

Creating Sustainable Community Parks

A Guide to Improving Quality of Life by Protecting Natural Resources



Prepared by the Pennsylvania
Department of
Conservation and Natural Resources

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Photo credits can be found on page 72.

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Introduction

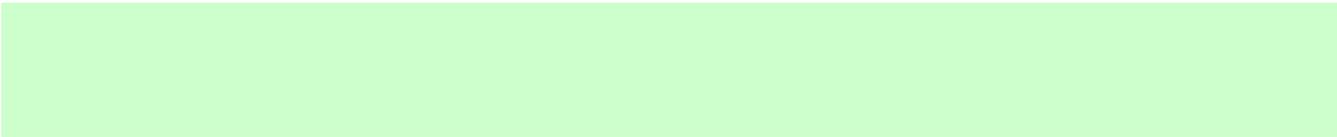
In too many instances, local parks provide barren vistas of mowed turf grasses, ornamental trees, and pavement. Little thought is given to incorporating a more naturalistic setting into park design. Research done at the Human-Environment Research Laboratory at the University of Illinois Urbana-Champaign has shown, however, that more trees, wildflowers, and other greenery in a neighborhood promotes a multitude of community and individual benefits. These benefits range from lower crime rates, stronger social ties, positive effects on health, and higher test scores in children. The environmental benefits that come from an increase in trees, wildflowers, and other native vegetation are also numerous: reduced flooding and erosion, air pollution filtration, air cooling, and protection of biodiversity, to name a few. Sustainable development, which incorporates more native greenery along with other environmental considerations, meets the needs of, and improves the quality of life for, the present without compromising the ability of future generations to meet their needs.¹ Therefore, a shift from purely recreation-based parks to sustainable community parks is one that not only improves the quality of the natural environment, but also enhances a park visitor's experiences and the community in general.

By devoting more attention to the natural resources in local park design, the livability of our towns and municipalities will be enhanced. This guidebook was created to outline the benefits of enhancing the natural resources in local parks, to maintain the park in a sustainable manner, and to provide a step-by-step guide to help park staff achieve those results. What does it mean to enhance natural resources? Well, everyone has a slightly different definition of nature. It can range from parks to backyard gardens to fields and forests. Nature can be small or large, nearby or far away, and can be closely managed or left to fend for itself. None of these is right or wrong, because all types of natural settings are beneficial to human quality of life.² Therefore, enhancing natural resources and creating sustainable community parks means that the flora, fauna, and the habitats (including the underlying geology) they inhabit will be managed in a manner that protects them from human-induced and naturally occurring disturbances, while ensuring that everyone can appreciate the resources.

The guidebook is directed primarily towards park staff charged with the design and maintenance of local parklands. It will provide steps for those who wish to enhance the natural resources of one small area of a park, as well as to those who want to make their maintenance processes more environmentally-sound. However, this guidebook is also applicable to local government officials who have the authority to create new - and enhance existing - parks. Locating a new sustainable community park on fallow agricultural land, on an old mine site or other brownfield is a way to protect and enhance wildlife habitat while making use of less than desirable land. This document could also be of assistance to state agencies when deciding on which parks to award grants. The information in this guidebook can help to show the benefits of shifting some funding from traditional recreation-focused parks to ones that incorporate natural resource conservation and sustainability into their design process and programming.

¹ "Building Livable Communities," by William Hosler, *Sylvan Communities*, Winter/Spring 2006

² Kaplan, Rachel et. al. (1998) *With People in Mind: Design and Management of Everyday Nature*, Island Press, Washington, DC. ISBN# 1-55963-594-0.



This guidebook is broken into six chapters, each of which highlights a step in the process of creating a new sustainable community park, or enhancing a traditional recreation-based park so that the park is more environmentally-focused.

- Chapter 1 gives a brief introduction to the costs of traditional parks in terms of their impact on the environment and maintenance, and highlights the economic, environmental, and health benefits of a sustainable community park.
- Chapter 2 defines “sustainable community park” and the elements that are needed to create one. These include ecological landscaping principles, attracting wildlife, protecting water resources, the differences between native and invasive species, and balancing recreation with conservation.
- Chapter 3 is the design guide. It provides information for people wishing to change just one or a few aspects of their park, to those who wish for a complete park makeover.
- Chapter 4 is the maintenance guide, and describes the native plants to use and how to keep them healthy.
- Chapter 5 involves a key piece of the puzzle: education. Making these sometimes drastic changes to a park will require buy-in from the public and the park staff. This chapter outlines the public relations campaigns, educational materials and programs, use of volunteers, and training that can be used to make the park’s transition much more appealing.
- Chapter 6 provides several case studies of parks in Pennsylvania that have successfully incorporated natural resource conservation and sustainability into their design and maintenance practices. These examples can provide ideas and inspiration for others wishing to make changes to their park.

At the end of the guidebook are five appendices full of useful information. Appendix 1 provides a list of native plants that can be used in a park to enhance the wildlife habitat and aesthetic quality. Appendix 2 provides a map of the plant hardiness zones in Pennsylvania. Appendix 3 lists those invasive plants that should not be used in a park, and should be removed if they are already present. Appendix 4 provides valuable Internet resources and publications that will supplement the information presented in this guidebook. Appendix 5 provides a list of photo credits for this publication.

Costs of Traditional Recreation-Based Parks

When people think of their local parks, the images that come to mind probably include ball fields, playgrounds, grassy areas, and perhaps a few trees. While these parks offer some benefits to residents, such as exercise opportunities and a place to relax, they offer limited value to the environment, and can in fact degrade the local ecosystem through their maintenance practices. The problems with maintaining traditional parks are numerous. Maintenance can be very labor and resource intensive, thus costly. As stated in *The Excellent City Park System: What Makes it Great and How to Get There* by Peter Harnik, “It is so much more expensive to create and operate ‘designed’ landscapes (constructed parks that are mowed or regularly cleaned up) than natural landscapes (those which are left alone, except for the occasional trail).”³

The turf grass that dominates most parks can require frequent mowing, raking, irrigation, and periodic applications of chemical fertilizers and pesticides. The use of gasoline and diesel powered lawn equipment contributes to air pollution, sometimes of a greater magnitude than automobiles since the mowers lack the same emission controls that have been placed on autos. The use of this equipment, particularly during midday, contributes to smog conditions and ozone warnings. Grass is typically mowed to the edge of water bodies, which can leave the bank unstable and foster a habitat highly suited towards nuisance geese. Even the noise from

³ “The Excellent City Park System: What Makes it Great and How to Get There,” *The Trust for Public Land*, 2003, p.20, www.tpl.org/tier3_cd.cfm?content_item_id=11428&folder_id=175.

the mowers can disturb nesting, breeding, and hiding wildlife.

When irrigation is used, the excess water travels over impermeable surfaces in the park and can carry away excess fertilizers that could promote the growth of algae and invasive plant species. When pesticides are improperly used or disposed of, any excess pesticide could potentially reach drinking water supplies and could harm native plants and animals.

In addition to maintenance practices, the design of traditional parks is not always conducive to conserving and enhancing the natural

“A flat patch of grass may be perfect for organized sports, but not for unstructured or natural play.”

-From *Last Child in the Woods*, by Richard Louv

environment. Roads and parking lots fragment habitats, plants are chosen for their aesthetics rather than their wildlife benefits, and the recreational ball fields

and playgrounds are not suitable habitat for most animal and plant species. Furthermore, the underlying geology and resulting soil chemistry may not naturally support the chosen plants. So as development pressures rise, wildlife have nowhere to go, with all the turf yards, shopping plaza parking lots, and freeways taking up all available habitat, creating an unbalanced landscape.

