walked in a grid pattern and any invasive plant can be pulled, cut and paint, or sprayed. The density of the invasive species is low and no noticeable effect on vegetation density will be noticeable. Natives the fit into a Beech-Maple forest would be ideal replacements.

Young Forest

The young or "succession" forest will be an ideal place to do an educational demonstration of invasive plant removal and native plantings. This part of the part could be done after the meadow restoration is completed and will complement the educational signage from its neighbor. The 1.9 acre size of this portion of forest makes it manageable in a single season and would be ideal to do with volunteer groups. The invasive plants are smaller and more manageable and the results will be seen immediately.

Wetlands

Wetlands are delicate ecosystems and a lot of care should be taken when dealing with removal of invasive species. The biggest issue is the Ranunculus ficaria, which can be sprayed with a non-surfactant based glyphosate herbicide in early spring when it has a good level of leaf growth and the native spring species have not yet leafed out. This will take multiple year treatments, so should be started as soon as possible. Natives should be planted until it has been brought under control. Spraying should kill a large percentage of it, but the detached

tubers that R. ficaria produce might persist in the soil for a couple of years before the treatments can reduce their population down to a level that will allow heavy planting of native species. R. ficaria will continue to be an issue since it most likely exist upstream of the site and since it comes up way before any of our native species it will not see much competition.

Degraded Forest

The degraded forest is the worst to deal with and will have to be done in small segments over at least 10 years before the park could be considered to be under control form invasive species. A good plan of action for these sections would be to grid out manageable sections of the park that can be done in a given season that will cause the least amount of disturbance to the park. The priority will be the edge of the park, which will help to reduce the influx of new seed. The size and location of these sections can vary depending on the amount of staff and volunteers available and on current funding. Once one section is completed and native plants have been established a new section in that general area could be treated. The finished sections will have to be monitored very closely to ensure the invasive do not get re-established, which be much easier to do while the invasive are seedlings. The current site got to its almost unmanageable state from many decades of neglect, so should not be a deterrent from what future management plans will require.

Creating these pockets of native species will help to bring in new wildlife, which might also bring in new native plant species into the surrounding areas of the park. This will help to reduce the need for buying many new plants for future projects. The native stock could also be used as a seed and cuttings source for planting in other areas.

Education Components

Given the park's strong stance on education, all of these projects will include signage and demonstration pieces that will showcase the many aspects of invasive species removal and management. This will help to foster a strong knowledge and interest level in need for reducing the spread of invasive species and the importance of planting native species. These young kids will be the future home owners and community leaders who will make important decisions surrounding ecological restoration.

Local Community

Getting the community on board with the invasive removal process will also be very beneficial. Robbins Park is surrounded by many residential properties, which might be a large contributor to the invasive seed stock that enters the park. Getting these people educated about invasive will help to reduce the number of people that plant invasive species in their yards.

Phasing

Phase I (1-1.5 years)

Install deer fence and remove invasive plants from within that area. Restore meadow and plant within fenced area. Install interactive signs for the fenced in area and comparative signs to show the difference within the areas not restored. Install forest succession tower.

Phase II (Year 2)

Plant new forest growth area with saplings after meadow has been well established in that area. Begin stream and pond restoration, starting at the pond and working downstream within both stream segments. Install reed beds for pond to help filter water. Clear invasive plants and walnut trees in wetland creation area along the stream. Install temporary deer fence around wetland creation area, damn it up and plant. Install sill logs and do streambank restoration anywhere that needs it on these upstream creek branches. Selectively remove invasive plants and replace with native alternatives as time and volunteer availability allow.

Phase II (Year 10)

Install deer fence and cattle grates around remaining portion of the park. Remove remaining invasive plants and plant native replacements. Change out interactive displays that no longer apply because of the many changes that have now taken place.

20 Restoration Schematics

All of the schematics for the different restoration designs talked about in this report are shown in the following pages. These diagrams are meant to help show design principles and design elements that are a key factor for the specific design showcased. Some deviation from these schematics will be required to meet the exact needs of the site that they will be installed in. Modifications may also have to made over the years as the site changes or as better designs are created to better suit the exact site conditions as they develop. The restoration process will in itself change how the site functions, so future modification are very likely and should be adapted and evolved as the restoration does.

Stormwater Control Structure

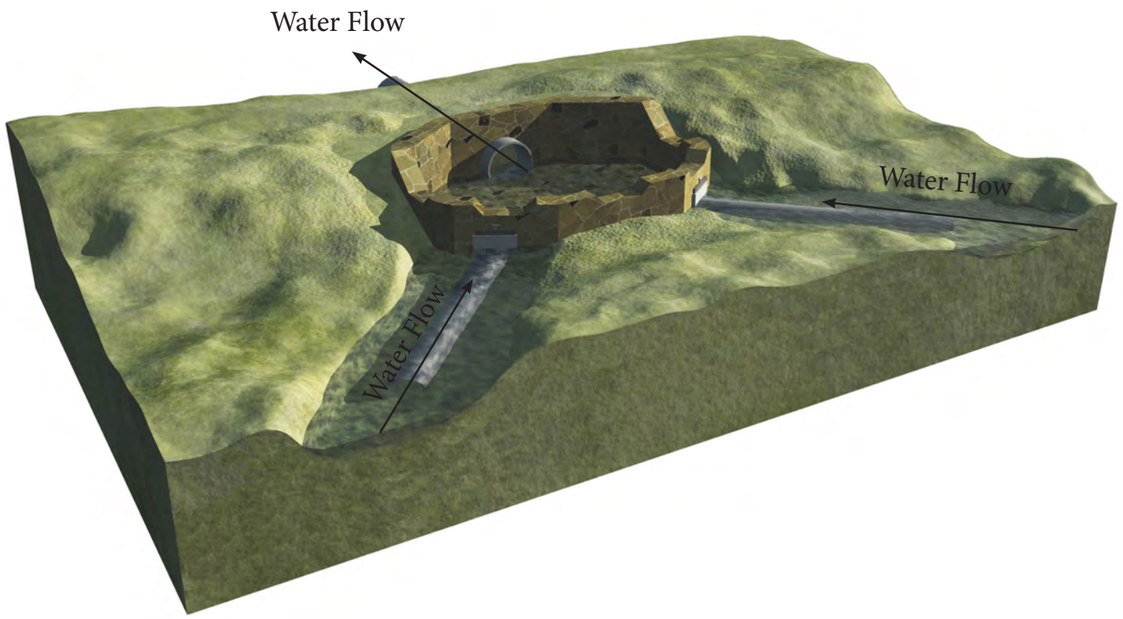


Figure 56 : Normal flow - During normal flow the creek water flows into a perforated pipe and before entering the stone control structure. The perforated pipe reduces the flow rate at a focused point, which helps reduce clogs. There is also a flow control valve on this pipe, which can be adjusted to vary the amount of water draining to the lower creek.

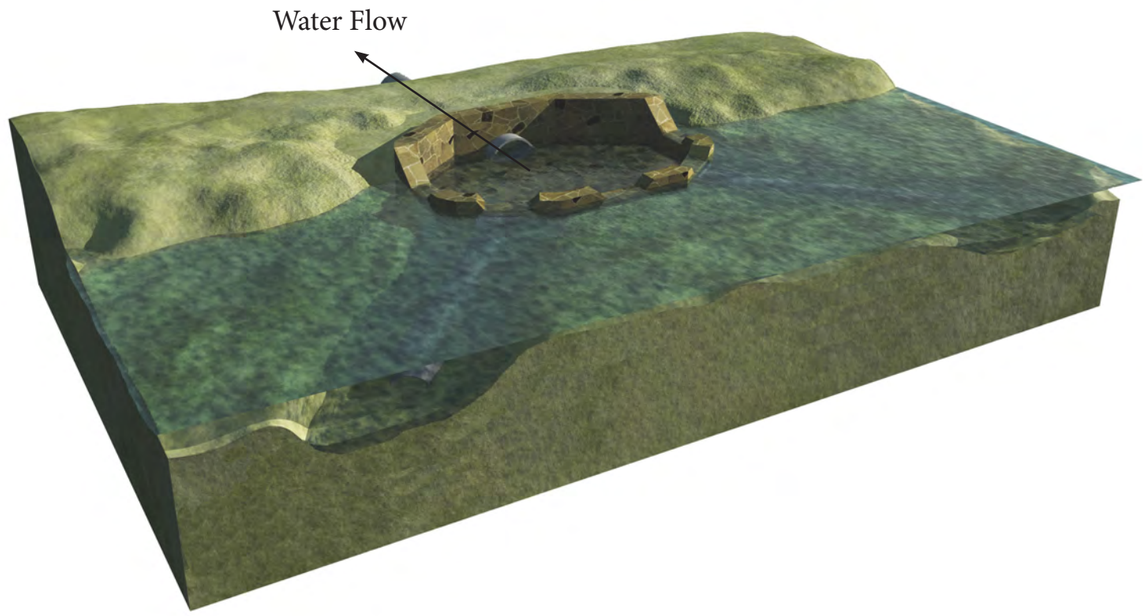


Figure 57: Storm flow - During a big storm event the stormwater will build up behind the structure creating a ponding wetland. This will slow the flow of water downstream and give it more time to infiltrate naturally. During really large storms the water can spill over the overflow portions of the structure.

Construction Details -Stream Restoration

Plan view of stream bank installation

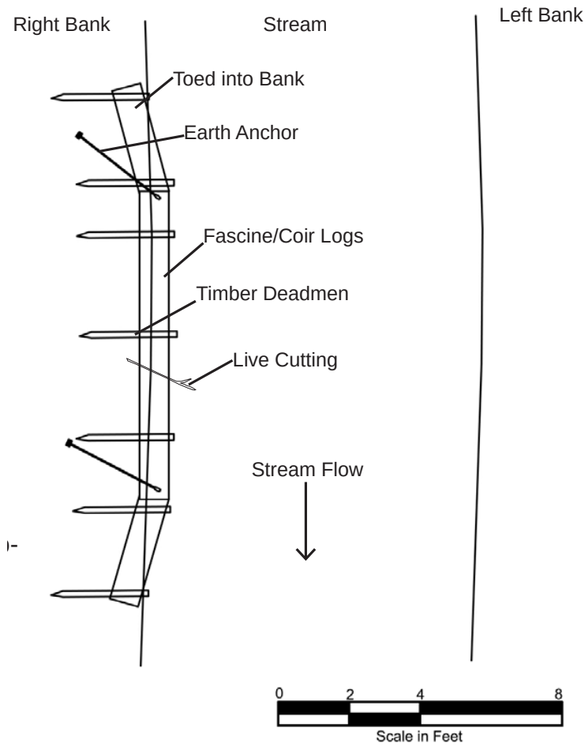


Figure 58: Plan view schematic of a typical streambank stabilization design.

Cross section of stream bank installation and plantings

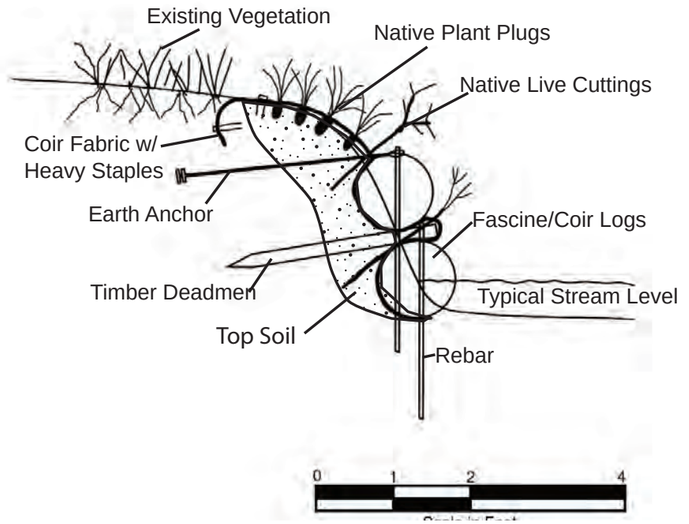
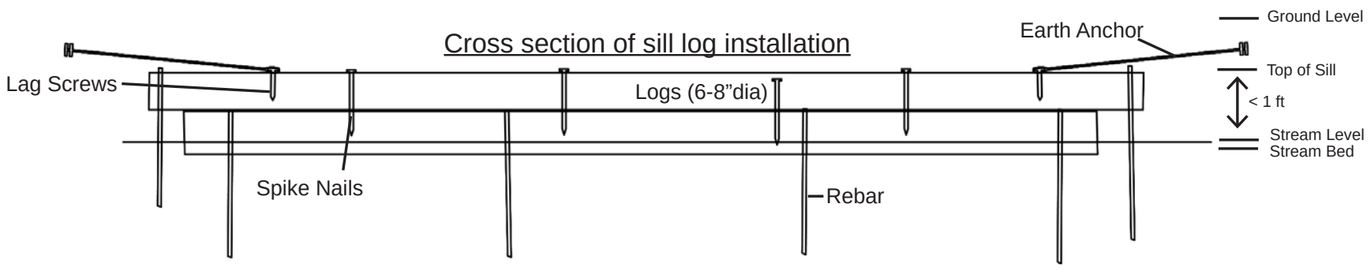


Figure 59: Section view schematic of a typical streambank stabilization design with plantings.

Cross section of sill log installation



- Height of structure not to exceed 1 foot above water level
- Used in areas of high storm water flow

Figure 60: Front section view of a typical stream sill design.

Construction Details -Trails

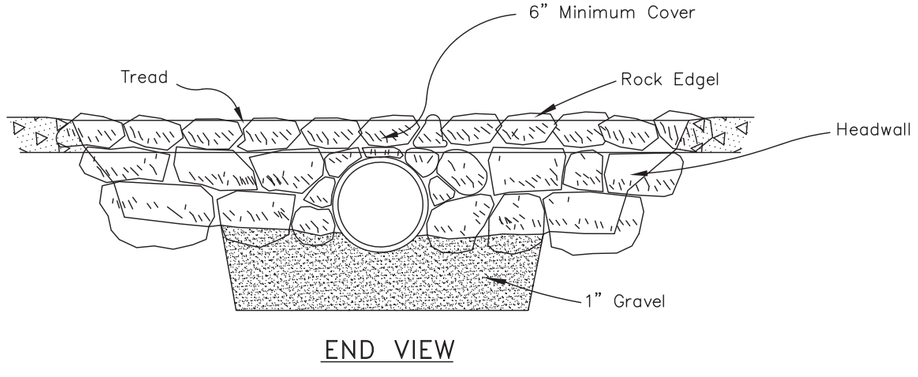


Figure 61: End view of a trail headwall drainage culvert. These structures can be built in a variety of sizes to fit the need of a specific trail. They will be installed in areas that stormwater run-off is causing the trail to washed away.

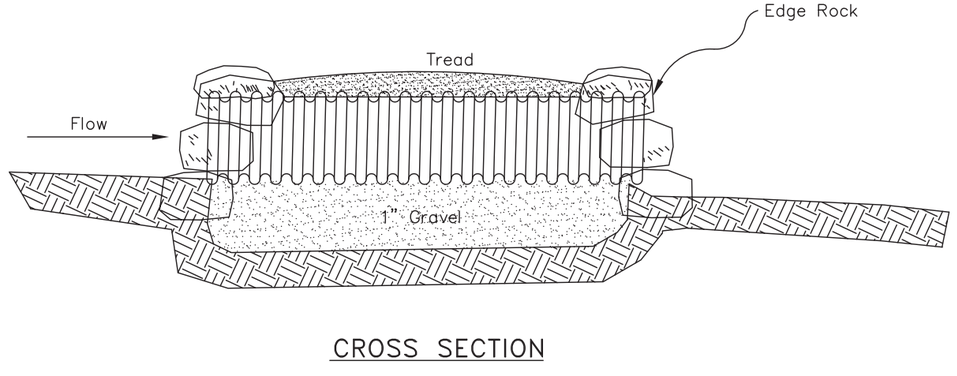


Figure 62: Cross section of trail headwall drainage culvert.

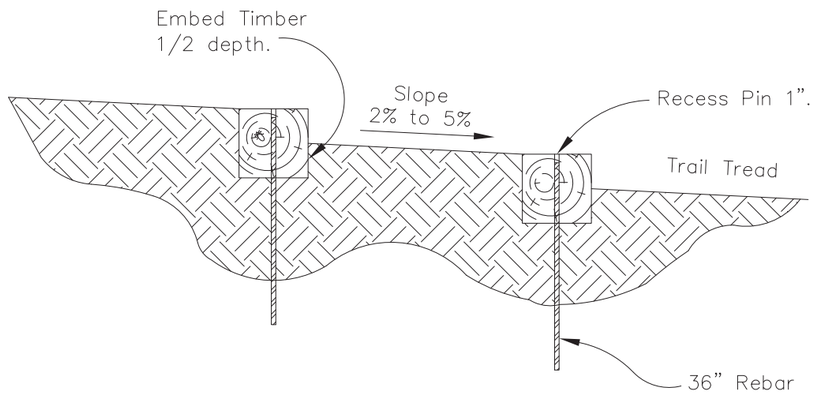


Figure 63: Cross section view of an embedded timber trail step system. This type of step system will be installed on the hill section of trail.

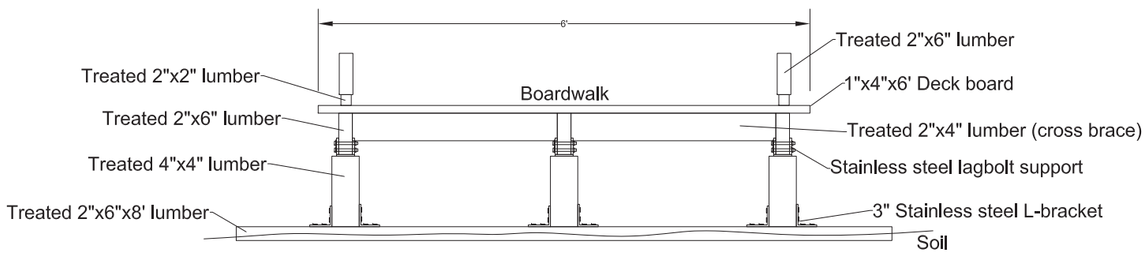


Figure 64: Schematic of a boardwalk design for the trails that will cross over wetland areas of the park. Using a cross plank will reduce the need to dig within the wetland areas, while also providing good stability for the boardwalk.

Floating Plant Beds

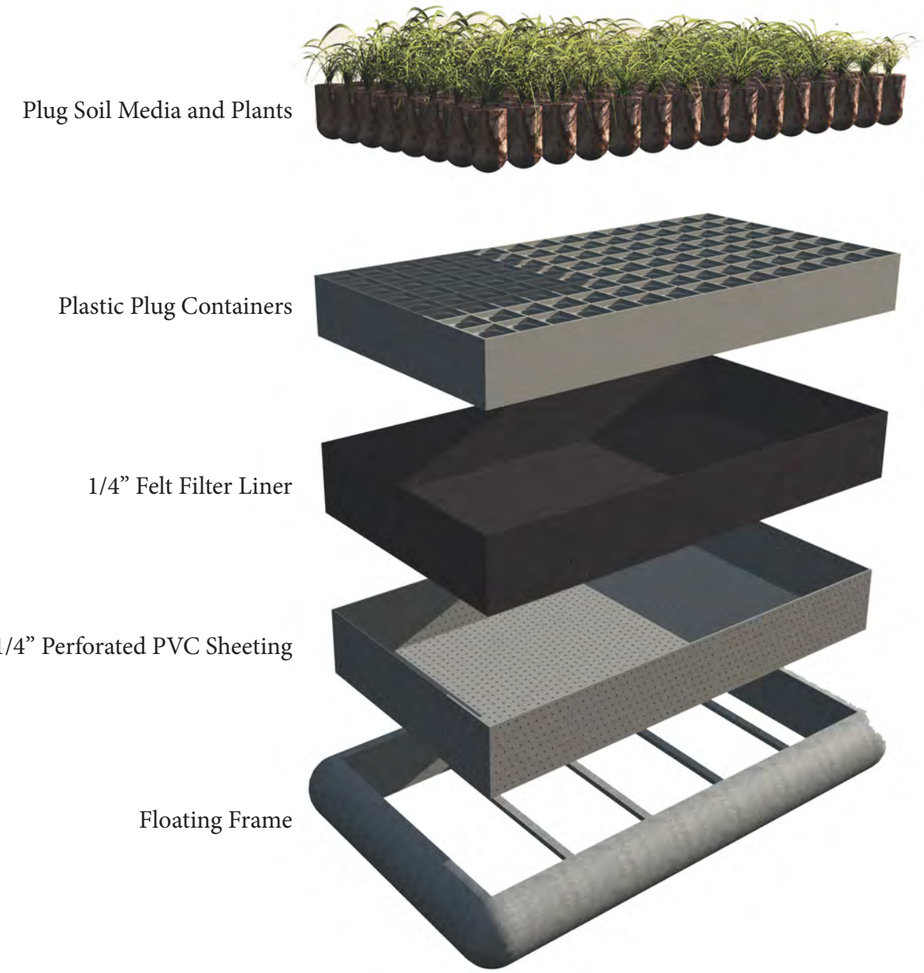


Figure 65: Schematic showing how the different layers of the floating plant beds. Each layer can easily be removed for easy cleaning and maintenance. The plastic plug containers can be recycled from nurseries and can vary in size depending on what will be grown. The felt liner helps to keep the soil media from going into the pond. The perforated PVC provides structure, while allowing water to flow through. The floating frame can be made from a variety of water resistant floating and structural materials.

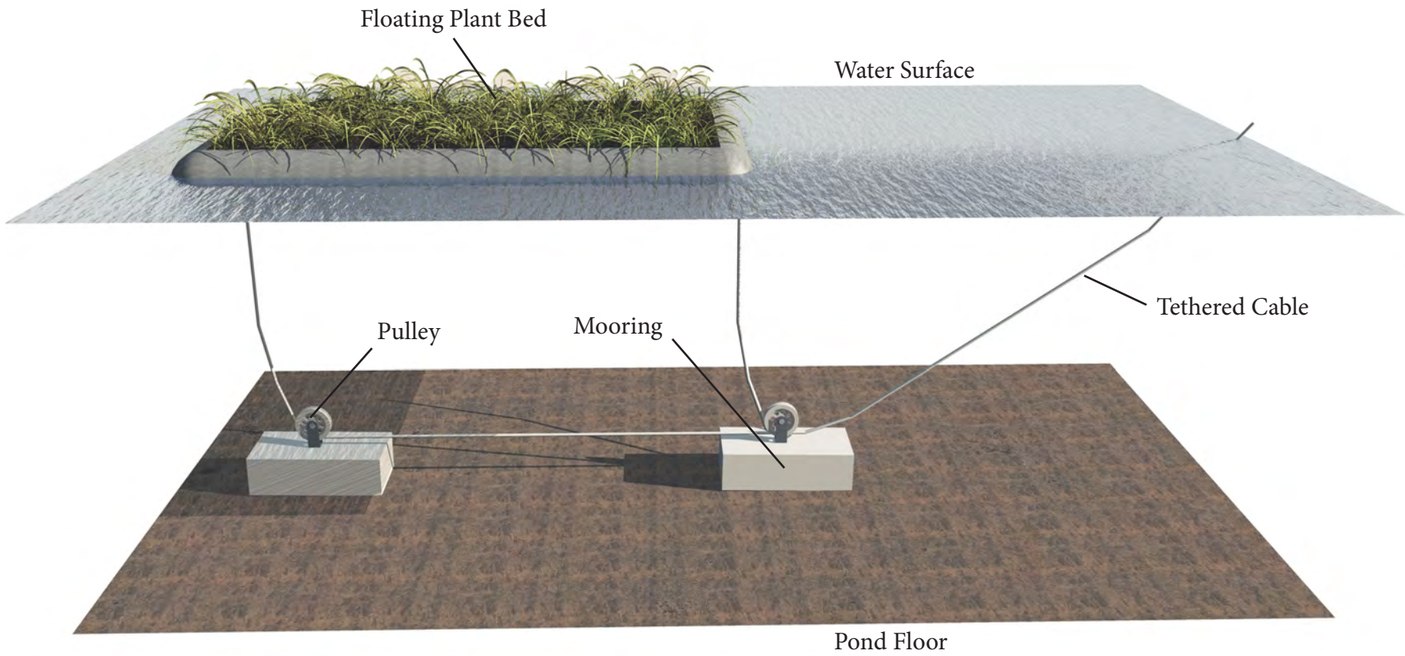


Figure 66: Schematic showing how the floating plant bed could be secured within the pond. Having two mooring anchor points will keep the structure from spinning freely on a pivot point , which might push the structure into an undesired place. To set the floating bed into position, the tether cables will be pulled tight and secured on the pond edge. To pull the floating bed to the shore, the tethering cables will be loosened and a long pole will be used to pull them ashore.

Circulating Reed Bed Details

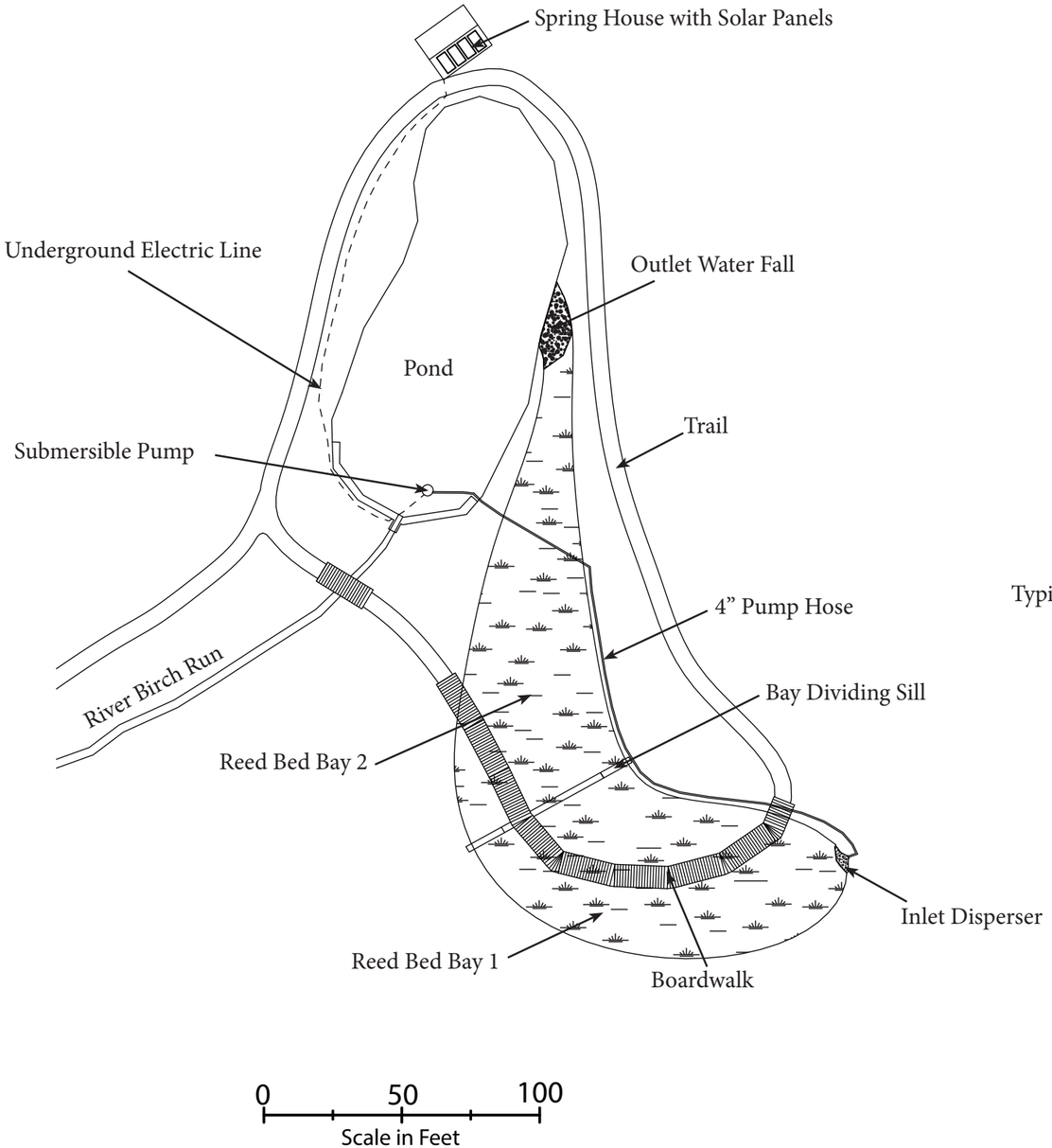


Figure 67: Plan view of the recirculating reed bed design.

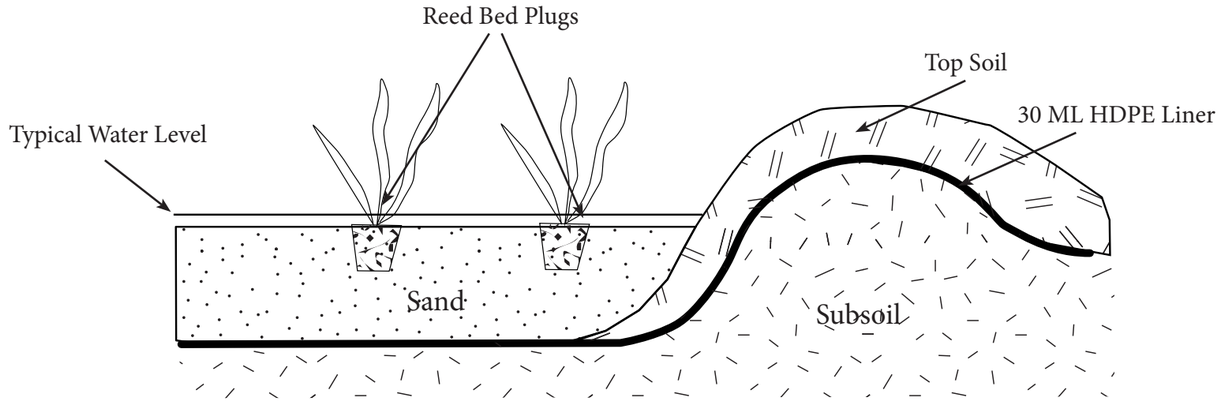


Figure 68: Section view of the reed bed design to show how the liner is placed and how the planting matrix is designed.