This guidebook is not advocating for the elimination of recreational parks, as they exist today, but rather tries to encourage these parks to incorporate more wildlife habitat, natural resource protection efforts, and environmentally-sustainable maintenance practices into their design and management so that they fit more harmoniously into their surroundings.

Benefits of Sustainable Community Parks

A sustainable community park, for the purposes of this guidebook, is one where the natural resources are protected, where wildlife habitat is improved, and where human recreational uses and maintenance practices do not conflict with the environment, but are rather enhanced by it. Native vegetation is used whenever possible, and the use of turf grass is minimized.

Maintenance practices focus on reducing their impact on the environment, while at the same time saving money. Parks that focus more attention on natural resources and sustainable practices have been shown to have numerous benefits, some of which are highlighted below.

Economic Benefits

Vegetation in parks can provide flood control and storm water benefits by absorbing and storing precipitation and pollutants in their roots and stems, instead of allowing the pollution to end up in streams and lakes. Run-off, which is the part of precipitation that flows over the land into surface water bodies, can lead to flooding, which in turn can lead to property damage and habitat loss. The lower the percentage of run-off, the less likely flooding is to occur.

In areas with large amounts of vegetation like parks and forests, the rate of run-off is estimated to be just 10 to 20 percent. Compare that to areas with large areas of impermeable surfaces like roads and rooftops, where the rate of run-off is 60 to 70 percent. The more native plants in an area, the greater the protection against flooding and water pollution.⁴

⁴ “How Cities Use Parks for Green Infrastructure,” *City Parks Forum Briefing Papers: Number 5*, American Planning Association, <http://www.planning.org/cpf/pdf/greeninfrastructure.pdf>.

Developing parks in urban areas can help revitalize failing or threatened commercial areas, thus bringing in revenues vital to a city’s success.⁵ According to the Brookings Institution report, *Back to Prosperity: A Competitive Agenda for Renewing Pennsylvania*,⁶ the Commonwealth is suffering from “serious brain drain.” Many of our young and highly skilled workers are moving to other states. These “knowledge workers” prefer places with a variety of outdoor activities, from walking trails to rock climbing.

Improving the Commonwealth’s parks can attract and retain these “knowledge workers” who will then put money back into the economy through housing, consumer goods, and taxes.⁷ Park improvements may also increase tourism,⁸ an industry sector that currently contributes significant revenues to the Commonwealth, and is expected to increase over the years.

Parks can be more than just recreation centers. They can provide economic benefits in terms of cost savings and creating more appealing places to live.

⁵ “How Cities Use Parks for Community Revitalization,” *City Parks Forum Briefing Papers: Number 1*, American Planning Association, <http://www.planning.org/cpf/pdf/communityrevitalization.pdf>.

⁶ <http://www.brookings.edu/es/urban/publications/pa.htm>.
⁷ “How Cities Use Parks for Economic Development,” *City Parks Forum Briefing Papers: Number 3*, American Planning Association, <http://www.planning.org/cpf/pdf/economicdevelopment.pdf>.

⁸ “How Cities Use Parks to Promote Tourism,” *City Parks Forum Briefing Papers: Number 9*, American Planning Association, <http://www.planning.org/cpf/pdf/promotetourism.pdf>.

Environmental Benefits

The biodiversity, or the variety of living things, in a town or municipality depends in large part on the quality of parks, forests, and farmlands. When parks are designed to minimize the fragmentation from roads and link parks together with surrounding natural areas, they are more capable of benefiting people, wildlife, environmental quality, and the economy. Many species of wildlife need large tracts of land to find food, shelter, and mates. A network of sustainable community parks would provide pathways for wildlife moving from one isolated park to the next, particularly in areas where development pressures are high. Integrating parks with riparian corridors, wetlands, and other open spaces will increase the ecological protection value many times over.

As was mentioned previously, increasing the number of native plants in a park, where it can be supported by the underlying geology, would help prevent flooding events that can damage the environment through siltation of water bodies, erosion of banks, and destruction of wildlife habitat. According to the US Forest Service, just one tree can generate \$31,250 worth of oxygen, provide \$62,000 worth of air pollution control, recycle \$37,500 worth of water, and control \$31,250 worth of soil erosion over a 50-year lifespan.⁹ So planting more native trees and other vegetation in a sustainable community park can protect and enhance environmental quality, particularly when combined with the maintenance practices outlined in Chapter 4.

⁹ U.S. Department of Agriculture, Forest Service Pamphlet #R1-92-100, cited in “Benefits of Trees in Urban Areas,” *Colorado Tree Coalition*, www.coloradotrees.org.

Health and Safety Benefits

Scientists at the University of Illinois¹⁰ have discovered that time spent in nature relieves mental fatigue and the feelings of violence and aggression that can spring from it. Two groups of young adults were studied; one that took a walk through a nature reserve, the other took a walk through an urban setting. Performance on attentional tests improved in the nature group, and they expressed less feelings of anger than the urban group. Nearly everyone experiences mental fatigue now and then, and natural settings can provide great activities to relieve this fatigue.

Time spent in nature relieves mental fatigue and the feelings of violence and aggression that can spring from it.

Natural resources provide many “activities” that require little to no effort, yet provide ways to restore a person’s health and mental well-being: viewing fall foliage,

gazing at the clouds, and watching squirrels climb trees. These are not “passive” activities, as some might consider them. They are active recreational activities in that they actively engage the mind. We all need to feel “away” at times, and parks that focus on natural resources and sustainability can provide that to park visitors.

Researchers from the University of Illinois also found that areas with many trees, wildflowers, and other vegetation help neighbors form social ties that create stronger, safer neighborhoods. The more trees and greenery that existed in a space, the more heavily used the space was by all age groups. And the more heavily used the area is, the less likely criminal behavior is to occur.

¹⁰ “How Cities Use Parks to Create Safer Neighborhoods,” *City Parks Forum Briefing Papers: Number 4*, American Planning Association, www.planning.org/cpf/pdf/createsaferneighborhoods.pdf.

The researchers found that roughly half as many quality-of-life crimes were reported in urban areas with high amounts of vegetation. These crimes include littering, graffiti, and disruptive neighbors. The creation of new parks, or the enhancement of existing parks, is one of the quickest and most effective ways local politicians can improve the image of, and quality of life for, their community.¹¹

The richer and more diverse a park environment is, the richer the learning opportunities can be for children. Particularly for children in urban areas, parks not only offer opportunities for healthy physical activity, but also provide a connection with the natural world. Recent scientific studies have demonstrated that natural areas have positive health impacts on development issues, particularly behavioral disorders like attention deficit hyperactivity disorder (ADHD).¹² Health studies have also shown that contact with nature offers a range of medical benefits such as lower blood pressure and cholesterol levels, enhanced survival after a heart attack, a more rapid recovery after surgery, and lower levels of stress and depression.¹³

Roughly half as many quality-of-life crimes were reported in areas with high amounts of vegetation.

According to the University of Washington's Center for Urban Horticulture, a mature tree canopy can reduce air temperature by five to ten degrees, while the addition of blacktop and other impermeable surfaces contributes to higher temperatures. The evaporation from one large tree can produce the same cooling effect of 10 room-size air conditioners operating 24 hours a day.⁹ Considering that more people die in summer hot spells than all other U.S. weather events combined, the public health benefits of increased native trees and other greenery in parks, particularly when combined with a reduction in impermeable surfaces, is staggering. In addition, trees have the capacity to remove pollutants like sulfur dioxide and nitrogen from the air, thus reducing the incidences of asthma and other respiratory diseases.¹³



Sustainable community parks not only have tremendous value for the environment and wildlife habitat, but also for human health, safety, and the state of the economy. Creating new parks and enhancing old ones so that they focus more attention towards natural resource conservation and sustainability is a step that can improve the quality of life for everyone in a community.

¹¹ "How Cities Use Parks for Community Engagement," *City Parks Forum Briefing Papers: Number 2*, American Planning Association, <http://www.planning.org/cpf/pdf/communityengagement.pdf>.

¹² "How Cities Use Parks to Help Children Learn," *City Parks Forum Briefing Papers: Number 6*, American Planning Association, <http://www.planning.org/cpf/pdf/helpchildrenlearn.pdf>.

¹³ "How Cities Use Parks to Improve Public Health," *City Parks Forum Briefing Papers: Number 7*, American Planning Association, <http://www.planning.org/cpf/pdf/improvepublichealth.pdf>

The traditional park focuses on recreational facilities and typically consists of turf grass, with a few trees, shrubs, and flowers interspersed throughout. The layout and maintenance of these parks offers limited habitat for wildlife, may require considerable inputs of water and nutrients to maintain, and can contribute to various forms of environmental degradation. Sustainable community parks, on the other hand, focus on creating a park environment that is beneficial for both human uses and natural resource conservation in both the short and long-terms. Ideally, it is in harmony with the entire environment, both above ground and beneath the vegetation and soils. More attention is focused on selecting appropriate native plants, on minimizing human impacts on the environment, and on selecting other methods that will preserve the community's natural resources and improve overall quality of life. Chapter 2 outlines the various components that make up a sustainable community park, from identifying the park's natural resources to managing for improved wildlife habitat.

Natural Resource Inventory

Before any steps can be taken towards creating and managing a sustainable community park, you will have to know what kinds of natural resources are found within the park. A natural resource inventory will help do that. A *natural resource inventory* is a list and description of all the characteristics of the land, including soils, bedrock, ground and surface water, vegetation, and wildlife. The inventory could also include the built landscape (roads, trails, utility rights-of-way, buildings).

The following resource categories are typically used to define the natural environment in a natural resource inventory:¹⁴

- significant wildlife habitat
- scenic areas
- riparian corridors
- recreational resources
- productive forest resources
- special landscapes
- wetlands and floodplains
- historical and cultural resources
- vulnerable landscapes
- moderate and steep slopes
- geology and soils

¹⁴ "Using Comprehensive Planning to Conserve the Community Forest," by Bill Elmendorf, *Sylvan Communities*, Winter/Spring 2006

Natural resource inventories are made up of a map of the locations of all resources, a description of the relationships between resources, identification of the stresses and threats to the resources, uses affecting the resources, benchmarks to use when measuring future change, and suggestions for the future.¹⁵

Stresses and threats to the natural resources can include nearby development pressures, steep stream banks that could lead to erosion, hunting and fishing pressures, invasive species, and deer overbrowse, to name just a few. Solutions for how to deal with these threats can be listed within a natural resource plan for the park (*see next section*).

The inventory should also include a Pennsylvania Natural Diversity Inventory (PNDI) search of the proposed site. PNDI is a project-screening tool for locating species of special concern that may occur on a site. The tool is operated by the Pennsylvania Natural Heritage Program (PNHP), which is a collaborative effort between DCNR, the Western Pennsylvania Conservancy, and The Nature Conservancy. For more information on

¹⁵ "Natural Resource Inventory for the Town of Meredith, NH," *Meredith Conservation Commission*, www.meredithnh.org/pdfdocs/Meredith%20NRI.pdf.

PNDI and to use the tool, visit www.naturalheritage.state.pa.us/whypnhp.aspx.

Inventories can be done by park staff (if they are knowledgeable in geology, hydrology, and biology), by a consultant, or by an environmental organization experienced in conducting natural resource inventories. Inventories should be repeated on a regular basis, say every five years, to ensure that changes to the natural resources and the stresses on them are identified.

To help complement the information obtained in an inventory you could hold a BioBlitz event in the park. A BioBlitz is a rapid assessment, over the course of 24 hours, intended to identify as many species as possible within a selected area, like a park. During a BioBlitz, scientists work alongside park staff, amateur naturalists, and the general public to complete an inventory of the park. Holding such an event can be a great way to raise public awareness of the natural world, but there is a lot of planning and coordination needed for it to work successfully. The following link provides more information on organizing a BioBlitz, www.gllhabitat.org/GL_Toolbox_v1/BioBlitzGuide.pdf.

Natural Resource Management Plan

A *natural resource management plan* is a document that outlines the objectives for park management and provides a list of actions for meeting the objectives. The plan is like a road map, directing your park on where to go next. The results from the inventory form the basis of the natural resource management plan. The structure of the plan typically includes the background information on the park (ownership, acreage, location, history of the property), the results from the natural resource inventory, management objectives, management recommendations, a timeline for upcoming construction and maintenance projects, and budget estimates for a three or five-year term.

However, the plan should be tailored to meet a park's specific needs, so the structure might differ somewhat from what is listed above.

Park staff or hired consultants can write management plans. The decision on who should write the plan will come down to staff time, budget, and the level of detail desired for the plan. However, if a consultant is chosen to write the plan that does not mean that park staff can sit back and let the consultant do all the work. The more involvement park staff has in the development of the plan, the easier it will be for them to implement it in the future. Park visitors and other stakeholders should also be involved in developing the plan, as they are the ones who will be using the park and impacting its natural resources. For more on working with consultants for plan development, visit www.jonkohl.com/publications/n-z/sol-plans.pdf.

The most integral part of the management plan is the objectives section. Objectives are the short-term and long-term goals for the park. To help determine management objectives for the park, there are many questions¹⁶ you can ask yourself, other staff members, and park visitors:

- How many acres are in forest? Grass? Wetland? Total?
- What is the management history?
- What active and passive uses will you have in your park? (bird watching, biking, hiking, fishing, camping, other)
- What are your priorities for the park? (recreation/aesthetics, wildlife management, erosion control, other)
- What wildlife would you like in your park?

¹⁶ "What is a Natural Resource Management Plan," *University of Florida Extension*, <http://edis.ifas.ufl.edu/fr126>.

- What are your management constraints? (limited capital, lack of equipment, financial or technical assistance needs, other)
- Are there outstanding or unique features that require special management or protection?
- What are some threats to your park? (steep streambanks, nearby development pressures, invasive species, other)

DCNR's Bureau of Forestry has completed a statewide Resource Management Plan that can be viewed at www.dcnr.state.pa.us/forestry/sfrmp/index.htm. This document may provide you with ideas on how to complete a plan for your park, as it encompasses not only information on natural resources but also covers recreational uses and infrastructure.

You may also want to complete an invasive species management and control plan to help prioritize a few of the most damaging species. More information on invasive species management plans is included in Chapter 4.

Once the management goals for the park are established, determine what can be done to reach those goals. Management recommendations are the actions that can be taken to achieve the objectives outlined in the plan. These recommendations can be made for the park as a whole, or for individual areas of the park. The recommendations will outline best management practices (BMPs) to use, along with a discussion of the expected results. BMPs can include where to plant native vegetation, when to mow or burn warm-season grasses, and which herbicides to use, among others.

When the inventory and plan writing process are finished, and the public has had a chance to

comment on them and feel involved, then work on the natural resource design and maintenance of the park can begin. However, park management plans should be reviewed on a five to 10-year basis to include new changes to the park, and to ensure that the suggestions are up-to-date. Natural resource planning in your park will be a continuous process if it is to be effective.

Principles of Sustainable Community Park Design and Landscaping

This section is a quick reference guide for someone wishing to create a sustainable community park. The following ten suggestions highlight various principles to consider when designing and landscaping a sustainable community park. Each suggestion could be used separately for a park that has a modest budget and staff, or the suggestions can be combined to create a park that protects and enhances all of its natural resources while still providing recreational opportunities.