Wildlife Structures

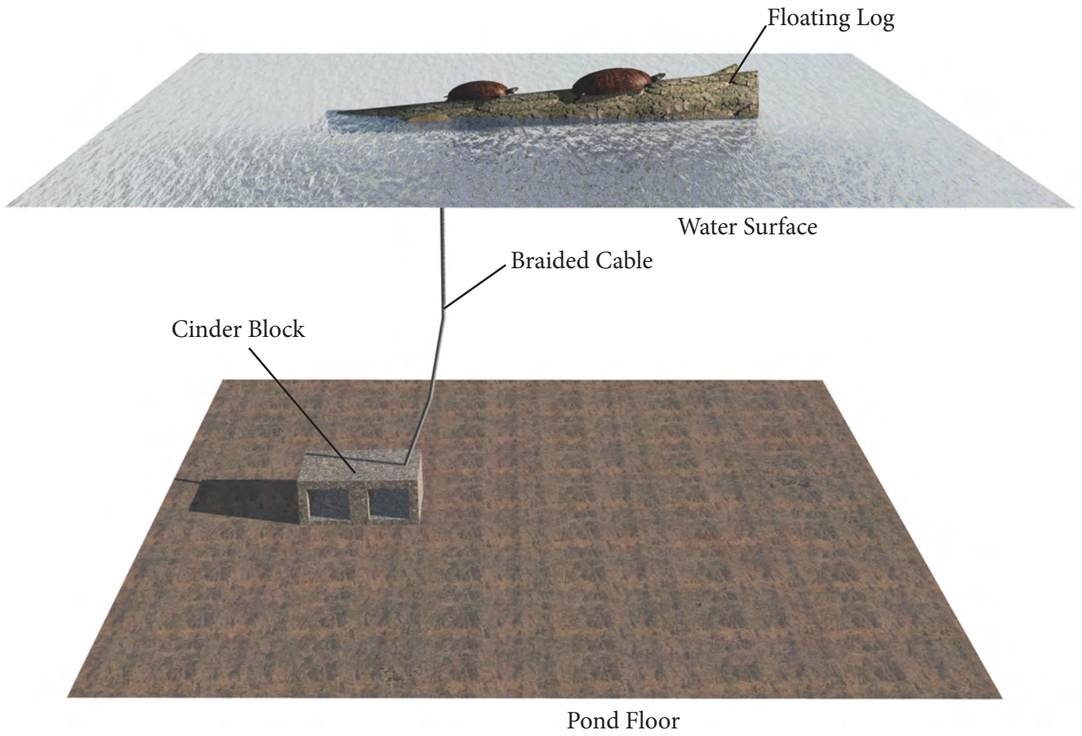


Figure 69 : Schematic of a turtle log. A natural log can be tethered to a cinder block or other heavy object and placed in the center of the pond. The log can also be weighted (attaching metal weights) to give it a slight angle for easy access for turtles, snakes and frogs. Tethering the log will help to keep it near the center of the pond, where wildlife will feel safer and be more apt to climb out to sun themselves. This provides a double benefit. The humans get to view the animals and the animals get to safely sun themselves, which is important for both body temperature regulation and hygiene (UV light helps to reduce bacterial, algal and fungal growth on their bodies).

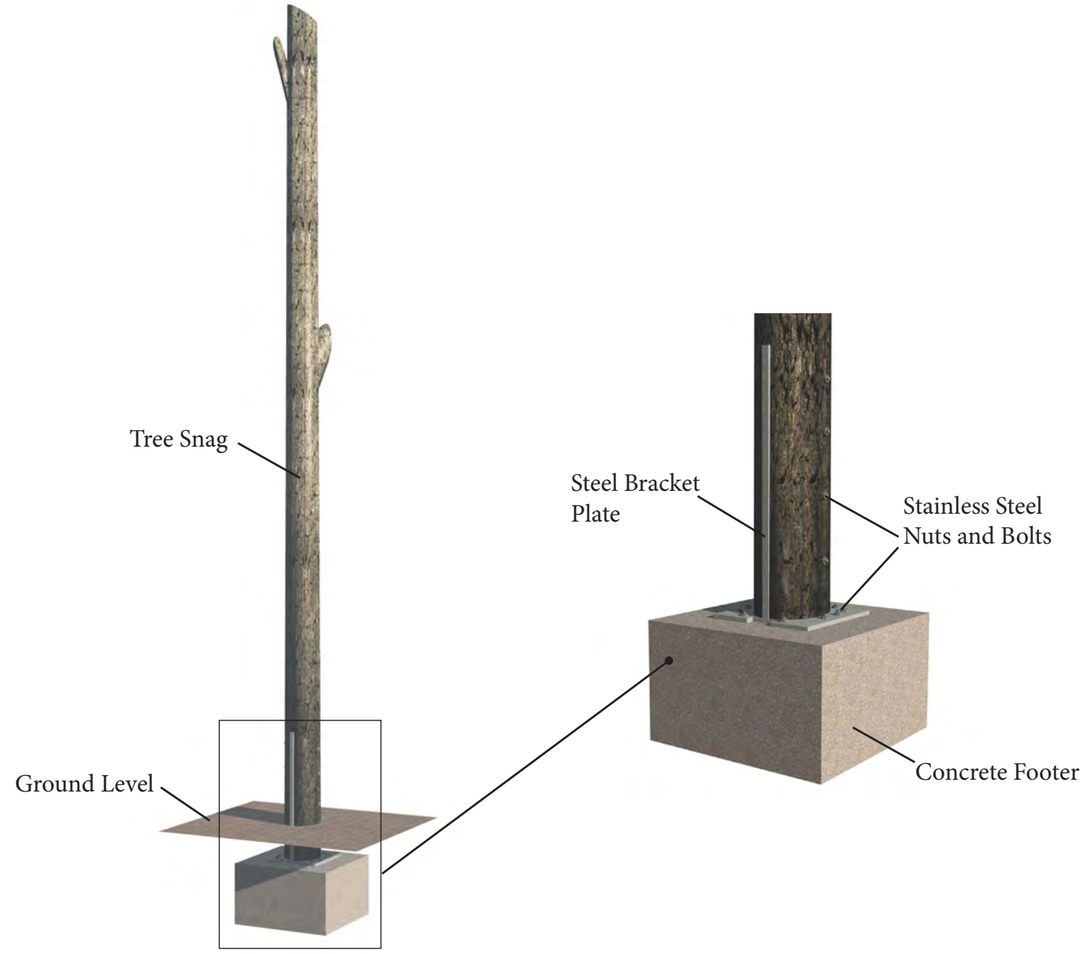
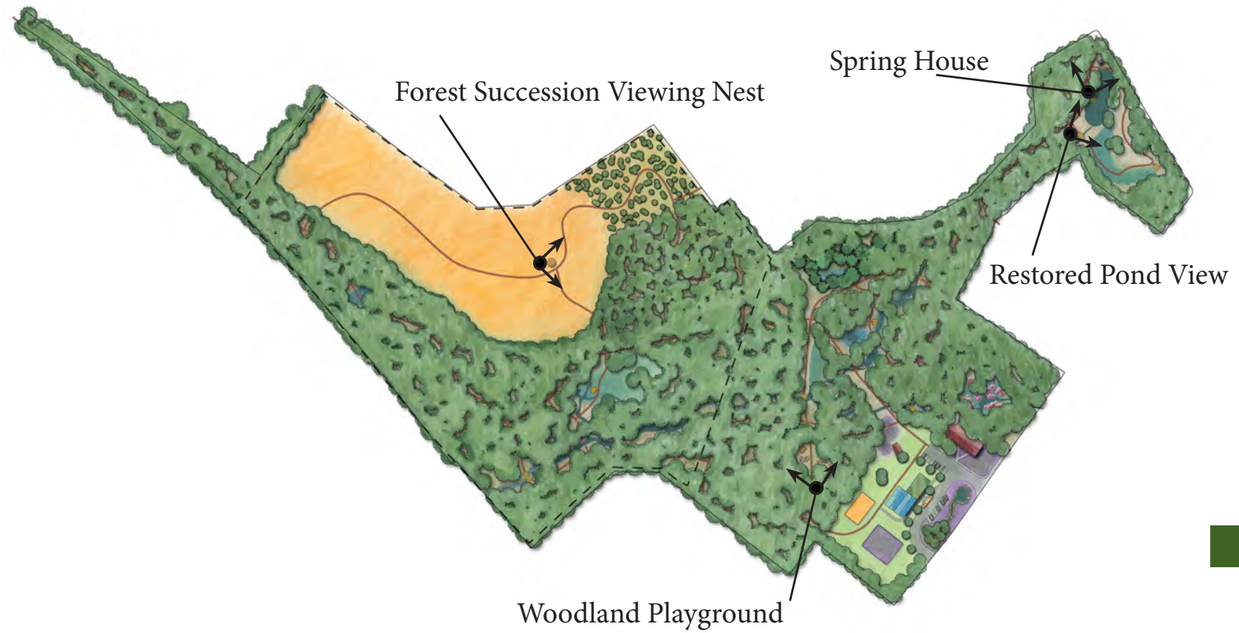


Figure 70: Schematic of a tree snag built for bird perching habitat in the meadow. A dead tree is trimmed of its long branches and attached to a concrete footer with a thick steel bracket plate. The bracket plate is inserted into a cut notch in the base o the tree and the tree is bolted to the bracket. The concrete base is buried at least 6 inches underground in order to hide the structure.

49 Illustrative Perspectives

The following are a series of different illustrative perspectives. These manufactured images are meant to convey the end result of some of the important design elements. Each of the perspective viewing location and direction is shown on the map to the right.

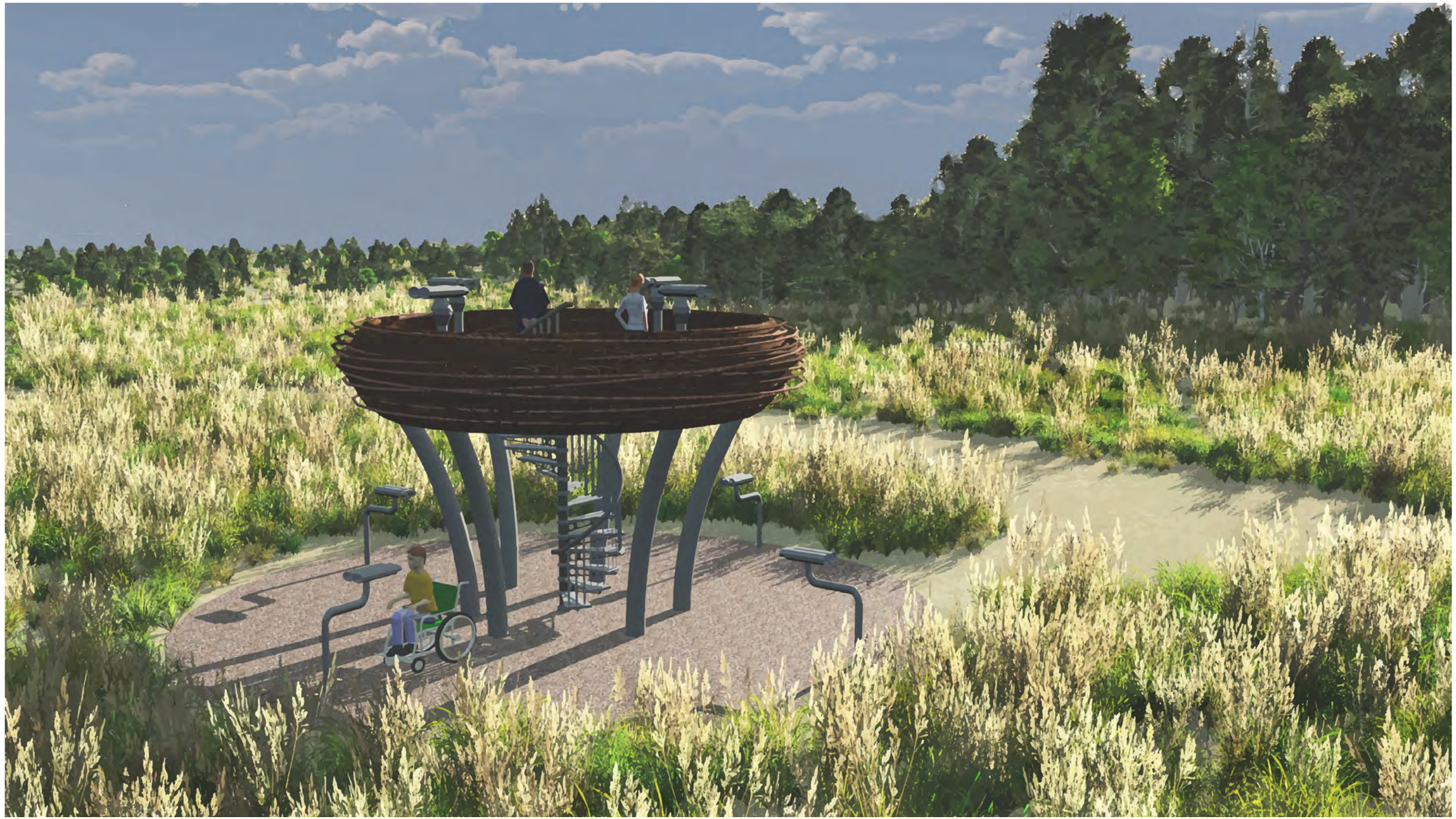
Illustrative Perspectives Location Map



Woodland Playground

Woodland Playground - This play area will focus on using natural materials and elements of a forest to provide structures for children to play and interact with. This type of playground will help to stimulate the children's play time, while also helping to better connect them with nature.

Forest Succession Viewing Nest



Forest Succession Viewing Nest - This viewing area will have a ground (ADA) and an elevated viewing area (bird's nest), which will be fitted with special panoramic viewing scopes. The structure will help to give visitors a bird's eye view of the different stages of forest succession. The special viewing scopes will allow the user to both look at the current site, as well as transition through an overlay series of site matching images showing changes over time and during different seasons.

Restored Spring House

Historic Spring House - The historic spring house on site will be restored as a demonstration of how people use to collect water. Educational signs will also teach about water tables and water quality issues. The roof of the spring house will be covered in solar panels, which will be used to pump water up to the recirculating reed bed system.

Restored Pond Ecosystem

Restored Pond System : Illustrative image showing the restored conditions of the pond area. Invasive plants are removed from the water and pond bank and planted with native species. Floating planting beds are used to both clean the water and grow out planting stock for the park. A tethered turtle log is placed in the center of the pond to provide sun bathing areas for turtles. There is also a viewing deck and a recirculating reed bed system powered by solar panels installed on the restored spring house.

25 Planting Plans

The following diagrams and tables are to be used when doing plantings at the park. The forest planting is more open ended and only confined to the use of native species from the PA Flora atlas for Montgomery County. A list of all the native plant species is provided in the appendix. The meadow has a very specific planting plan that should be followed as instructed. The diagrams to the right show different forest edge planting designs that would help to create a healthy interior forest by holding in moisture and providing a barrier from foreign invaders.

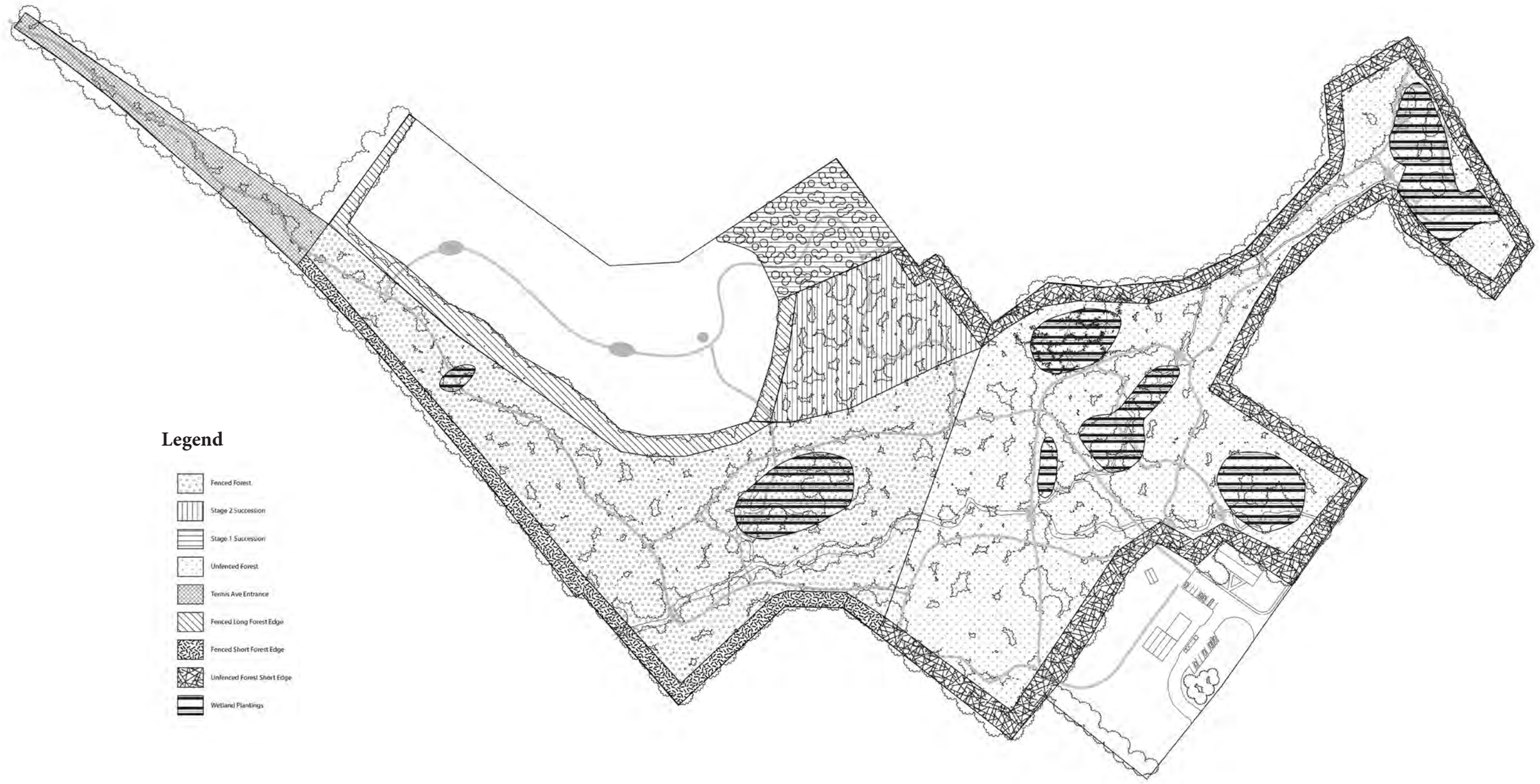
Confined Edge

Confined Edge Planting Schematic: Schematic showing how to go about planting a dense edge along a forest edge that is highly confined by a road, neighboring property or other obstruction.

Ideal Edge

Ideal Edge Planting Schematic: Schematic showing how to go about planting a forest edge when enough space is available. Place plant species within the tapered edge according their growth habits.

Forest Planting Plan



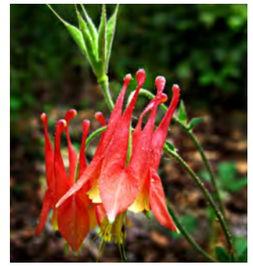
Meadow Planting Plan

Elymus hystrix
K. Chayka

Solidago nemoralis
Ellen Honeycutt

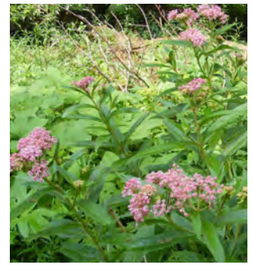
Andropogon gerardii
NRCS Plant Materials Center

Penstemon digitalis
Paul L. Redfearn, Jr.



Aquilegia canadensis
William Tanneberger

Liatris spicata
Tom Butzler



Asclepias incarnata
Jeremy Sell

Carex vulpinoidea
eMonocot Team Media

Primary Meadow Plants

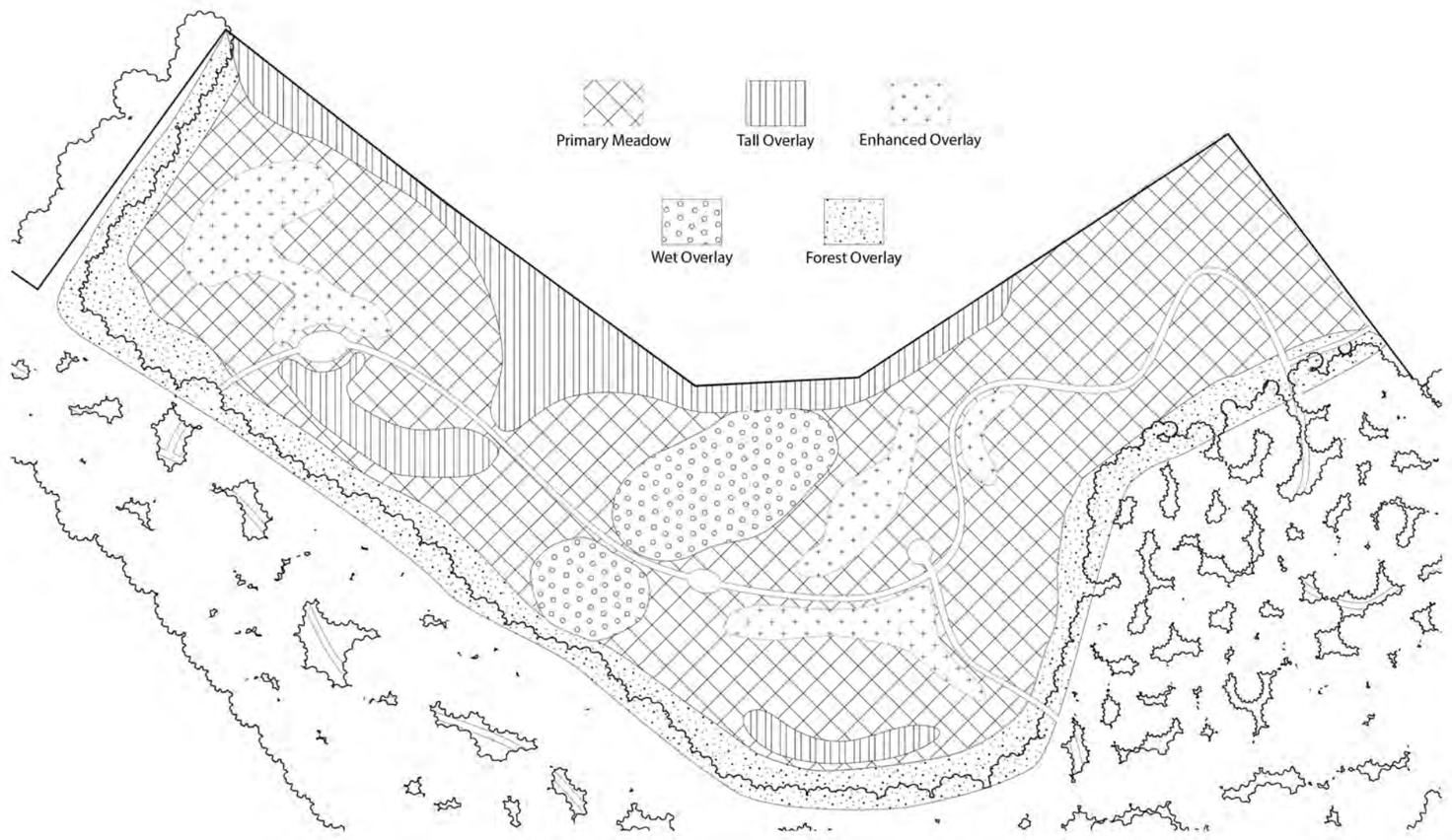
Species Name	Common Name
Andropogon virginicus	Broomsedge bluestem
Carex conoidea	Openfield sedge
Carex vulpinoidea	Fox sedge
Elymus virginicus	Virginia wild-rye
Juncus canadensis	Canada rush
Schizachyrium scoparium	Little bluestem
Asclepias tuberosa	Butterfly-weed
Symphyotrichum novae-angliae	New England aster
Chamaecrista fasciculata	Partridge-pea
Conoclinium coelestinum	Mistflower
Gentiana clausa	Meadow closed gentian
Hypericum punctatum	Spotted St. John's-wort
Lespedeza capitata	Round-headed bush-clover
Liatris spicata	Blazing-star
Penstemon digitalis	Tall white beard-tongue
Pycnanthemum tenuifolium	Narrowleaf mountainmint
Rudbeckia fulgida	Eastern coneflower
Rudbeckia hirta	Beautiful black-eyed-susan
Solidago nemoralis	Gray goldenrod
Tradescantia ohiensis	Bluejacket
Zizia aurea	Golden-alexander

Tall Species Overlay Plants

Species Name	Common Name
Andropogon gerardii	Big bluestem
Sorghastrum nutans	Indian-grass
Tridens flavus	Purpletop
Doellingeria umbellata	Parasol whitetop
Coreopsis tripteris	Tall tickseed
Heliopsis helianthoides	Ox-eye
Lilium superbum	Turk's-cap lily
Pycnanthemum virginianum	Virginia mountainmint
Rudbeckia laciniata	Cutleaf coneflower
Solidago speciosa	Showy goldenrod
Thalictrum pubescens	Tall meadow-rue
Veronicastrum virginicum	Culver's-root

Meadow Enhancement Overlay Plants

Species Name	Common Name
Asclepias tuberosa	Butterfly-weed
Symphyotrichum laeve	Smooth blue aster
Gentiana clausa	Meadow closed gentian
Liatris spicata	Blazing-star
Parthenium integrifolium	American fever-few
Penstemon digitalis	Tall white beard-tongue
Rudbeckia fulgida	Eastern coneflower
Scutellaria integrifolia	Hyssop skullcup
Tradescantia ohiensis	Bluejacket



Wet Area Overlay Plants

Species Name	Common Name
Asclepias incarnata	Swamp milkweed
Bidens cernua	Bur-marigold
Carex crinita	Short hair sedge
Carex intumescens	Greater bladder sedge
Carex lupulina	Hop sedge
Carex lurida	Shallow sedge
Carex scoparia	Broom sedge
Chelone glabra	Turtlehead
Elymus riparius	Riverbank wild-rye
Elymus villosus	Wild-rye
Eupatorium perfoliatum	Boneset
Helianthus giganteus	Giant sunflower
Hibiscus moscheutos	Rose-mallow
Juncus effusus	Common rush
Juncus tenuis	Path rush
Lobelia cardinalis	Cardinal-flower
Lobelia siphilitica	Great blue lobelia
Ludwigia alternifolia	Seedbox
Mimulus ringens	Allegheny monkey-flower
Physostegia virginiana	False dragonhead
Pycnanthemum muticum	Clustered mountainmint
Scirpus atrovirens	Black bulrush
Scirpus cyperinus	Woolgrass
Solidago rugosa	Wrinkle-leaf goldenrod
Symphyotrichum puniceum	Purplestem aster
Verbena hastata	Blue vervain
Vernonia noveboracensis	New York ironweed

Forest Edge Overlay Plants

Species Name	Common Name
Elymus hystrix	Bottlebrush-grass
Tridens flavus	Purpletop
Agastache scrophulariifolia	Purple giant-hyssop
Aquilegia canadensis	Wild columbine
Symphyotrichum cordifolium	Blue wood aster
Helianthus decapetalus	Thin-leaved sunflower
Pycnanthemum virginianum	Virginia mountainmint
Rudbeckia triloba	Three-lobed coneflower
Solidago caesia	Bluestem goldenrod
Zizia aurea	Golden-alexander

0 100 200
Scale in Feet

N

Meadow Planting Seed Mixes

Primary Seed Mix

Planting Area: 7.4 acres
Seed Density: 16 pounds/acre

Species Name	Common Name	Pounds per Acre	Pounds Needed
Andropogon virginicus	Broomsedge bluestem	1.0	7.4
Carex conoidea	Openfield sedge	0.1	0.7
Carex vulpinoidea	Fox sedge	0.5	3.7
Elymus virginicus	Virginia wild-rye	4.0	29.6
Juncus canadensis	Canada rush	0.2	1.5
Schizachyrium scoparium	Little bluestem	4.0	29.6
Asclepias tuberosa	Butterfly-weed	0.5	3.7
Symphyotrichum novae-angliae	New England aster	0.1	0.7
Chamaecrista fasciculata	Partridge-pea	2.0	14.8
Conoclinium coelestinum	Mistflower	0.1	0.7
Gentiana clausa	Meadow closed gentian	0.1	0.7
Hypericum punctatum	Spotted St. John's-wort	0.1	0.7
Lespedeza capitata	Round-headed bush-clover	0.2	1.5
Liatris spicata	Blazing-star	1.0	7.4
Penstemon digitalis	Tall white beard-tongue	0.2	1.5
Pycnanthemum tenuifolium	Narrowleaf mountainmint	0.1	0.7
Rudbeckia fulgida	Eastern coneflower	0.2	1.5
Rudbeckia hirta	Beautiful black-eyed-susan	0.2	1.5
Solidago nemoralis	Gray goldenrod	0.5	3.7
Tradescantia ohiensis	Bluejacket	0.3	2.2
Zizia aurea	Golden-alexander	0.6	4.4
	Total	16.0	118.4

Tall Seed Overlay Mix

Planting Area: 1 acres
Seed Density: 7 pounds/acre

Species Name	Common Name	Pounds per Acre	Pounds Needed
Andropogon gerardii	Big bluestem	2.0	2.0
Sorghastrum nutans	Indian-grass	2.0	2.0
Tridens flavus	Purpletop	0.6	0.6
Doellingeria umbellata	Parasol whitetop	0.2	0.2
Coreopsis tripteris	Tall tickseed	0.3	0.3
Heliopsis helianthoides	Ox-eye	0.7	0.7
Lilium superbum	Turk's-cap lily	0.3	0.3
Pycnanthemum virginianum	Virginia mountainmint	0.1	0.1
Rudbeckia laciniata	Cutleaf coneflower	0.3	0.3
Solidago speciosa	Showy goldenrod	0.1	0.1
Thalictrum pubescens	Tall meadow-rue	0.4	0.4
Veronicastrum virginicum	Culver's-root	0.1	0.1
	Total	7.0	7.0

Enhancement Seed Overlay Mix

Planting Area: 0.6 acres
Seed Density: 4 pounds/acre

Species Name	Common Name	Pounds per Acre	Pounds Needed
Asclepias tuberosa	Butterfly-weed	0.6	0.4
Symphyotrichum laeve	Smooth blue aster	0.5	0.3
Gentiana clausa	Meadow closed gentian	0.1	0.1
Liatris spicata	Blazing-star	0.7	0.4
Parthenium integrifolium	American fever-few	0.5	0.3
Penstemon digitalis	Tall white beard-tongue	0.5	0.3
Rudbeckia fulgida	Eastern coneflower	0.4	0.2
Scutellaria integrifolia	Hyssop skullcup	0.2	0.1
Tradescantia ohiensis	Bluejacket	0.5	0.3
	Total	4.0	2.4

Forest Seed Overlay Mix

Planting Area: 1.5 acres
Seed Density: 14 pounds/acre

Species Name	Common Name	Pounds per Acre	Pounds Needed
Elymus hystrix	Bottlebrush-grass	9.8	14.7
Tridens flavus	Purpletop	2.5	3.8
Agastache scrophulariifolia	Purple giant-hyssop	0.1	0.2
Aquilegia canadensis	Wild columbine	0.2	0.3
Symphyotrichum cordifolium	Blue wood aster	0.7	1.1
Helianthus decapetalus	Thin-leaved sunflower	0.1	0.2
Pycnanthemum virginianum	Virginia mountainmint	0.1	0.2
Rudbeckia triloba	Three-lobed coneflower	0.1	0.2
Solidago caesia	Bluestem goldenrod	0.2	0.2
Zizia aurea	Golden-alexander	0.3	0.4
	Total	14.0	21.0