1. Retain as much of the pre-existing landscape as possible during new construction, including the soil, rocks, native vegetation, wetlands, and contours. This will minimize disturbances, which can open up an area to invasive species. It can also keep costs down, as fewer new plants, soil amendments, and habitat enhancements will be needed.
2. Maintain high quality soils that will hold water and supply plants with proper nutrients. During construction, leave as much existing topsoil as possible. When new soil is brought in, ensure that it is certified weed free, in order to prevent the spread of new invasive species. Using compost and other natural products for mulch and fertilizer will help enhance the soil and feed the native plants. Good quality

soil will reduce the need for fertilizers and supplemental watering.

3. Connect new landscape components with the surrounding native vegetation to create larger contiguous areas of habitat. Many wildlife species need large ranges to find adequate food, mates, and shelter. By reducing the amount of roads, parking lots, and turf areas, or by placing these together, habitat quality will be enhanced.
4. Create natural storm water management systems and other green infrastructure, such as rain gardens and swales of native grasses. These systems help to minimize downstream flooding, recharge and filter groundwater, and are more cost-effective and environmentally-sound than man-made systems of pipes and storage tanks.
5. Protect wetlands from disturbance and fill. Avoid placing construction projects, day-use areas, and roads/parking lots near or in wetlands. Natural wetlands provide many benefits to the environment that cannot easily be duplicated with man-made ones.
6. Use integrated pest management (IPM) strategies to minimize the use of chemical pesticides to control plant and insect pests. IPM is an ecologically-based approach to pest control that helps maintain strong and healthy plants. IPM can include the use of traps, sterile male pests, and quarantines.
7. Minimize impermeable surfaces like roads, parking lots, and paved trails. Consider replacing asphalt and concrete with permeable pavement, mulch paths, gravel lots, and native vegetation. Permeable surfaces help to recharge ground water, reduce erosion, lessen flooding events, and filter out pollutants. When impermeable surfaces must be used, arrange them in an

area where they will not fragment habitat, make them as small in area as possible, and keep them away from water bodies.

8. Reduce turf to only those areas essential for recreational and other human use activities. Turf offers little habitat benefit and is not as effective as many native plants in pollution filtration, flood prevention, and erosion control. In addition, turf maintenance can have negative impacts on the surrounding environment and can require lots of mowing, watering, and fertilizing. Replace non-native turf grasses with native warm season grasses, which, once they are established, have lower maintenance needs.
9. Use native plants in riparian buffers around any surface water body, including wetlands. Riparian buffers help to filter pollutants before they reach water bodies, and the vegetation discourages nuisance geese from staying in the area. Roots from riparian vegetation also prevent erosion of soils into the water body and minimize flooding events. Shade from these buffers acts as a temperature control for the water body, which enhances habitat value for aquatic organisms. The food and shelter values of these buffers also enhances habitat. In addition, by selecting the right kinds of plants, the scenic views of the water bodies can be enhanced.
10. Identify and remove invasive plant species whenever possible. Invasive plants have a number of detrimental effects on natural habitats. Most invasive plants grow so densely and spread so rapidly that native vegetation is choked out. Appendix 3 lists some invasive plant species in Pennsylvania.

Enhancing Wildlife Habitat

Pennsylvania has a wealth of wildlife ranging from black bears and Jefferson salamanders to gray squirrels and northern cardinals. Local parks can tap into the Commonwealth's wide variety of animal species by enhancing existing habitats, and creating new ones. This will open up many opportunities for wildlife viewing, bird watching, and other outdoor activities.

In order to attract and retain wildlife in a park setting, it is important to meet the **four basic needs of all wildlife**, which are described below. For further information on attracting wildlife, see www.audubon.org/bird/at_home/pdf/AAHPA-73-80-Resources.pdf.

- ◉ **Food:** Native plants that include one or more of the following will provide valuable food for wildlife: fruits like berries and crabapples, seeds such as nuts or acorns, and nectar from flowers. The color of the flower can determine what types of birds and insects might appear. For instance, hummingbirds prefer red and orange flowers, while butterflies are attracted to yellow, purple, blue, or pink.¹⁷ See the text box on the left

Butterflies of Pennsylvania

There are approximately 149 different species of butterflies in Pennsylvania. Many park visitors welcome the added color and movement of butterflies.

The first step in attracting butterflies to an area is figuring out which types live in the area, and choosing the right plants for those butterflies. For more information, visit www.butterfliesandmoths.org.

Caterpillars, the juvenile form of butterflies, typically eat plant leaves, while adults tend to drink flower nectar. You will need to include food and water sources for both life stages in order to have a successful butterfly garden.

Butterflies also need to stay warm in order to fly. Having a few flat rocks in the garden will provide them with a place to get some sun. The butterflies should also be protected from the wind by some well-placed trees.

Do not use herbicides near butterfly habitat, as it could harm them.

for more information on attracting butterflies.

Some examples of native plants that provide food for wildlife include white pine, oak species, dogwoods, big and little bluestem grasses, and New England aster (*see photo below*). A list of additional native plants with wildlife benefits can be found in Appendix 1.



New England Aster

- ◉ **Water:** Parks that contain lakes, ponds, streams, or other water bodies have a pre-existing water source for wildlife. These areas can be made more attractive to wildlife if riparian buffers are created around them.

¹⁷ "Creating a Wildlife Garden," *National Wildlife Research Center*.

For parks without obvious sources of water, man-made ponds and wetlands could be created, or birdbaths could be utilized, in order to provide this necessity to the local wildlife.

- **Cover:** Wildlife need places to hide from predators, raise their young, and find shelter from harsh weather and temperatures. Standing and downed dead trees (*snags*) of various sizes provide habitat for over 35 species of birds, 20 species of mammals, and numerous reptiles, amphibians, and insects in Pennsylvania,¹⁸ so they should not be removed unless they pose a hazard. More information on snags can be found in the Penn State Cooperative Extension publication *Dead Wood for Wildlife*, which is available free of charge at county extension offices or online at http://pubs.cas.psu.edu/free_pubs/pdfs/uh065.pdf.

Brush piles are also an excellent form of wildlife cover (*see the box in the center*). A variety of native plant species, with differing foliage heights and arranged as naturally as possible, will provide the best

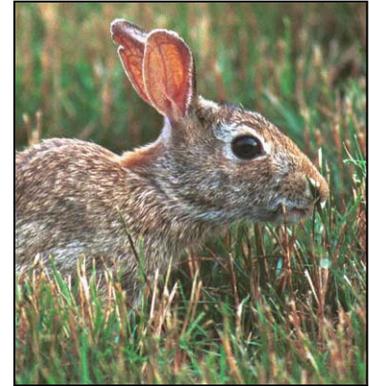
Brush Piles

Brush piles can be created from a variety of dead woody and herbaceous plant materials. These piles are used for cover by many animals, such as the eastern cottontail rabbit and other small mammals. Birds may use brush piles as perching sites, particularly if food or nesting sites are located nearby. Even reptiles and amphibians could make a brush pile their home if the pile is located near a source of water.

When creating a brush pile, it is best to place the largest materials (pole-sized logs) on the bottom and smaller materials (branches and small shrubs) on the top. This arrangement will slow the rate of the pile's decay and allow small animals to hide underneath the pile.

Place the brush piles near a food source and in an area where natural cover is sparse, like forest and field edges. This will make it more likely that the pile will be used.

cover for a variety of wildlife species. Nest boxes can be used to supplement natural cover sites and are particularly useful for cavity nesters like Eastern bluebirds and bats.



The eastern-cottontail rabbit will use brush piles for a source of cover.