Meadow Planting Seed Mixes

Wet Meadow Seed Overlay Mix

Planting Area: 0.5 acres
Seed Density: 10 pounds/acre

Species Name	Common Name	Pounds per Acre	Pounds Needed
Asclepias incarnata	Swamp milkweed	0.4	0.2
Bidens cernua	Bur-marigold	0.4	0.2
Carex crinita	Short hair sedge	0.3	0.2
Carex intumescens	Greater bladder sedge	0.3	0.2
Carex lupulina	Hop sedge	0.3	0.2
Carex lurida	Shallow sedge	0.3	0.2
Carex scoparia	Broom sedge	0.3	0.2
Chelone glabra	Turtlehead	0.2	0.1
Elymus riparius	Riverbank wild-rye	0.5	0.3
Elymus villosus	Wild-rye	0.4	0.2
Eupatorium perfoliatum	Boneset	0.3	0.2
Helianthus giganteus	Giant sunflower	0.3	0.2
Hibiscus moscheutos	Rose-mallow	0.4	0.2
Juncus effusus	Common rush	0.4	0.2
Juncus tenuis	Path rush	0.5	0.3
Lobelia cardinalis	Cardinal-flower	0.5	0.3
Lobelia siphilitica	Great blue lobelia	0.4	0.2
Ludwigia alternifolia	Seedbox	0.4	0.2
Mimulus ringens	Allegheny monkey-flower	0.3	0.2
Physostegia virginiana	False dragonhead	0.4	0.2
Pycnanthemum muticum	Clustered mountainmint	0.3	0.2
Scirpus atrovirens	Black bulrush	0.4	0.2
Scirpus cyperinus	Woolgrass	0.4	0.2
Solidago rugosa	Wrinkle-leaf goldenrod	0.5	0.3
Symphyotrichum puniceum	Purplestem aster	0.5	0.3
Verbena hastata	Blue vervain	0.3	0.2
Vernonia noveboracensis	New York ironweed	0.3	0.2
	Total	10.0	5.0

Notes:

Invasive Plant Removal

Common Name	Scientific Name	Growth Habbit	Removal Method	Timing
Hydrilla	Hydrilla verticillata	Aquatic	Net out of pond	Early and late summer
Bamboo	unknown	Herbaceous	Cut and Paint	During growing season
Canada thistle	Cirsium arvense	Herbaceous	Spot spray	Early to mid summer before seed
Common reed	Phragmites australis	Herbaceous	Spray and cut cycles	Spray in early summer and fall, cut in early winter
Crown vetch	Coronilla varia	Herbaceous	Spot spray/Burn in meadow	Spray in early to mid summer, burn according to schedule
Garlic-mustard	Alliaria petiolata	Herbaceous	Hand pull	Early to mid summer before seed
Goutweed	Aegopodium podagraria	Herbaceous	Spot spray/Burn in meadow	Spray in early summer, burn according to schedule
Japanese stilt grass	Microstegium vimineum	Herbaceous	Hand pull	Early to mid summer before seed
Lesser celandine	Ranunculus ficaria	Herbaceous	Spray	Spring before natives come up
Orange day-lily	Hemerocallis fulva	Herbaceous	Dig with shovel	Any time during growing season
Star-of-Bethlehem	Ornithogalum umbellatum	Herbaceous	Spot spray	Spring
Tall fescue	Festuca elatior	Herbaceous	Spot spray/Burn in meadow	Spray in early to mid summer, burn according to schedule
Wild parsnip	Pastinaca sativa	Herbaceous	Spot spray/Burn in meadow	Spray in early to mid summer, burn according to schedule
Amur honeysuckle	Lonicera maackii	Shrub	Cut and Paint/hand pull saplings	Anytime (mark during growing season)*
Border privet	Ligustrum obtusifolium	Shrub	Cut and Paint/hand pull saplings	Anytime (mark during growing season)*
Japanese barberry	Berberis thunbergii	Shrub	Hand pull	Anytime (mark during growing season)*
Japanese spiraea	Spiraea japonica	Shrub	Hand pull	Early to mid summer
Jetbead	Rhodotypos scandens	Shrub	Cut and Paint/hand pull saplings	Early to mid summer
Multiflora rose	Rosa multiflora	Shrub	Cut and Paint/hand pull saplings	Anytime (mark during growing season)*
Wineberry	Rubus phoenicolasius	Shrub	Hand pull/Burn in meadow	Early to mid summer, burn according to schedule
Winged euonymous	Euonymus alatus	Shrub	Cut and Paint/hand pull saplings	Early to mid summer
Callery pear	Pyrus calleryana	Tree	Cut and Paint/hand pull saplings	Spring
European bird cherry	Prunus padus	Tree	Cut and Paint	Anytime (mark during growing season)*
Japanese angelica-tree	Aralia elata	Tree	Cut and Paint/hand pull saplings	Anytime (mark during growing season)*
Norway maple	Acer platanoides	Tree	Cut and Paint/hand pull saplings	Anytime (mark during growing season)*
Princess Tree	Paulownia tomentosa	Tree	Cut and Paint/dig up samplings	Anytime (mark during growing season)*
Siberian elm	Ulmus pumila	Tree	Cut and Paint/hand pull saplings	Anytime (mark during growing season)*
Tree-of-heaven	Ailanthus altissima	Tree	Cut and Paint/hand pull saplings	Anytime (mark during growing season)*
White Mulberry	Morus alba	Tree	Cut and Paint	Anytime (mark during growing season)*
English ivy	Hedera helix	Vine	Hand pull/Spray	Hand pull anytime, spray in early spring
Japanese honeysuckle	Lonicera japonica	Vine	Hand pull	Early to mid summer
Lesser periwinkle	Vinca minor	Vine	Hand pull/Spray	Hand pull anytime, spray in early spring
Mile-a-minute weed	Polygonum perfoliatum	Vine	Hand pull	Early to mid summer
Oriental bittersweet	Celastrus orbiculatus	Vine	Cut and paint	Anytime (mark during growing season)*

*These plants can be removed anytime of year since seed is already heavly present in the greater area, but should ideally be removed before they seed

Native Plants for Montgomery County, PA

Species	Common Name
Acalypha gracilens	Slender mercury
Acalypha rhomboidea	Common threeseed mercury
Acalypha virginica	Virginia threeseed mercury
Acer negundo	Box-elder
Acer nigrum	Black maple
Acer rubrum	Red maple
Acer saccharinum	Silver maple
Acer saccharum	Sugar maple
Acer spicatum	Mountain maple
Actaea pachypoda	Doll's-eyes
Actaea racemosa	Black snakeroot
Adiantum pedatum	Northern maidenhair
Adlumia fungosa	Allegheny-vine
Aesculus glabra	Ohio buckeye
Agalinis auriculata	Eared false-foxglove
Agalinis paupercula	Small-flowered false-foxglove
Agalinis purpurea	Purple false foxglove
Agalinis tenuifolia	Slender false-foxglove
Agastache nepetoides	Yellow giant-hyssop
Agastache scrophulariifolia	Purple giant-hyssop
Ageratina altissima var. altissima	White-snakeroot
Ageratina aromatica	Small-leaved white-snakeroot
Agrimonia gryposepala	Agrimony
Agrimonia microcarpa	Small-fruited agrimony
Agrimonia parviflora	Southern agrimony
Agrimonia pubescens	Downy agrimony
Agrimonia rostellata	Woodland agrimony
Agrimonia striata	Roadside agrimony
Agrostis altissima	Tall bentgrass
Agrostis hyemalis	Winter bentgrass
Agrostis perennans	Autumn bent
Agrostis scabra	Fly-away grass
Aletris farinosa	Colic-root
Alisma subcordatum	American water plantain
Allium canadense	Wild onion
Allium tricoccum	Ramp
Alnus serrulata	Smooth alder
Alopecurus aequalis	Short-awned foxtail
Alopecurus carolinianus	Carolina foxtail
Amaranthus albus	Tumbleweed
Ambrosia artemisiifolia	Common ragweed
Ambrosia trifida	Giant ragweed
Amelanchier arborea	Common serviceberry
Amelanchier canadensis	Canadian serviceberry
Amelanchier laevis	Smooth serviceberry
Amelanchier obovalis	Coastal juneberry
Amelanchier stolonifera	Running serviceberry
Amianthium muscaetoxicum	Fly-poison
Ammophila breviligulata	American beachgrass
Amorpha fruticosa	False-indigo
Amphicarpaea bracteata	Hog peanut
Anaphalis margaritacea	Pearly everlasting
Andropogon gerardii	Big bluestem
Andropogon gyrans	Elliott's beardgrass
Andropogon virginicus	Broomsedge bluestem
Anemone americana	American Liverleaf
Anemone quinquefolia	Wood anemone
Anemone virginiana	Tall anemone
Angelica venenosa	Deadly angelica
Antennaria howellii	Howell's pussytoe
Antennaria neglecta	Overlooked pussytoe
Antennaria parlinii	Parlin's pussytoe
Antennaria plantaginifolia	Plantain-leaved pussytoe
Apios americana	Ground-nut
Aplectrum hyemale	Puttyroot
Apocynum androsaemifolium	Pink dogbane
Apocynum cannabinum	Indian hemp
Aquilegia canadensis	Wild columbine
Arabis canadensis	Sicklepod
Arabis glabra	Towercress
Arabis hirsuta var. adpressipilis	Hairy rockcress
Arabis hirsuta var. pycnocarpa	Creamflower rockcress
Arabis laevigata var. laevigata	Smooth rockcress
Arabis lyrata	Lyre-leaved rockcress
Arabis missouriensis	Missouri rockcress
Arabis patens	Spreading rockcress
Aralia hispida	Bristly sarsaparilla
Aralia nudicaulis	Wild sarsaparilla
Aralia racemosa	Spikenard
Aralia spinosa	Hercules'-club
Arisaema dracontium	Green-dragon
Arisaema triphyllum ssp. pusillum	Small jack-in-the-pulpit
Arisaema triphyllum ssp. triphyllum	Glaucous Jack-in-the-pulpit
Aristida dichotoma var. dichotoma	Churchmouse threeawn
Aristida longespica var. geniculata	Slimspike threeawn
Aristida longespica var. longespica	Slender threeawn
Aristida oligantha	Prairie threeawn
Aristolochia serpentaria	Virginia snakeroot
Asarum canadense	Short-lobed wild ginger
Asarum canadense	Wild ginger
Asclepias exaltata	Poke milkweed
Asclepias incarnata ssp. incarnata	Swamp milkweed
Asclepias incarnata ssp. pulchra	Hairy swamp milkweed
Asclepias purpurascens	Purple milkweed
Asclepias quadrifolia	Four-leaved milkweed
Asclepias rubra	Red milkweed
Asclepias syriaca	Common milkweed
Asclepias tuberosa	Butterfly-weed
Asclepias variegata	White milkweed
Asclepias verticillata	Whorled milkweed
Asclepias viridiflora	Green milkweed
Asimina triloba	Pawpaw
Asplenium platyneuron	Ebony spleenwort
Asplenium rhizophyllum	Walking fern
Asplenium ruta-muraria	Wall rue spleenwort
Asplenium trichomanes ssp. quadrivalens	Appressed maidenhair spleenwort
Asplenium trichomanes ssp. trichomanes	Maidenhair spleenwort
Asplenium x ebenoides	Scott's spleenwort
Athyrium filix-femina var. angustum	Lady fern
Athyrium filix-femina var. asplenioides	Southern lady fern
Atriplex littoralis	Seashore orach
Atriplex patula	Spreading orach
Atriplex prostrata	Halberd-leaved orach
Aureolaria flava var. flava	Smooth yellow false foxglove
Aureolaria pedicularia	Cut-leaf false-foxglove
Aureolaria virginica	Downy false-foxglove
Baptisia australis	Blue false-indigo
Baptisia tinctoria	Wild indigo
Bartonia paniculata	Screwstem
Bartonia virginica	Bartonia
Betula lenta	Black birch
Betula nigra	River birch
Betula populifolia	Gray birch
Bidens bipinnata	Spanish needles
Bidens cernua	Bur-marigold
Bidens connata	Purplestem beggarticks
Bidens frondosa	Devil's beggartick
Bidens laevis	Showy bur-marigold
Bidens trichosperma	Tickseed-sunflower
Bidens tripartita	Threelobe beggarticks
Bidens vulgata	Dig devils beggartick
Boehmeria cylindrica var. cylindrica	Smallspike false nettle
Boehmeria cylindrica var. drummondiana	False nettle
Botrychium dissectum	Cut-leaved grape-fern
Botrychium lanceolatum	Triangle moonwort
Botrychium matricariifolium	Daisy-leaved moonwort
Botrychium oneidense	Blunt-lobed grape fern
Botrychium virginianum	Rattlesnake fern

Brachyelytrum erectum	Brachyelytrum	Carex debilis var. rudgei	White edge sedge	Carex platyphylla	Broad-leaf sedge
Brickellia eupatorioides	False boneset	Carex digitalis	Slender woodland sedge	Carex prasina	Drooping sedge
Bromus altissimus	Earlyleaf brome	Carex echinata var. echinata	Star sedge	Carex projecta	Necklace sedge
Bromus pubescens	Canada brome	Carex emmonsii	Emmons' Sedge	Carex radiata	Eastern star sedge
Bulbostylis capillaris	Sandrush	Carex emoryi	Emory's sedge	Carex retroflexa	Reflexed sedge
Calamagrostis canadensis var. canadensis	Bluejoint	Carex festucacea	Fescue sedge	Carex rosea	Rosy sedge
Calamagrostis cinnoides	Reedgrass	Carex folliculata	Northern long sedge	Carex scoparia	Broom sedge
Callitriche heterophylla	Twoheaded water-starwort	Carex frankii	Frank's sedge	Carex seorsa	Weak stellate sedge
Callitriche palustris	Vernal water-starwort	Carex glaucodea	Blue sedge	Carex sparganioides	Bur-reed sedge
Callitriche terrestris	Terrestrial water-starwort	Carex gracilescens	Slender looseflower sedge	Carex sprengelii	Sprengel's sedge
Calopogon tuberosus	Grass-pink	Carex gracillima	graceful sedge	Carex squarrosa	Squarrose sedge
Caltha palustris	Marsh-marigold	Carex granularis var. granularis	Limestone meadow sedge	Carex sterilis	Atlantic sedge
Calystegia sepium	Hedge bindweed	Carex granularis var. haleana	Meadow Sedge	Carex stipata var. stipata	Owlfruit sedge
Calystegia spithamaea	Low bindweed	Carex grayi	Gray's sedge	Carex straminea	Eastern straw sedge
Campanula americana	Tall bellflower	Carex grisea	Inflated narrow-leaf sedge	Carex striatula	Lined sedge
Campanula aparinoides	Marsh bellflower	Carex gynandra	Nodding sedge	Carex stricta	Tussock sedge
Campsis radicans	Trumpet-vine	Carex haydenii	Cloud sedge	Carex styloflexa	Bent sedge
Cardamine angustata	Slender toothwort	Carex hirsutella	Fuzzy wuzzy sedge	Carex swanii	Swan's sedge
Cardamine bulbosa	Bulbous bittercress	Carex hirtifolia	Pubescent sedge	Carex tonsa var. tonsa	Shaved sedge
Cardamine concatenata	Cutleaf toothwort	Carex hitchcockiana	Hitchcock's sedge	Carex torta	Twisted sedge
Cardamine parviflora var. arenicola	Small-flowered bittercress	Carex hystericina	Bottlebrush sedge	Carex tribuloides var. tribuloides	Blunt broom sedge
Cardamine pensylvanica	Pennsylvania bittercress	Carex interior	Inland sedge	Carex trichocarpa	Hairyfruit sedge
Carex aggregata	Glomerate sedge	Carex intumescens	Greater bladder sedge	Carex typhina	Cat-tail sedge
Carex albicans	Whitetinge sedge	Carex jamesii	James' sedge	Carex umbellata	Parasol sedge
Carex albolutescens	Greenwhite sedge	Carex lacustris	Hairy sedge	Carex vestita	Velvet sedge
Carex amphibola	Eastern narrowleaf sedge	Carex laevivaginata	Smoothsheath sedge	Carex virescens	Ribbed sedge
Carex annectens	Yellowfruit sedge	Carex laxiculmis var. laxiculmis	Glaucous spreading sedge	Carex vulpinoidea	Fox sedge
Carex appalachica	Appalachian sedge	Carex laxiflora	Broad looseflower sedge	Carex willdenovii	Sedge
Carex argyrantha	Hay sedge	Carex leavenworthii	Leavenworth's sedge	Carpinus caroliniana	Hornbeam
Carex atlantica ssp. atlantica	Prickly bog sedge	Carex leptalea	Bristlystalked sedge	Carya cordiformis	Bitternut hickory
Carex atlantica ssp. capillacea	Prickly bog sedge	Carex leptonervia	Nerveless woodland sedge	Carya glabra	Pignut hickory
Carex bicknellii	Bicknell's sedge	Carex lucorum	Blue Ridge sedge	Carya laciniosa	Shellbark hickory
Carex blanda	Eastern woodland sedge	Carex lupuliformis	False hop sedge	Carya ovata	Shagbark hickory
Carex brevior	Shortbeak sedge	Carex lupulina	Hop sedge	Carya tomentosa	Mockernut hickory
Carex bromoides	Brome-like sedge	Carex lurida	Shallow sedge	Castanea dentata	American chestnut
Carex bushii	Bush's sedge	Carex meadii	Mead's sedge	Castilleja coccinea	Indian paintbrush
Carex buxbaumii	Brown sedge	Carex mesochorea	Midland sedge	Caulophyllum thalictroides	Blue cohosh
Carex caroliniana	Carolina sedge	Carex molesta	Troublesome sedge	Ceanothus americanus	New Jersey tea
Carex cephaloidea	Thinleaf sedge	Carex muhlenbergii	Muhlenberg's sedge	Celastrus scandens	American bittersweet
Carex cephalophora	Oval-leaf sedge	Carex nigromarginata	Black edge sedge	Celtis occidentalis	Dogberry
Carex communis	Fibrousroot sedge	Carex normalis	Greater straw sedge	Celtis occidentalis	Hackberry
Carex conjuncta	Soft fox sedge	Carex oligocarpa	Richwoods sedge	Celtis tenuifolia	Dwarf hackberry
Carex conoidea	Openfield sedge	Carex pallescens	Pale sedge	Cenchrus longispinus	Sandbur
Carex crinita var. crinita	Short hair sedge	Carex pedunculata	Longstalk sedge	Cephalanthus occidentalis	Buttonbush
Carex cristatella	Crested sedge	Carex pellita	Woolly sedge	Cerastium arvense ssp. arvense	Field chickweed
Carex davisii	Davis' sedge	Carex pensylvanica	Pennsylvania sedge	Cerastium nutans	Nodding chickweed
Carex debilis var. debilis	Swamp white edge sedge	Carex planispicata	Flat-spiked sedge	Ceratophyllum demersum	Coontail

Cercis canadensis	Redbud
Chaerophyllum procumbens	Slender chervil
Chamaecrista fasciculata	Partridge-pea
Chamaecrista nictitans	Wild sensitive-plant
Chamaelirium luteum	Fairywand
Cheilanthes lanosa	Hairy lip fern
Chelone glabra	Turtlehead
Chenopodium album var. missouriense	Missouri lambsquarters
Chenopodium simplex	Maple-leaved goosefoot
Chenopodium standleyanum	Woodland goosefoot
Chimaphila maculata	Striped prince's pine
Chimaphila umbellata	Pipsissewa
Chionanthus virginicus	Fringe-tree
Chrysopsis mariana	Golden aster
Chrysosplenium americanum	Golden saxifrage
Cicuta maculata var. maculata	Beaver-poison
Cinna arundinacea	Wood reedgrass
Circaea canadensis ssp. canadensis	Broadleaf enchanter's-nightshade
Cirsium altissimum	Tall thistle
Cirsium discolor	Field thistle
Cirsium muticum	Swamp thistle
Cirsium pumilum	Pasture thistle
Claytonia virginica	Spring-beauty
Clematis occidentalis	Purple clematis
Clematis virginiana	Virgin's-bower
Collinsonia canadensis	Horse balm
Comandra umbellata	Bastard toadflax
Comptonia peregrina	Sweet-fern
Conoclinium coelestinum	Mistflower
Conopholis americana	Squaw-root
Conyza canadensis var. canadensis	Horseweed
Corallorhiza maculata	Spotted coralroot
Corallorhiza odontorhiza	Autumn coralroot
Corallorhiza wisteriana	Wister's coralroot
Coreopsis tripteris	Tall tickseed
Cornus alternifolia	Alternate-leaved dogwood
Cornus amomum ssp. amomum	Silky dogwood
Cornus florida	Flowering dogwood
Cornus racemosa	Gray dogwood
Cornus rugosa	Round-leaved dogwood
Cornus sericea	Red-osier dogwood
Corydalis flavula	Yellow fumewort
Corydalis sempervirens	Rock harlequin
Corylus americana	American filbert
Corylus cornuta	Beaked hazelnut
Crataegus calpodendron	Pear hawthorn
Crataegus coccinea	Red-fruited hawthorn
Crataegus crus-galli	Cockspur hawthorn
Crataegus intricata	Biltmore hawthorn
Crataegus macrosperma	Fanleaf hawthorn
Crataegus pruinosa	Frosted hawthorn
Crataegus punctata	Dotted hawthorn
Crataegus uniflora	One-fruited hawthorn
Crotalaria sagittalis	Rattlebox
Croton capitatus	Hogwort
Cryptotaenia canadensis	Honewort
Cunila origanoides	Common dittany
Cuphea viscosissima	Blue waxweed
Cuscuta campestris	Golden dodder
Cuscuta compacta	Compact dodder
Cuscuta gronovii var. gronovii	Common dodder
Cuscuta pentagona	Field dodder
Cynoglossum virginianum	Wild comfrey
Cyperus bipartitus	Slender flatsedge
Cyperus compressus	Poorland flatsedge
Cyperus echinatus	Globe flatsedge
Cyperus engelmannii	Engelmann's flatsedge
Cyperus erythrorhizos	Redroot flatsedge
Cyperus esculentus	Yellow nutsedge
Cyperus flavescens	Yellow flatsedge
Cyperus houghtonii	Houghton's flatsedge
Cyperus lancastriensis	Manyflower flatsedge
Cyperus lupulinus	Great Plains flatsedge
Cyperus odoratus	Fragrant flatsedge
Cyperus schweinitzii	Schweinitz's flatsedge
Cyperus squarrosus	Bearded flatsedge
Cyperus strigosus	False nutsedge
Cyperus tenuifolius	Thin-leaved flatsedge
Cypripedium acaule	Pink lady's-slipper
Cypripedium parviflorum var. pubescens	Large yellow lady's-slipper
Cystopteris bulbifera	Bulblet bladder fern
Cystopteris fragilis	Brittle bladderfern
Cystopteris protrusa	Protruding bladder fern
Cystopteris tenuis	Upland brittle bladderfern
Danthonia compressa	Northern oatgrass
Danthonia spicata	Poverty-grass
Dennstaedtia punctilobula	Hay-scented fern
Deparia acrostichoides	Silvery glade fern
Deschampsia flexuosa	Common hairgrass
Desmodium canadense	Showy tick-trefoil
Desmodium canescens	Hoary tick-trefoil
Desmodium ciliare	Hairy small-leaf ticktrefoil
Desmodium cuspidatum	Largebract ticktrefoil
Desmodium glutinosum	Sticky tick-clover
Desmodium laevigatum	Smooth tick-clover
Desmodium marilandicum	Maryland tick-clover
Desmodium nudiflorum	Naked-flowered tick-trefoil
Desmodium obtusum	Stiff ticktrefoil
Desmodium paniculatum	Panicledleaf ticktrefoil
Desmodium perplexum	Perplexed ticktrefoil
Desmodium rotundifolium	Round-leaved tick-trefoil
Dicentra canadensis	Squirrel-corn
Dicentra cucullaria	Dutchman's-breeches
Dichanthelium acuminatum	Tapered rosette grass
Dichanthelium boscii	Bosc's panicgrass
Dichanthelium clandestinum	Deer-tongue grass
Dichanthelium commutatum	Variable Panic grass
Dichanthelium depauperatum	Poverty panic grass
Dichanthelium dichotomum	Cypress panicgrass
Dichanthelium latifolium	Broadleaf rosette grass
Dichanthelium linearifolium	Slimleaf panicgrass
Dichanthelium lucidum	Shining panic grass
Dichanthelium meridionale	Matting rosette grass
Dichanthelium microcarpon	Cyprus Panic grass
Dichanthelium oligosanthes	Heller's rosette grass
Dichanthelium polyanthes	Panic grass
Dichanthelium sphaerocarpon	Roundseed panicgrass
Dichanthelium villosissimum	Long-haired panic grass
Dichanthelium yadkinense	Yadkin River panic grass
Diervilla lonicera	Bush-honeysuckle
Digitaria filiformis	Slender crabgrass
Diodia teres	Rough buttonweed
Dioscorea villosa	Wild yam
Diospyros virginiana	Persimmon
Diphasiastrum digitatum	Fan clubmoss
Diphasiastrum tristachyum	Deeproot clubmoss
Diplazium pycnocarpon	Narrow-leaved glade fern
Dodecatheon meadia	Shooting-star
Doellingeria infirma	Cornel-leaf whitetop
Doellingeria umbellata	Parasol whitetop
Dracocephalum parviflorum	Dragonhead
Dryopteris carthusiana	Spinulose wood fern
Dryopteris celsa	Log fern
Dryopteris cristata	Crested shield fern
Dryopteris goldiana	Goldie's wood fern
Dryopteris intermedia	Evergreen wood-fern
Dryopteris marginalis	Marginal wood fern
Dryopteris x boottii	Boott's hybrid wood fern
Dryopteris x triploidea	Triploid hybrid wood fern
Dulichium arundinaceum	Three-way sedge
Echinochloa muricata	Rough barnyardgrass

Echinocystis lobata	Prickly cucumber	Eupatorium pilosum	Ragged eupatorium	Gentiana clausa	Meadow closed gentian
Eclipta prostrata	Yerba-de-tajo	Eupatorium rotundifolium var. rotundifolium	Roundleaf thoroughwort	Gentiana saponaria	Soapwort gentian
Eleocharis acicularis	Needle spike-rush	Eupatorium sessilifolium	Upland eupatorium	Gentiana villosa	Striped gentian
Eleocharis engelmannii	Engelmann's spikerush	Euphorbia corollata	Flowering spurge	Gentianopsis crinita	Eastern fringed gentian
Eleocharis erythropoda	Bald spikerush	Euphorbia dentata	Toothed spurge	Geranium carolinianum	Wild geranium
Eleocharis obtusa var. obtusa	Blunt spike-rush	Euphorbia maculata	Spotted spurge	Geranium maculatum	Wood geranium
Eleocharis palustris	Creeping spike-rush	Euphorbia nutans	Eyebane	Geranium robertianum	Herb-robert
Eleocharis tenuis var. pseudoptera	Winged slender spike-rush	Euphorbia vermiculata	Hairy spurge	Geum canadense	White avens
Eleocharis tenuis var. tenuis	Slender spikerush	Eurybia divaricata	White wood aster	Geum laciniatum	Herb-bennet
Eleocharis tenuis var. verrucosa	Warty slender spike-rush	Eurybia macrophylla	Bigleaf aster	Geum vernum	Spring avens
Eleocharis tuberculosa	Long-tubercled spike-rush	Eurybia schreberi	Schreber's aster	Geum virginianum	Cream-colored avens
Ellisia nyctelea	Waterpod	Euthamia caroliniana	Slender goldentop	Gillenia trifoliata	Bowman's-root
Elodea canadensis	Ditch-moss	Euthamia graminifolia	Flat-top goldentop	Gleditsia triacanthos	Honey-locust
Elodea nuttallii	Waterweed	Euthamia graminifolia	Grass-leaved goldenrod	Glyceria acutiflora	Mannagrass
Elymus canadensis var. canadensis	Canada wild-rye	Eutrochium dubium	Coastal plain joepyeweed	Glyceria canadensis	Rattlesnake mannagrass
Elymus hystrix	Bottlebrush-grass	Eutrochium fistulosum	Trumpetweed	Glyceria obtusa	Coastal mannagrass
Elymus riparius	Riverbank wild-rye	Eutrochium maculatum	Spotted joe-pye-weed	Glyceria septentrionalis	Floating mannagrass
Elymus villosus	Wild-rye	Eutrochium purpureum	Sweet joepyeweed	Glyceria striata	Fowl mannagrass
Elymus virginicus	Virginia wild-rye	Fagus grandifolia	American beech	Gnaphalium uliginosum	Low cudweed
Epifagus virginiana	Beechdrops	Fallopia scandens	Climbing false-buckwheat	Goodyera pubescens	Downy rattlesnake-plantain
Epigaea repens	Trailing-arbutus	Festuca obtusa	Nodding fescue	Gratiola neglecta	Hedge hyssop
Epilobium angustifolium	Fireweed	Fimbristylis autumnalis	Slender fimbry	Gymnocarpium dryopteris	Common oak fern
Epilobium ciliatum	Fringed willowherb	Floerkea proserpinacoides	False-mermaid	Gymnocladus dioicus	Kentucky coffee-tree
Epilobium coloratum	Purple-leaved willow-herb	Fragaria vesca ssp. americana	Woodland strawberry	Hackelia virginiana	Beggarslice
Epilobium leptophyllum	Bog willowherb	Fragaria virginiana	Wild strawberry	Hamamelis virginiana	Witch-hazel
Epilobium strictum	Downy willow-herb	Fraxinus americana var. americana	White ash	Hedeoma pulegioides	American pennyroyal
Equisetum arvense	Field horsetail	Fraxinus americana var. biltmoreana	Biltmore ash	Helenium autumnale	Common sneezeweed
Equisetum hyemale	Scouring-rush	Fraxinus nigra	Black ash	Helianthemum canadense	Longbranch frostweed
Equisetum sylvaticum	Woodland horsetail	Fraxinus pennsylvanica	Red ash	Helianthemum propinquum	Low frostweed
Eragrostis capillaris	Lacegrass	Galearis spectabilis	Showy orchis	Helianthus decapetalus	Thin-leaved sunflower
Eragrostis frankii	Sandbar lovegrass	Galium aparine	Stickywilly	Helianthus divaricatus	Rough sunflower
Eragrostis hypnoides	Creeping lovegrass	Galium asprellum	Rough bedstraw	Helianthus giganteus	Giant sunflower
Eragrostis pectinacea	Carolina lovegrass	Galium boreale	Northern bedstraw	Helianthus strumosus	Rough-leaved sunflower
Eragrostis spectabilis	Purple lovegrass	Galium circaezans var. circaezans	Wild Licorice bedstraw	Heliopsis helianthoides	Ox-eye
Erechtites hieraciifolius	American burnweed	Galium circaezans var. hypomalacum	Licorice bedstraw	Heracleum lanatum	Cow-parsnip
Erigeron annuus	Eastern daisy fleabane	Galium lanceolatum	Lanceleaf wild licorice	Heteranthera dubia	Water star-grass
Erigeron philadelphicus	Philadelphia fleabane	Galium obtusum	Bluntleaf bedstraw	Heteranthera reniformis	Kidneyleaf mudplantain
Erigeron pulchellus	Robin's-plantain	Galium pilosum	Hairy bedstraw	Heuchera americana	American alumroot
Erigeron strigosus var. strigosus	Prairie fleabane	Galium tinctorium	Stiff marsh bedstraw	Hibiscus laevis	Halberd-leaved rose-mallow
Eriophorum gracile	Slender cotton-grass	Galium triflorum	Sweet-scented bedstraw	Hibiscus moscheutos	Rose-mallow
Eriophorum virginicum	Tawny cotton-grass	Gamochaeta purpurea var. purpurea	Purple cudweed	Hieracium gronovii	Queendevil
Erythronium americanum	Yellow trout-lily	Gaultheria procumbens	Teaberry	Hieracium paniculatum	Allegheny hawkweed
Euonymus americanus	Hearts-a-bursting	Gaura biennis	Gaura	Hieracium scabrum	Rough hawkweed
Euonymus atropurpureus	Burning-bush	Gaylussacia baccata	Black huckleberry	Hieracium venosum	Rattlesnake-weed
Eupatorium album	White-bracted eupatorium	Gaylussacia dumosa	Dwarf huckleberry	Hordeum jubatum	Foxtail-barley
Eupatorium hyssopifolium	Hyssop-leaved eupatorium	Gaylussacia frondosa	Dangleberry	Hordeum pusillum	Little-barley
Eupatorium perfoliatum	Boneset	Gentiana andrewsii	Bottle gentian	Houstonia caerulea	Bluets