- **Space:** The size of an area needed for food, water, and cover will depend on the species of animal. The more a park can be left in a natural state, the more wildlife that the park can attract. Human-use areas should be arranged in such a way as to maximize the connectivity between natural habitat areas.

Wildlife corridors are used to connect two undeveloped habitat areas that are isolated from one another. Forming partnerships with nearby counties, townships, or municipalities to connect several local parks by a corridor would be a great way to expand wildlife habitat regionally.

¹⁸ "Management Practices for Enhancing Wildlife Habitat," *Penn State College of Agricultural Sciences Cooperative Extension*, http://conserveonline.org/docs/2001/11/Management_Practices.pdf.

Conserving and Protecting Water Resources

Maintaining and operating a park can use up large quantities of water, whether the park's focus is on recreation, natural resource protection and sustainability, or both. Determining water budgets, a topic that will be described below, can help define sustainability in terms of overall water use and impacts. Water uses can range from irrigating turf fields to filling up swimming pools. With higher water consumption comes higher water bills and less water available for the natural resources, including the plants and animals. This section offers suggestions on how a park can reduce its water use and preserve its water resources in a manner that will be beneficial to humans, wildlife, and the environment.

Monitor and Minimize Water Uses

A water budget quantifies all the water flowing into and out of a defined area, such as a watershed or a local park, over a fixed period of time. A water budget looks at precipitation rates, the infiltration of water through the soil – which depends in large part on the amount of impermeable surfaces like roads – evaporation, and the various water users in the area.

A water budget can show a park how much water it will need for things like pools, restrooms, drinking fountains, and irrigation, versus how much water is available. The amount of water being used will depend on factors such as the efficiency rating of faucets and toilets, the time of year (water use is typically higher in the spring and summer because of pool use and watering plants), and a whole host of site-specific conditions. The amount of water available will depend on precipitation rates, groundwater levels, and stored water (in reservoirs, tanks, etc.). For information on how to create a water budget for your park, visit www.greenbuilder.com/sourcebook/WaterBudget.html.

Knowing the amount of water in an area will help to make decisions on how to use and preserve water resources. A sustainable community park will ensure that human uses of water do not negatively impact the water available for wildlife, plants, and the environment. Parks can achieve this in many ways. The use of low-flow toilets,

automatic shut-off faucets, soaker hoses instead of sprinklers for irrigation, and checking for leaky pipes can all help reduce water waste in a park. This can not only save the park money in the long run, but also ensure that water remains available for other water users, including wildlife and plants.

Another option is to reuse the park's graywater. Graywater is any water that has been used in a home, park, or business setting (except from toilets) that can then be reused for things such as irrigation, mixing with herbicides, and in commercial toilet flushing. Graywater reuse has many benefits including a reduction in fresh water demands and the cost savings that go with that. To learn more about graywater in general, visit www.graywater.net.

There are many strict guidelines to follow when using graywater, however. Basically if graywater is to be used for irrigation in a park, it will have to undergo secondary treatment followed by filtration and disinfection. These processes may be cost-prohibitive for a single park, but a park system or collaboration between local municipalities might make it affordable. Before starting anything, consult the Department of Environmental Protection (DEP) and their draft technical guidance on the use of graywater, which can be viewed at www.dep.state.pa.us/TechnicalGuidance/Draft_technical_guidance.asp, document #362-0300-009,

“Reuse of Treated Wastewater Guidance Manual.”

Create and Enhance Riparian Buffers

Riparian buffers are areas of vegetation alongside streams and other bodies of water. Thousands of miles of riparian buffers in Pennsylvania have been degraded or lost over the years, due to development.¹⁹ These losses are damaging to the environment because buffers offer many water quality benefits for humans and wildlife. Riparian buffers mitigate floods, recharge groundwater, prevent erosion and sedimentation of the stream, trap pollutants within plant roots, and improve aquatic and terrestrial species habitat.

This is accomplished in several ways. Riparian buffer plants slow runoff from precipitation and allow it to infiltrate into the soil. This settles out sediment, nutrients, and pollution before they can reach the stream. Forested buffers have the greatest filtration capacity; infiltration rates are 10 to 15 times higher than those of turf grass areas. Studies have also shown a 30 to 98 percent reduction of pollution and excess nutrients in surface and groundwater that have passed through a forested buffer.²⁰

The trees found in forested buffers also help to regulate the water temperature of a stream by providing shade. The higher the water temperature, the more likely algae and aquatic nuisance plant species are to grow. Dissolved oxygen levels are reduced as temperatures increase, and this can lead to increased mortality

¹⁹ “Wetlands and Riparian Buffers: Protecting and Restoring Important Waterways,” *Pennsylvania Audubon*, http://www.audubon.org/bird/at_home/pdf/AAHPA-33-42-Wetland.pdf.

²⁰ “Riparian Forest Buffers,” *Chesapeake Bay Program*, www.chesapeakebay.net/info/forestbuff.cfm.

of aquatic wildlife. While trees will provide better shade in riparian areas than grasses and other vegetation, any buffer is better than none at all. Using a combination of trees, warm season grasses, and other native vegetation in the riparian buffer will not only protect the water body, but also provide a variety of habitats for both aquatic and terrestrial species. Stroud Water Research Center (www.stroudcenter.org) suggests the use of eight to ten species in a buffer planting to restore a wide range of stream functions.²¹

The quality of the riparian buffer and its wildlife habitat increases as the size of the buffer increases. Riparian buffers of 35 to 100

Riparian buffers help to prevent floods, reduce erosion, and protect water quality, among other benefits.

feet wide on each side of the stream are very effective, but buffers under 35 feet will still provide some value to habitat quality and environmental

protection. Buffers with a width of 100 to 300 feet on each side provide the most significant benefits to wildlife, but dedicating that much space within a park may be a challenge. Deciding on the width of the buffer will depend on many factors, including the quality of the water body for human and wildlife uses, the extent of the floodplain, the degree of slope on the banks, and the amount of land not already devoted towards some other use. In any case, as much land as possible should be devoted towards the buffer.

Riparian buffers are a new concept to many people, and the appearance of the buffer is something to keep in mind prior to its creation. Care should be taken to ensure that maintenance staff does not accidentally mow or remove plants within the riparian buffer.

²¹ “Riparian Forest Buffer Design and Maintenance,” *Maryland Department of Natural Resources*, June 2005.

Using signs, flagging, or tape to distinguish the no-mow areas from those that can be mowed will accomplish this.

Park visitors that have come to expect easy access to the stream will need to be educated on the importance of the riparian buffer. They should also be provided with a few well-marked access points to the water. Otherwise the visitors might see the buffer as a “weedy” nuisance and request that it be mowed down. This occurred along the Turkey Run stream in Lower Southampton Township, outside of Philadelphia. Wildflower meadows and no-mow areas were installed to protect the stream from pollutants, which included droppings from hundreds of aggressive geese. An education campaign helped to gain acceptance and buy-in of the buffer from the local residents.¹⁹

Protect Wetlands and Critical Recharge Areas

Just like riparian buffers, wetlands have a crucial function in the health of not just aquatic ecosystems, but terrestrial ones as well. Wetlands act as a natural flood control by slowing down storm water. They also recharge groundwater and trap sediment, fertilizers, and pollutants before they enter the water cycle. Most of Pennsylvania’s wildlife spends some or all of their life in a wetland environment. And nearly half of all isolated wetlands (those not connected to navigable waters) provide habitat for federally listed species under the Endangered Species Act.²²

Unfortunately, more than half of Pennsylvania’s wetlands have disappeared since the 1700s because of development, agriculture, and habitat degradation. Nowadays, less than two percent of Pennsylvania is covered by wetlands.¹⁹

Luckily there are many ways that parks can protect wetlands. Construction and other forms of

²² “Biodiversity Values of Geographically Isolated Wetlands in the United States,” *Nature Serve*, www.natureserve.org/publications/isolatedwetlands.jsp.

disturbance should be avoided in and near wetlands. Filling in or building near a wetland can have profound negative impacts on the environment, and so, should be avoided at all costs. Parks should also keep roads, trails, and recreational activities as far away from wetlands as possible. Another source of protection can come from planting riparian buffers around all wetlands within the park.

Sometimes protecting wetlands depends on protecting critical recharge areas. Critical recharge areas are typically large contiguous areas of land that allow precipitation and other surface waters to infiltrate through the soil to recharge the groundwater. Typically 80 percent of precipitation infiltrates through the soils in Pennsylvania, and plants then take more than half of that water up. The rest of that water feeds wetlands, streams, and drinking water aquifers. Without this constant recharge, periods of drought could leave streams and wells dry, thus affecting available drinking water and wildlife habitat.²³ An estimated 37 percent of Pennsylvanians get their drinking water from groundwater wells, so it is therefore imperative to protect these critical recharge areas.²⁴

Developing a sustainable community park in a critical recharge area is one way to ensure that the area is protected from development—housing, strip malls, industrial parks - and the large areas of impermeable surfaces and pollution that can come with it. If your park is located within one of these recharge areas,

²³ “Pennsylvania Stormwater Best Management Practices Manual: Chapter 3,” *Pennsylvania DEP*, http://www.dep.state.pa.us/dep/deputate/watermgmt/Wc/Subjects/StormwaterManagement/BMP%20Manual/03_Chapter_Final_Draft.doc.

²⁴ “Groundwater: A Primer for Pennsylvania,” www.dep.state.pa.us/dep/deputate/watermgmt/wc/Subject/s/SrceProt/source/SourcewaterProtectionTraining/pdf/GroundWaterPrimer.pdf.

care should be taken to minimize the use of synthetic fertilizers and pesticides, reduce the amount of roads and parking lots, and increase the area covered by native vegetation, to ensure the protection of the groundwater.

How do you know if your park is located within a critical recharge area? There are several factors that contribute to an area being designated as such: groundwater is the primary source of water supply in the area, adequate groundwater flow is required for a biological resource such as aquatic organisms in a nearby stream, there is little to no existing groundwater contamination and the area is at risk from development or other land uses, and groundwater conditions will remain high quality if protected.²⁵ The underlying geology and soils of the area also play a large part in the effectiveness of precipitation recharging back into the groundwater. To find specific information on the groundwater and recharge rates in your county, visit the Pennsylvania Geological Survey's website, www.dcnr.state.pa.us/topogeo/groundwater/index.aspx.

Design Natural Stormwater Management Systems

One way to effectively manage stormwater is to minimize the areas of impermeable surfaces such as roads, rooftops, and parking lots. This can be accomplished through narrower roads, permeable pavements, and rainwater catchment systems on roofs. The remaining runoff can be directed to natural stormwater management systems like native grass swales or rain gardens where the runoff will slowly infiltrate into the ground, while

²⁵ "Groundwater Protection Strategy," *Maryland DEP*, www.montgomerycountymd.gov/content/dep/Publications/groundwater_strategy.pdf

pollutants and excess nutrients are absorbed into the plants' roots.

Natural stormwater systems are beneficial because they can greatly reduce the need for pipes and other gray infrastructure. Those traditional methods send irregular, high velocity water flows into natural bodies of water, along with high loads of sediment and pollutants, which can negatively harm wildlife and their habitat. For example, it is estimated that were it not for the natural stormwater systems that were installed in the city of Seattle, WA, there would be no way that the city's urban creeks could support healthy and sustainable salmon populations.²⁶

Natural stormwater management systems filter out pollutants and increase wildlife habitat.

Even just the planting of more trees near impermeable surfaces can reduce the need

for large, expensive stormwater management systems, according to the American Forests Urban Resource Center.²⁷ The conservation group American Forests estimates that trees save U.S. cities \$400 billion in the cost of building storm water retention facilities.²⁸ For further information on stormwater management, visit www.stormwaterauthority.org.

²⁶ "Using Nature's Plumbing to Restore Aquatic Ecosystems: The City of Seattle's Natural Drainage System," *NWQEP Notes newsletter*, February 2005, Number 116, *North Carolina State University Cooperative Extension*, www.bae.ncsu.edu/programs/extension/wqg/issues/note_s116.pdf.

²⁷ Beattie, Knollin, and Moll, "Trees Help Cities Meet Clean Water Regulations," p. 18.

²⁸ "The State of the Urban Forest: Assessing Tree Cover and Developing Goals," *American Forests*, September 1997, cited in Lerner and Poole, *The Economic Benefits of Parks and Open Space*, p. 42.

For a list of native plants that can be used in natural stormwater systems, visit <http://dsf.chesco.org/conservation/lib/conservation/pdf/appendixc.pdf>.

There are two common forms of natural stormwater systems: grass swales and rain gardens. A *grass swale* is a gently sloped vegetated ditch where pollutants are removed from storm water by filtration through grasses. Their design lends itself to roadsides and edges of parking lots, where oil, gasoline, and salts can be trapped before reaching surface or ground water. Swales are a less expensive alternative than underground stormwater pipes and holding tanks, and they can provide wildlife habitat if the right plants are chosen. Swales should be designed to be as wide (at least 2 feet wide at bottom) and as shallow (no more than 4 feet deep) as possible to reduce erosion risks from fast moving water. Properly maintained swales should drain completely within 24 hours.²⁹ This will remove the threat of mosquitoes breeding, as mosquito eggs take 48 hours in water to hatch.³⁰

The second form of natural stormwater system is the *rain garden*. A rain garden is a shallow depression in the ground that is planted with deep-rooted native vegetation.

The garden is situated where it can receive runoff from impermeable surfaces. The gardens slow down the speed of runoff and hold the water so it can naturally infiltrate into the ground. Rain gardens offer many benefits to the environment including the creation of habitat for birds and butterflies, pollution filtration, and a decreased

²⁹ “Grassed Swales,” *Duluth Streams*, www.duluthstreams.org/stormwater/toolkit/swales.html

³⁰ “What’s All the Buzz About Mosquitoes,” *Cornell University Extension*, www.nysipm.cornell.edu/publications/mosquitobro/mosquito.pdf.

need for irrigation. The basic steps to create a rain garden are to (1) pick a location that has suitable soils for infiltration, (2) measure the drainage area, (3) draw a simple design, (4) choose the plants, (5) layout and dig the garden, (6) plant the vegetation, (7) and perform regular maintenance. For more information on creating rain gardens visit www.raingardennetwork.com and www.audubon.org/bird/at_home/pdf/AAHPA-43-52-Rain.pdf.

Minimize Impermeable Surfaces and Turf Areas

Impermeable surfaces include roads, parking lots, paved trails, roofs, basketball and tennis courts, and other park facilities. These surfaces do not allow precipitation to infiltrate into the soils, so there is less ground water recharge, which in turn can lead to less available drinking water. Precipitation flows quickly over impermeable surfaces and carries with it soil, valuable nutrients, pollutants, and

weed seeds. Turf that has been mown low to the ground also has a higher runoff rate than native vegetation, particularly on steeper slopes.

In watersheds that are covered by more than 25 percent impermeable surfaces only pollution tolerant reptiles and amphibians can thrive.