Humulus lupulus var. lupuloides	Hop
Humulus lupulus var. lupulus	Common hop
Huperzia lucidula	Shining firmoss
Hybanthus concolor	Green-violet
Hydrangea arborescens	Sevenbark
Hydrastis canadensis	Goldenseal
Hydrocotyle americana	Marsh pennywort
Hydrocotyle ranunculoides	Floating pennywort
Hydrophyllum virginianum	Virginia waterleaf
Hypericum canadense	Canadian St.John's-wort
Hypericum dissimulatum	Disguised St. Johnswort
Hypericum ellipticum	Pale St. John's-wort
Hypericum gentianoides	Orange-grass
Hypericum mutilum	Dwarf St. John's-wort
Hypericum prolificum	Shrubby St. John's-wort
Hypericum punctatum	Spotted St. John's-wort
Hypericum stragulum	St. Andrew's-cross
Hypoxis hirsuta	Yellow star-grass
Ilex opaca	American holly
Ilex verticillata	Winterberry
Impatiens capensis	Jewelweed
Impatiens pallida	Pale jewelweed
Ionactis linariifolius	Stiff-leaved aster
Ipomoea pandurata	Man-of-the-earth
Iris prismatica	Slender blue flag
Iris versicolor	Northern blue flag
Isoetes engelmannii	Carolina quillwort
Isoetes engelmannii	Appalachian quillwort
Isoetes engelmannii	Engelmann's quillwort
Isotria medeoloides	Small whorled-pogonia
Isotria verticillata	Whorled-pogonia
Jeffersonia diphylla	Twinleaf
Juglans cinerea	Butternut
Juglans nigra	Black walnut
Juncus acuminatus	Sharp-fruited rush
Juncus biflorus	Grass rush
Juncus bufonius	Toad rush
Juncus canadensis	Canada rush
Juncus dichotomus	Forked rush
Juncus dudleyi	Dudley's rush
Juncus effusus var. pylaei	Common rush
Juncus effusus var. solutus	Lamp rush
Juncus gerardii	Blackfoot rush
Juncus marginatus	Grass-leaved rush
Juncus scirpoides	Sedge rush
Juncus secundus	Lopsided rush
Juncus subcaudatus	Woodland rush
Juncus tenuis var. tenuis	Path rush
Juniperus communis	Common juniper
Juniperus virginiana	Eastern red-cedar
Justicia americana	American water-willow
Kalmia angustifolia	Sheep laurel
Kalmia latifolia	Mountain laurel
Krigia biflora	Twoflower dwarfdandelion
Krigia virginica	Virginia dwarfdandelion
Lactuca biennis	Blue lettuce
Lactuca canadensis	Wild lettuce
Lactuca floridana var. floridana	Woodland lettuce
Lactuca floridana var. villosa	Villous lettuce
Laportea canadensis	Wood-nettle
Lechea minor	Thyme-leaved pinweed
Lechea pulchella	Leggett's pinweed
Lechea racemulosa	Illinois pinweed
Lechea villosa	Hairy Pinweed
Leersia oryzoides	Rice cutgrass
Leersia virginica	Cutgrass
Lemna minor	Common duckweed
Lemna trisulca	Star duckweed
Lepidium virginicum	Poor-man's-pepper
Lespedeza capitata	Round-headed bush-clover
Lespedeza hirta	Hairy lespedeza
Lespedeza hirta x intermedia	Nuttall's bush-clover
Lespedeza intermedia	Intermediate lespedeza
Lespedeza procumbens	Trailing bush-clover
Lespedeza repens	Creeping bush-clover
Lespedeza violacea	Violet lespedeza
Lespedeza virginica	Slender lespedeza
Leucothoe racemosa	Fetter-bush
Liatris spicata var. spicata	Blazing-star
Lilium canadense ssp. canadense	Canada lily
Lilium canadense ssp. editorum	Wider-leaved Canada lily
Lilium philadelphicum	Wood lily
Lilium superbum	Turk's-cap lily
Linaria canadensis	Old-field toadflax
Lindera benzoin	Spicebush
Lindernia dubia var. anagallidea	Yellowseed false pimpernel
Lindernia dubia var. dubia	False pimpernel
Linum intercursum	Sandplain wild flax
Linum medium var. texanum	Yellow flax
Linum striatum	Ridged yellow flax
Linum virginianum	Slender yellow flax
Liparis liliifolia	Lily-leaved twayblade
Liparis loeselii	Yellow twayblade
Liquidambar styraciflua	Sweetgum
Liriodendron tulipifera	Tuliptree
Lobelia cardinalis	Cardinal-flower
Lobelia inflata	Indian-tobacco
Lobelia siphilitica	Great blue lobelia
Lobelia spicata var. spicata	Palespike lobelia
Lonicera dioica var. dioica	Limber honeysuckle
Lonicera sempervirens	Trumpet honeysuckle
Ludwigia alternifolia	Seedbox
Ludwigia palustris	Marsh-purslane
Ludwigia peploides ssp. glabrescens	Primrose-willow
Luzula acuminata	Hairy woodrush
Luzula echinata	Common woodrush
Luzula multiflora	Field woodrush
Lycopodiella appressa	Appressed bog clubmoss
Lycopodium clavatum	Common clubmoss
Lycopodium clavatum	One-cone clubmoss
Lycopodium dendroideum	Round-branch ground-pine
Lycopodium hickeyi	Hickey's ground-pine
Lycopodium obscurum	Flat-branched ground-pine
Lycopus americanus	Water-horehound
Lycopus rubellus	Gypsy-wort
Lycopus uniflorus	Northern bugleweed
Lycopus virginicus	Virginia water horehound
Lyonia ligustrina	Maleberry
Lyonia mariana	Staggerbush
Lysimachia ciliata	Fringed loosestrife
Lysimachia hybrida	Lance-leaved loosestrife
Lysimachia quadrifolia	Whorled loosestrife
Lysimachia terrestris	Swamp-candles
Lysimachia x producta	Hybrid Loosestrife
Lythrum alatum	Winged loosestrife
Magnolia acuminata	Cucumber-tree
Magnolia tripetala	Umbrella-tree
Magnolia virginiana	Sweet-bay magnolia
Maianthemum canadense	Canada mayflower
Maianthemum racemosum	Feathery false lily of the valley
Maianthemum stellatum	Starflower
Malaxis unifolia	Green adder's-mouth
Malus coronaria	Sweet crabapple
Matelea obliqua	Anglepod
Matteuccia struthiopteris	Ostrich fern
Medeola virginiana	Indian cucumber-root
Menispermum canadense	Moonseed
Mentha arvensis	Field mint
Mertensia virginica	Virginia bluebell
Mikania scandens	Climbing hempweed
Mimulus alatus	Winged monkey-flower

Mimulus moschatus	Muskflower
Mimulus ringens	Allegheny monkey-flower
Minuartia michauxii	Rock sandwort
Mitchella repens	Partridge-berry
Mitella diphylla	Twoleaf miterwort
Moehringia lateriflora	Blunt-leaved sandwort
Monarda clinopodia	White bergamot
Monarda didyma	Scarlet beebalm
Monarda media	Purple bergamot
Monotropa hypopithys	Pinesap
Monotropa uniflora	Indian-pipe
Morus rubra	Red mulberry
Muhlenbergia frondosa	Wirestem muhly
Muhlenbergia mexicana	Mexican muhly
Muhlenbergia schreberi	Nimblewill
Muhlenbergia sobolifera	Creeping muhly
Muhlenbergia sylvatica	Woodland muhly
Muhlenbergia tenuiflora	Slimflower muhly
Myosotis laxa	Wild forget-me-not
Myosotis verna	Spring forget-me-not
Myrica pensylvanica	Bayberry
Myriophyllum sibiricum	Northern water-milfoil
Najas flexilis	Northern waternymph
Najas gracillima	Slender waternymph
Nuphar advena	Yellow Pond Lily
Nuphar microphylla	Small-leaved Pond Lily
Nymphaea odorata	Fragrant water-lily
Nyssa sylvatica	Sourgum
Obolaria virginica	Pennywort
Oclemena acuminata	Wood aster
Oenothera biennis	Common evening primrose
Oenothera fruticosa ssp. fruticosa	Narrowleaf evening primrose
Oenothera fruticosa ssp. glauca	Glaucous evening primrose
Oenothera laciniata	Cut-leaved evening-primrose
Oenothera nutans	Nodding evening primrose
Oenothera oakesiana	Oakes' evening primrose
Oenothera parviflora	Northern evening primrose
Oenothera perennis	Little evening primrose
Oenothera pilosella	Meadow evening primrose
Onoclea sensibilis	Sensitive fern
Ophioglossum pusillum	Northern adder's-tongue
Ophioglossum vulgatum	Southern adder's-tongue
Opuntia humifusa	Eastern prickly-pear cactus
Orobanche uniflora	Broom-rape
Orontium aquaticum	Goldenclub
Orthilia secunda	One-sided shinleaf
Osmorhiza claytonii	Sweet-cicely
Osmorhiza longistylis	Anise root
Osmunda cinnamomea	Cinnamon fern
Osmunda claytoniana	Interrupted fern
Osmunda regalis	Royal fern
Ostrya virginiana	Hop-hornbeam
Oxalis dillenii ssp. filipes	Southern yellow wood-sorrel
Oxalis stricta	Common yellow wood-sorrel
Oxalis violacea	Violet wood-sorrel
Oxypolis rigidior	Cowbane
Packera anonyma	Appalachian groundsel
Packera aurea	Golden ragwort
Packera obovata	Ragwort
Packera paupercula	Balsam ragwort
Panax quinquefolius	Ginseng
Panax trifolius	Dwarf ginseng
Panicum anceps	Beaked panicgrass
Panicum capillare	Witchgrass
Panicum dichotomiflorum	Smooth panic grass
Panicum flexile	Old witchgrass
Panicum gattingeri	Gattinger's panicgrass
Panicum longifolium	Long-leaved panic grass
Panicum philadelphicum	Philadelphia panicgrass
Panicum rigidulum	Redtop panicgrass
Panicum stipitatum	Stipitate Panic grass
Panicum virgatum	Switchgrass
Parietaria pensylvanica	Pellitory
Parnassia glauca	Grass-of-parnassus
Paronychia canadensis	Smooth forked nailwort
Paronychia fastigiata var. fastigiata	Hairy forked nailwort
Parthenium integrifolium	American fever-few
Parthenocissus quinquefolia	Virginia-creeper
Paspalum laeve	Field beadgrass
Paspalum setaceum var. muhlenbergii	Muhlenberg's beadgrass
Paspalum setaceum var. psammophilum	Slender beadgrass
Paspalum setaceum var. setaceum	Thin beadgrass
Pedicularis canadensis	Forest lousewort
Pedicularis lanceolata	Swamp lousewort
Pellaea atropurpurea	Purple cliffbrake
Pellaea glabella	Smooth cliffbrake
Peltandra virginica	Arrow-arum
Penstemon digitalis	Tall white beard-tongue
Penstemon hirsutus	Northeastern beard-tongue
Penthorum sedoides	Ditch stonecrop
Persicaria amphibia	Water smartweed
Persicaria arifolia	Halberd-leaf tearthumb
Persicaria hydropiperoides	Mild water-pepper
Persicaria hydropiperoides	smartweed
Persicaria pensylvanica	Smartweed
Persicaria punctata	Dotted smartweed
Persicaria sagittata	Tearthumb
Persicaria virginiana	Jumpseed
Phacelia purshii	Miami-mist
Phalaris arundinacea	Reed canary-grass
Phaseolus polystachios	Thicket bean
Phegopteris connectilis	Long beech fern
Phegopteris hexagonoptera	Broad beech fern
Phlox divaricata ssp. divaricata	Wild blue phlox
Phlox maculata	Wild sweet-william
Phlox maculata	Meadow phlox
Phlox paniculata	Summer phlox
Phlox pilosa	Downy phlox
Phlox subulata ssp. subulata	Moss phlox
Photinia melanocarpa	Black chokeberry
Photinia pyrifolia	Red chokeberry
Phryma leptostachya	Lopseed
Phyla lanceolata	Fog-fruit
Physalis heterophylla	Clammy ground-cherry
Physalis pubescens var. integrifolia	Husk tomato
Physalis subglabrata	Ground-cherry
Physalis virginiana	Virginia ground-cherry
Physocarpus opulifolius	Ninebark
Physostegia virginiana	False dragonhead
Phytolacca americana	Pokeweed
Pilea pumila	Clearweed
Pinus echinata	Short-leaf pine
Pinus rigida	Pitch pine
Pinus strobus	Eastern white pine
Pinus virginiana	Virginia pine
Piptatherum racemosum	Ricegrass
Plantago rugelii	Rugel's plantain
Plantago virginica	Virginia plantain
Platanthera clavellata	Clubspur orchid
Platanthera cristata	Crested fringed-orchid
Platanthera flava var. herbiola	Tubercled rein-orchid
Platanthera grandiflora	Large purple fringed-orchid
Platanthera lacera	Ragged fringed-orchid
Platanus occidentalis	Sycamore
Pluchea odorata var. succulenta	Marsh fleabane
Poa alsodes	Grove bluegrass
Poa cuspidata	Bluegrass
Poa palustris	Fowl bluegrass
Poa sylvestris	Woodland bluegrass
Podophyllum peltatum	Mayapple
Pogonia ophioglossoides	Rose pogonia