Without riparian buffers and natural stormwater systems, the pollutants end up in water bodies where they can fill up streams, poison aquatic life, and encourage the spread of invasive species. The Maryland Department of Natural Resources has found that in watersheds covered by more than 25 percent impermeable surfaces, only pollution tolerant reptiles and amphibians can thrive. When a watershed is more than 15 percent impervious, it never has a “good” stream health rating, and even at 2 percent

impermeable land cover sensitive species like brook trout are never found.³¹ It is essential, therefore, to limit the area covered by impermeable surfaces and turf grass within parks.

Some impermeable surfaces can be replaced by permeable pavement, mulch, gravel, or vegetation. For those impermeable surfaces that must be kept, their width should be minimized as much as possible. Paved parking lots should have just enough spaces for low-use seasons, with gravel or grass overflow parking for busier seasons. Turf should be limited to recreational areas (ball fields and picnic pavilions) only. Turf in other areas can be replaced with native warm season grasses such as big and little bluestem or with wildflower meadows and shrubs. These plants have a higher rate of absorption, and provide many more habitat benefits, than do turf grasses. For more information on warm season grasses, visit www.dcnr.state.pa.us/news/resource/res2005/05-0510-naturenotes.aspx.

Reduce the Use of Chemicals Whenever Possible

Park construction and maintenance might involve the use of many chemical substances, including chemically-treated wood for picnic tables, synthetic fertilizers on turf areas, and herbicides on weeds. In many cases, their use is justified and essential for proper park maintenance.

However, these chemicals can have negative effects on the environment and wildlife habitat, particularly in aquatic ecosystems. The use of chemical substances should be minimized whenever possible. If alternatives exist that have less of a negative impact on natural resources, they should be used, especially in high quality or fragile habitats.

³¹ "Sprawl," *Potomac Riverkeeper*, www.potomacriverkeeper.org/briefing/sprawl.html

No matter what the chemical is, and what it is being used for, it should be properly used, stored, and disposed of so that it does not cause harm to humans or the park's natural resources. By following the suggestions given in this section, you will help ensure that aquatic habitats and natural resources are protected and enhanced for park visitors.

Pesticides

Many times the use of herbicides, insecticides, and fungicides is the only way to remove nuisance and invasive species from an area. To minimize the risks these chemicals pose to non-target organisms and the environment, be sure they are properly used, stored, and disposed of. Always be sure to read the label carefully and follow the directions exactly, in order to minimize the accidental use of too much chemical, using a chemical that is not approved for that area, or applying it in the wrong way. When applying herbicide in or near a body of water, be sure that it is specifically formulated for use in aquatic habitats. To legally apply many of the pesticides available, you must be certified as a pesticide applicator. The Pennsylvania Department of Agriculture offers this certification. Information on the certification process can be found at www.agriculture.state.pa.us/agriculture/cwp/view.asp?a=3&q=128271.



Invasive Species Control

It can be a challenge to choose the proper control method for an invasive species. Sometimes manual methods work best, sometimes pesticides do, and sometimes a combination is needed. Integrated Pest Management (IPM) is another option that might work well (*see Chapter 4 for a variety*

of invasive species prevention and control methods).

Some of the resources on control methods available include Penn State University, College of Agricultural Sciences, Roadside Research Project's "Tips for Managing Problem Weeds in Forest and Wildland Settings" at http://rvm.cas.psu.edu/Publications/FS_4_ForestWildlandWeeds.pdf, The Nature Conservancy's "Weed Control Methods Handbook" at <http://tncweeds.ucdavis.edu/handbook.html>, and Maryland Native Plant Society's "Control of Invasive Non-Native Plants" at <http://mdflora.org/publications/invasives.htm>.

Some pesticides can only be applied by certified



Chemical Fertilizers

Chemical fertilizers are sometimes used to keep recreational turf fields green, particularly in areas with poor soil quality. Problems can arise when these fertilizers are misused, and during periods of high precipitation. Applying too much fertilizer can cause burn-out of the plants. It also increases the chance that these extra nutrients will get washed into a water body where they could cause algal blooms and outbreaks of invasive plants. Chapter 4 discusses alternatives to chemical fertilizers that could have less of a negative effect.

Pressure-treated Lumber

Up until 2003, pressure-treated lumber contained a compound called chromated copper arsenate (CCA). This chemical protected the wood from rot and insect damage. However, the Environmental Protection Agency (EPA)

found that the arsenic in the wood raised the risk of several forms of cancer, and so banned its production.³² Many playgrounds, picnic tables, and park benches were made from this wood, and have been leaching arsenic into the environment for years. These should be replaced with composites, or plastic, vinyl, and/or rubber "wood" whenever possible, and the soil in those areas should be tested to make sure it does not contain potentially dangerous levels of arsenic. For more information on arsenic and its possible health effects, visit www.epa.gov/ttn/atw/hlthef/arsenic.html.

There are also new pressure-treated lumbers available that are treated with different chemicals such as ACQ and copper azole. They do not produce the dangerous arsenic byproducts that the CCA does. However, they still should not be used for bird and bat houses, or other structures that could be used by wildlife. For more information on CCA and other pressure-treated lumbers, see www.epa.gov/oppad001/reregistration/cca/.

Swimming Pool Chemicals

Just like other chemicals, swimming pool chemicals can become dangerous when improperly used or stored. Dangers can include fires, toxic vapors, and personal injuries. The EPA provides information on the proper use of these chemicals at [http://yosemite.epa.gov/oswer/ceppoweb.nsf/vwResourcesByFilename/spalert.pdf/\\$File/spalert.pdf](http://yosemite.epa.gov/oswer/ceppoweb.nsf/vwResourcesByFilename/spalert.pdf/$File/spalert.pdf).

Alternatives to traditional pool chemicals exist that are more environmentally-sound, but they are typically much more expensive. These alternatives include salt-based sanitation systems, ionization, and ozonation.

³² Eisler, Peter. "Safety Concerns Cut Down Treated Lumber Used by Millions," *USA Today*, www.usatoday.com/news/nation/2003-12-29-treated-lumber_x.htm.

Selecting Plants

The selection and location of plants will rely in large part on the use(s) within each area. Items to take into consideration include recreation (active versus passive, group versus individual), storm water management, natural resource protection, and wildlife habitat. Areas of human use will require resilient ground cover like drought-resistant native cool season turf grass, whereas areas of low or no-impact use can be planted with native wildflowers, warm season grasses, trees and shrubs.

Plant selection depends on the soil, moisture, slope, climate, hardiness zone, and light conditions in a given site.

Planting a wetland plant (*like the marsh marigold shown below*) in a dry sunny area is a waste of time and money, as the plant will mostly likely not survive a season. By matching the plant type to the site conditions, the more likely the plant will establish and thrive.



Marsh marigold

Because the way a park is designed and landscaped will determine the benefits it offers, including reduced pollution, food for wildlife, or aesthetics, the design and plant selection process should be a thoughtful one. The process may be ongoing for several seasons, but careful planning upfront will make it much easier.

Native Plants

Native plants are those that have grown in Pennsylvania prior to the arrival of the first European settlers. These plants have adapted to the soils, pests, and other conditions in the different ecoregions of Pennsylvania. An ecoregion is a geographic area with its own composition of native plants, soils, and natural communities. Information on each of Pennsylvania's 18 ecoregions can be found at www.dcnr.state.pa.us/forestry/sfrmp/docs/PA%20Ecoregions%20section%20descriptions%20&%20links.pdf.

Using plants that are native to Pennsylvania is usually the best choice. However, it is better to grow a plant from your ecoregion but a different state, rather than use a plant from a different ecoregion in Pennsylvania. For

example, it might be acceptable to plant a wetland plant from West Virginia in a wetland here in Pennsylvania, but it would not be appropriate to plant a shore grass from Erie in a city park outside of Pittsburgh.