Polemonium reptans	Spreading Jacob's-ladder
Polygala cruciata	Cross-leaved milkwort
Polygala paucifolia	Bird-on-the-wing
Polygala sanguinea	Field milkwort
Polygala verticillata var. ambigua	Alternate whorled milkwort
Polygala verticillata var. isocycla	Purple sepal whorled milkwort
Polygala verticillata var. verticillata	Whorled milkwort
Polygonatum biflorum var. biflorum	Smooth Solomon's seal
Polygonatum biflorum var. commutatum	Solomon's-seal
Polygonatum pubescens	Hairy Solomon's seal
Polygonella articulata	Jointweed
Polygonum erectum	Erect knotweed
Polygonum tenue	Slender knotweed
Polypodium appalachianum	Appalachian polypody
Polypodium virginianum	Common polypody
Polystichum acrostichoides	Christmas fern
Pontederia cordata	Pickerel-weed
Populus balsamifera	Balsam poplar
Populus deltoides	Eastern cottonwood
Populus grandidentata	Bigtooth aspen
Populus tremuloides	Quaking aspen
Portulaca oleracea	Purslane
Potamogeton amplifolius	Bigleaf pondweed
Potamogeton diversifolius	Waterthread pondweed
Potamogeton epihydrus	Ribbonleaf pondweed
Potamogeton foliosus	Leafy pondweed
Potamogeton illinoensis	Illinois pondweed
Potamogeton natans	Floating pondweed
Potamogeton nodosus	Longleaf pondweed
Potamogeton pectinatus	Sago pondweed
Potamogeton pusillus	Small pondweed
Potentilla canadensis	Cinquefoil
Potentilla norvegica ssp. monspeliensis	Strawberry-weed
Potentilla simplex	Old-field cinquefoil
Prenanthes alba	White rattlesnakeroot
Prenanthes altissima	Tall rattlesnakeroot
Prenanthes serpentaria	Lion's-foot
Prenanthes trifoliolata	Gall-of-the-earth
Proserpinaca palustris var. crebra	Marsh mermaidweed
Prunella vulgaris ssp. lanceolata	Lance selfheal
Prunus americana	Wild plum
Prunus maritima	Beach plum
Prunus pensylvanica	Pin cherry
Prunus pumila var. susquehanae	Susquehana sand cherry
Prunus serotina	Wild black cherry
Prunus virginiana	Choke cherry
Pseudognaphalium obtusifolium	Rabbit-tobacco
Ptelea trifoliata	Hoptree
Pteridium aquilinum	Northern bracken fern
Pycnanthemum clinopodioides	Basil mountainmint
Pycnanthemum incanum	Hoary mountainmint
Pycnanthemum muticum	Clustered mountainmint
Pycnanthemum tenuifolium	Narrowleaf mountainmint
Pycnanthemum verticillatum var. verticillatum	Whorled mountainmint
Pycnanthemum virginianum	Virginia mountainmint
Pyrola americana	Wild lily-of-the-valley
Pyrola chlorantha	Wintergreen
Pyrola elliptica	Shinleaf
Quercus alba	White oak
Quercus alba x montana	Saul oak
Quercus bicolor	Swamp white oak
Quercus coccinea	Scarlet oak
Quercus falcata	Southern red oak
Quercus ilicifolia	Scrub oak
Quercus imbricaria	Shingle oak
Quercus macrocarpa	Bur oak
Quercus marilandica	Blackjack oak
Quercus montana	Chestnut oak
Quercus muhlenbergii	Yellow oak
Quercus palustris	Pin oak
Quercus phellos x rubra	Bartram oak
Quercus prinoides	Dwarf chestnut oak
Quercus rubra	Northern red oak
Quercus stellata	Post oak
Quercus velutina	Black oak
Ranunculus abortivus	Small-flowered crowfoot
Ranunculus ambigens	Water-plantain spearwort
Ranunculus aquatilis var. diffusus	White water-crowfoot
Ranunculus fascicularis	Early buttercup
Ranunculus hispidus var. caricetorum	Marsh buttercup
Ranunculus hispidus var. hispidus	Bristly buttercup
Ranunculus hispidus var. nitidus	Shiny bristly buttercup
Ranunculus micranthus	Rock buttercup
Ranunculus recurvatus	Hooked crowfoot
Rhexia virginica	Meadow-beauty
Rhododendron calendulaceum	Flame azalea
Rhododendron maximum	Rosebay
Rhododendron periclymenoides	Pink azalea
Rhododendron viscosum	Swamp azalea
Rhus copallinum var. latifolia	Shining sumac
Rhus glabra	Smooth sumac
Rhus typhina	Staghorn sumac
Rhynchospora alba	White beak-rush
Rhynchospora capitellata	Brownish beaksedge
Ribes americanum	Wild black currant
Ribes hirtellum	Northern wild gooseberry
Robinia pseudoacacia	Black locust
Rorippa palustris	Marsh watercress
Rosa carolina	Pasture rose
Rosa palustris	Swamp rose
Rosa virginiana	Wild rose
Rotala ramosior	Lowland rotala
Rubus allegheniensis	Common blackberry
Rubus enslenii	Southern dewberry
Rubus flagellaris	Prickly dewberry
Rubus hispidus	Swamp dewberry
Rubus idaeus var. strigosus	Red raspberry
Rubus occidentalis	Black-cap
Rubus odoratus	Purple-flowering raspberry
Rubus pensilvanicus	Pennsylvania Blackberry
Rubus pubescens	Dwarf blackberry
Rubus recurvicaulis	Dewberry
Rubus setosus	Bristly blackberry
Rudbeckia fulgida var. fulgida	Eastern coneflower
Rudbeckia hirta var. pulcherrima	Beautiful black-eyed-susan
Rudbeckia laciniata var. laciniata	Cutleaf coneflower
Rudbeckia triloba var. triloba	Three-lobed coneflower
Rumex altissimus	Tall dock
Sabatia angularis	Common marsh-pink
Sagina decumbens	Pearlwort
Sagina procumbens	Birdeye pearlwort
Sagittaria australis	Appalachian arrowhead
Sagittaria latifolia var. latifolia	Wapato
Sagittaria latifolia var. pubescens	Hairy Wapato
Sagittaria rigida	Sessilefruit arrowhead
Salix bebbiana	Long-beaked willow
Salix discolor	Pussy willow
Salix eriocephala	Diamond willow
Salix humilis var. humilis	Upland willow
Salix humilis var. tristis	Dwarf upland willow
Salix lucida ssp. lucida	Shining willow
Salix myricoides	Broad-leaved willow
Salix myricoides	Shoreline willow
Salix nigra	Black willow
Salix sericea	Silky willow
Salvia lyrata	Lyre-leaved sage
Salvia reflexa	Lance-leaved sage
Sambucus canadensis	American elder
Samolus parviflorus	Water pimpernel
Sanguinaria canadensis	Bloodroot
Sanguisorba canadensis	American burnet

Sanicula canadensis var. canadensis	Canadian blacksnakeroot
Sanicula canadensis var. grandis	Grand Canadian blacksnakeroot
Sanicula marilandica	Black snake root
Sanicula odorata	Yellow-flowered sanicle
Sanicula trifoliata	Large-fruited sanicle
Sarracenia purpurea	Pitcher-plant
Sassafras albidum	Sassafras
Saururus cernuus	Lizard's-tail
Saxifraga pensylvanica	Swamp saxifrage
Saxifraga virginiensis	Early saxifrage
Schizachyrium scoparium var. scoparium	Little bluestem
Schoenoplectus pungens	Chairmaker's rush
Schoenoplectus purshianus	Weakstalk bulrush
Schoenoplectus tabernaemontani	Softstem bulrush
Scirpus atrovirens	Black bulrush
Scirpus cyperinus	Woolgrass
Scirpus expansus	Wood bulrush
Scirpus georgianus	Georgia bulrush
Scirpus hattorianus	Mosquito bulrush
Scirpus microcarpus	Panicled bulrush
Scirpus pendulus	Rufous bulrush
Scirpus polyphyllus	Leafy bulrush
Scleria muhlenbergii	Reticulated nut-rush
Scleria pauciflora	Few-flowered nut-rush
Scrophularia lanceolata	Lanceleaf figwort
Scrophularia marilandica	Eastern figwort
Scutellaria elliptica var. elliptica	Elliptic skullcap
Scutellaria integrifolia	Hyssop skullcup
Scutellaria lateriflora	Mad-dog skullcap
Scutellaria leonardii	Small skullcap
Scutellaria nervosa	Skullcap
Selaginella apoda	Meadow spikemoss
Selaginella rupestris	Rock spikemoss
Senna hebecarpa	Northern wild senna
Sericocarpus asteroides	White-topped aster
Sericocarpus linifolius	Narrow-leaved white-topped aster
Setaria parviflora	Perennial foxtail
Sicyos angulatus	Bur cucumber
Silene antirrhina	Sleepy catchfly
Silene caroliniana ssp. pensylvanica	Wild pink
Silene stellata	Starry campion
Sisyrinchium angustifolium	Narrowleaf blue-eyed grass
Sisyrinchium atlanticum	Eastern blue-eyed-grass
Sisyrinchium mucronatum	Needletip blue-eyed grass
Sium suave	Water-parsnip
Smallanthus uvedalia	Bear's-foot
Smilax glauca	Cat greenbrier
Smilax herbacea	Smooth carrionflower
Smilax hispida	Bristly greenbrier
Smilax pulverulenta	Downy carrionflower
Smilax rotundifolia	Roundleaf greenbrier
Solanum carolinense	Horse-nettle
Solidago altissima	Late goldenrod
Solidago arguta var. arguta	Forest goldenrod
Solidago bicolor	Silver-rod
Solidago caesia	Bluestem goldenrod
Solidago canadensis var. canadensis	Canada goldenrod
Solidago canadensis var. hargeri	Harger's goldenrod
Solidago flexicaulis	Zigzag goldenrod
Solidago gigantea var. gigantea	Giant Smooth goldenrod
Solidago gigantea var. serotina	Smooth goldenrod
Solidago juncea	Early goldenrod
Solidago nemoralis	Gray goldenrod
Solidago patula ssp. patula	Spreading goldenrod
Solidago puberula	Downy goldenrod
Solidago rigida	Stiff goldenrod
Solidago rugosa ssp. aspera var. aspera	Thick-leaf goldenrod
Solidago rugosa ssp. rugosa var. rugosa	Wrinkle-leaf goldenrod
Solidago rugosa ssp. rugosa var. sphagnophila	Bog wrinkle-leaf goldenrod
Solidago speciosa	Showy goldenrod
Solidago squarrosa	Ragged goldenrod
Solidago ulmifolia var. ulmifolia	Elm-leaved goldenrod
Sorghastrum nutans	Indian-grass
Sparganium americanum	American bur-reed
Sparganium eurycarpum	Broadfruit bur-reed
Sphenopholis nitida	Shiny wedgescale
Sphenopholis obtusata var. major	Slender wedgegrass
Sphenopholis obtusata var. obtusata	Prairie wedgegrass
Sphenopholis obtusata x pensylvanica	Wedgegrass
Sphenopholis pensylvanica	Swamp-oats
Spiraea alba	White meadowsweet
Spiraea latifolia	Meadowsweet
Spiranthes cernua	Nodding ladies'-tresses
Spiranthes lacera var. gracilis	Southern slender ladies'-tresses
Spiranthes lucida	Shining ladies'-tresses
Spiranthes ochroleuca	Yellow nodding ladies'-tresses
Spiranthes romanzoffiana	Hooded ladies'-tresses
Spiranthes tuberosa	Slender ladies'-tresses
Spiranthes vernalis	Spring ladies'-tresses
Spirodela polyrhiza	Greater duckweed
Sporobolus compositus	Composite dropseed
Sporobolus neglectus	Small rushgrass
Sporobolus vaginiflorus	Poverty grass
Stachys palustris var. pilosa	Hairy hedge-nettle
Stachys tenuifolia	Creeping hedge-nettle
Staphylea trifolia	Bladdernut
Stellaria longifolia	Long-leaved stitchwort
Stellaria pubera	Great chickweed
Strophostyles helvola	Amberique-bean
Stylosanthes biflora	Pencil-flower
Symphoricarpos albus var. albus	Common snowberry
Symphoricarpos orbiculatus	Coralberry
Symphyotrichum cordifolium	Blue wood aster
Symphyotrichum dumosum	Bushy aster
Symphyotrichum laeve var. concinnum	Wide-leaved smooth blue aster
Symphyotrichum laeve var. laeve	Smooth blue aster
Symphyotrichum lanceolatum	Panicled aster
Symphyotrichum lateriflorum	Calico aster
Symphyotrichum lowrieanum	Smooth heart-leaved aster
Symphyotrichum novae-angliae	New England aster
Symphyotrichum novi-belgii	New York aster
Symphyotrichum patens	Late purple aster
Symphyotrichum phlogifolium	Thinleaf late purple aster
Symphyotrichum pilosum var. pilosum	Hairy white oldfield aster
Symphyotrichum pilosum var. pringlei	Pringle's aster
Symphyotrichum prenanthoides	Zig-zag aster
Symphyotrichum puniceum	Purplestem aster
Symphyotrichum racemosum	Small white aster
Symphyotrichum undulatum	Clasping heart-leaved aster
Symphyotrichum urophyllum	White arrowleaf aster
Symplocarpus foetidus	Skunk cabbage
Taenidia integerrima	Yellow pimpernel
Taxus canadensis	Canadian yew
Tephrosia virginiana	Virginia tephrosia
Teucrium canadense var. virginicum	Wild germander
Thalictrum dioicum	Early meadow-rue
Thalictrum pubescens	Tall meadow-rue
Thalictrum revolutum	Waxyleaf meadow-rue
Thalictrum thalictroides	Rue anemone
Thaspium barbinode	Hairyjoint meadowparsnip
Thaspium trifoliatum var. trifoliatum	Purple meadowparsnip
Thelypteris noveboracensis	New York fern
Thelypteris palustris	Marsh fern
Tilia americana var. americana	Basswood
Torreyochloa pallida var. pallida	Pale false mannagrass
Toxicodendron radicans	Poison-ivy
Toxicodendron vernix	Poison sumac
Tradescantia ohiensis	Bluejacket
Tradescantia virginiana	Virginia spiderwort
Triadenum virginicum	Marsh St. John's-wort
Trichomanes intricatum	Filmy fern

Trichophorum planifolium	Club-rush
Trichostema brachiatum	False pennyroyal
Trichostema dichotomum	Blue-curls
Tridens flavus	Purpletop
Trientalis borealis	Star-flower
Trifolium reflexum	Buffalo clover
Trillium cernuum var. cernuum	Whip-poor-will flower
Trillium cernuum var. macranthum	Nodding trillium
Trillium cuneatum	Huger's trillium
Trillium erectum var. album	Purple trillium
Trillium erectum var. erectum	Red trillium
Trillium grandiflorum	Large-flowered trillium
Triodanis perfoliata var. perfoliata	Clasping Venus' looking-glass
Triosteum angustifolium	Yellowfruit horse-gentian
Triosteum aurantiacum	Wild-coffee
Triosteum perfoliatum	Feverwort
Triphora trianthophora	Nodding pogonia
Tsuga canadensis	Canada hemlock
Typha angustifolia	Narrow-leaved cat-tail
Typha latifolia	Common cat-tail
Ulmus americana	American elm
Ulmus rubra	Red elm
Urtica dioica ssp. gracilis	California nettle
Uvularia perfoliata	Perfoliate bellwort
Uvularia sessilifolia	Sessileleaf bellwort
Vaccinium angustifolium	Low sweet blueberry
Vaccinium corymbosum	Highbush blueberry
Vaccinium macrocarpon	Cranberry
Vaccinium pallidum	Lowbush blueberry
Vaccinium stamineum	Deerberry
Valerianella umbilicata	Navel cornsalad
Vallisneria americana var. americana	Tape-grass
Veratrum latifolium	Slender bunchflower
Veratrum viride	False hellebore
Verbena hastata	Blue vervain
Verbena urticifolia var. leiocarpa	Velutinous white vervain
Verbena urticifolia var. urticifolia	White vervain
Verbena x engelmannii	Vervain
Vernonia glauca	Appalachian ironweed
Vernonia noveboracensis	New York ironweed
Veronica americana	American brooklime
Veronica officinalis	Common speedwell
Veronica peregrina ssp. peregrina	Neckweed
Veronica scutellata	Marsh speedwell
Veronicastrum virginicum	Culver's-root
Viburnum acerifolium	Maple-leaved viburnum
Viburnum cassinoides	Witherod
Viburnum dentatum	Southern arrow-wood
Viburnum lentago	Nannyberry
Viburnum nudum	Possum-haw
Viburnum prunifolium	Black-haw
Viburnum rafinesquianum	Downy arrow-wood
Viburnum recognitum	Northern arrow-wood
Viburnum trilobum	Highbush-cranberry
Vicia americana	Purple vetch
Viola affinis	LeConte's violet
Viola blanda	Sweet white violet
Viola cucullata	Blue marsh violet
Viola hirsutula	Southern wood violet
Viola labradorica	American dog violet
Viola macloskeyi ssp. pallens	Smooth white violet
Viola palmata	Early blue violet
Viola pedata	Birdfoot violet
Viola primulifolia	Primrose violet
Viola pubescens var. scabriuscula	Glabrous Downy yellow violet
Viola rostrata	Long-spurred violet
Viola rotundifolia	Round-leaved violet
Viola sagittata var. ovata	Ovate-leaved violet
Viola sagittata var. sagittata	Arrow-leaved violet
Viola sororia	Common blue violet
Viola sororia	Missouri violet
Viola striata	Striped violet
Vitis aestivalis	Summer grape
Vitis labrusca	Fox grape
Vitis riparia	Riverbank grape
Vitis vulpina	Frost grape
Vulpia octoflora var. glauca	Six-weeks fescue
Waldsteinia fragarioides	Barren strawberry
Wolffia borealis	Dotted water-meal
Wolffia columbiana	Water-meal
Woodsia obtusa	Blunt-lobed woodsia
Woodwardia areolata	Netted chain fern
Xanthium strumarium	Common cocklebur
Xanthium strumarium	Rough cocklebur
Xyris torta	Slender yelloweyed grass
Zanthoxylum americanum	Prickly-ash
Zizia aptera	Meadow zizia
Zizia aurea	Golden-alexander

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