Growing native plants by ecoregion is important because of the different underlying geology and soils in each ecoregion. For instance, highbush and lowbush blueberries cannot be sustainably grown in an area of limestone terrain. You need to match the plant to the soils and geology that are found within your particular ecoregion.

Using native plants is beneficial because once they are established they tend to require less supplemental watering, fertilizer, and other maintenance needs – assuming that they have been properly selected and planted. A list of plants that are native to Pennsylvania can be found in Appendix 1. These plants can be purchased from nurseries throughout the state. The Pennsylvania Native Plant Society's website provides a list of these nurseries (www.pawildflower.org/04_links/links2.htm).

Native plants may require fewer resources to maintain.

While there are many non-natives that might work well in a park setting and not become invasive (*see the next section*), they might not necessarily offer the same benefits which natives do, since our native wildlife has adapted alongside native plants and uses them as food and sources of cover. Research has shown that native plants may support 10 to 50 times as many species as non-natives.³³ If non-natives are used, make sure they will grow under the site conditions and offer benefits to wildlife.

Be aware that some native plants available for sale have been collected from the wild, thus threatening their populations. Be sure to ask where the plants came from before purchasing them. Something else to consider is the difference between perennials and annuals. Perennial plants should be chosen over annuals whenever possible. Perennials continue to grow for many years, while annuals typically only last one year. Maintenance costs are therefore lower on perennials, as they will not need to be replanted every year like annuals.

Planting times vary depending on the species, but they typically fall between September and October for trees and shrubs, and April through May for herbaceous plants. Planting during the summer months runs the risk of not having enough precipitation, while planting after October might not give the plant enough time to establish before the first frost. Planting during the wrong time of year could result in the death of the plants. Also, ensure that each plant is capable of growing in the hardiness zone of the area, (<http://www.usna.usda.gov/Hardzone/hzm-ne1.html>). A map of the hardiness zones in Pennsylvania can be found on page 66 of this publication.

³³ “More Than Just a Yard,” *MA EOE*, www.mass.gov/envir/mwrc/pdf/More_Than_Just_Yard.pdf.

Tree Planting

As has been stated earlier, planting trees can have many benefits for a park. Properly placed trees can act as a temperature buffer for buildings, thus lowering heating and cooling costs by up to as much as 25 percent.³⁴ Trees on the north and western sides of a building will block cold winter winds, while trees on the eastern side of a building will provide shade from the hot summer sun. Two rows of evergreen trees are best for blocking wind, but five to six rows of deciduous trees will also work.

**Plant a tree high,
the tree won't die.
Plant a tree low,
the tree won't
grow.**

Trees can be purchased as bare-root seedlings, as containerized stock, as ball and burlap stock, or as live stakes. Containerized and ball and burlap trees are much more expensive than bare-root

seedlings, however they have greater immediate visual impact and are less likely to be mowed down or damaged by wildlife. After about five years, however, it is often difficult to tell the difference between trees that started out in containers versus seedlings.

One way to protect seedlings from potential damage is to use tree shelters. Tree shelters are plastic tubes that help seedlings grow and protect them from pests. They increase the moisture available to the seedlings and block wind, helping the trees to grow taller, faster. They can also facilitate the application of herbicides and fertilizers. Tree shelters range in price from one to five dollars, but can be well worth the cost to protect the seedlings in areas of high deer densities, in areas that will be mowed, or in areas prone to flooding. For more information on tree shelters, visit <http://forestry.msu.edu/extension/extdocs/facts12.pdf>.

³⁴ “Landscaping for Energy Efficiency,” *American Evergreen Foundation*, www.usagreen.org/landscaping.html.

The type(s) of trees you choose will depend on your budget and the availability of the trees. Penn State University's Cooperative Extension offers several publications that can help you select and plant appropriate trees (<http://pubs.cas.psu.edu/Publications.asp>).

Another good source of information for planting trees is the Arbor Day Foundation (www.arborday.org).

According to their website, a properly planted tree will grow twice as fast and live at least twice as long as one improperly planted. As some land manager say, "If you plant a tree high, the tree won't die. But if you plant a tree low, the tree won't grow." When planting trees, do not dig the hole too deep. If you plant the tree at the proper depth, the tree will be less likely to die. If you plant it deeper, the tree may not grow because not enough oxygen will reach the roots.



Rather than planting trees in straight parallel rows, try staggering or clustering them to create a more realistic natural look. In any case, be sure to plant small trees at least five feet away from any buildings, and medium to large trees at least 15 to 20 feet away, in order to protect the building from tree roots and branches as the trees mature.

Invasive Species

Invasive species are species that are non-native to the ecosystem under consideration, and whose introduction causes or is likely to cause harm to the economy, to the environment, or to human health. In many areas of Pennsylvania, one quarter or more of the plant species in a given area are invasive. Examples of invasive plants include Japanese knotweed, mile-a-minute vine, Japanese stiltgrass, and Japanese barberry (*see photos below*).



Japanese knotweed



Mile-a-minute



Japanese stiltgrass



Japanese barberry

There are also many invasive insects, animals, and pathogens to deal with as well. This includes forest pest insects like hemlock wooly adelgid and gypsy moth (*see photo on right*), which have the potential to destroy large areas of hemlock, oak, and other native tree species. Some invasive insects that are not present in Pa. yet, but are on our borders, include the emerald



Gypsy moths

ash borer and Asian longhorned beetle. These two insects have caused major damage to native tree species in New York, Michigan, Ohio, and other states. More information on these and other forest pests is available at www.dcnr.state.pa.us/forestry/pests/index.aspx.

Invasive birds in Pennsylvania include the European starling (*see photo below*), the European house sparrow, and the mute swan. These birds are a concern because they can out-compete native birds for food and nesting sites, and in the case of the swans, can consume large quantities of aquatic native vegetation that is vital to the health of aquatic ecosystems.



European starlings

Invasive mammals are currently not very common in the state, but there are two that could grow into a bigger concern in the future: wild boar and nutria. Wild boar, also known as Russian boar, have escaped from hunting preserves in south central Pennsylvania and Maryland. They are a concern because they destroy habitat and can spread diseases to domesticated swine. Nutria are large rodents from South America that live in aquatic habitats. Nutria cause significant damage to wetlands by over-consuming the vegetation, which can lead to erosion. Nutria are not in Pennsylvania yet, but are in some neighboring states and could cross the border in the future. The website www.invasivespeciesinfo.gov can provide more information on these and other invasive species.

Information on aquatic invasives is available at http://sites.state.pa.us/PA_Exec/Fish_Boat/ans.htm. These include several species of fish and shellfish that are altering aquatic ecosystems across the state, like the zebra mussels (*shown below*).



Zebra mussels

It is important to remember that not all non-native species are invasive. For instance, many of our domesticated animals and plants are non-native, but they are not considered invasive because they do not spread from the farm fields into the surrounding wild habitats. Invasives, on the other hand, can out-compete native vegetation, offer little to no value to wildlife, and can negatively impact recreational activities and the economy.

Once an invasive species becomes established, it could be difficult if not impossible to completely eradicate. It is therefore essential that park staff can identify the various invasive species so that they can monitor for, prevent, and remove them right away. The best way to manage for invasives is to prevent them from entering the park. Once they are in the park, it comes down to controlling them.

The “Weed and Pest” section in Chapter 4 discusses some methods for dealing with invasives. Appendix 3 lists many plants in the Commonwealth that are considered to be invasive. For further information on identifying and controlling invasive plants, visit www.dcnr.state.pa.us/forestry/invasivetutorial/info.htm. This is a very comprehensive site that includes invasive plant factsheets that include photos, characteristics, and control options.

A Few Simple Steps

While an ideal park would equally balance human uses with natural resource protection and sustainability, this is not always a feasible option. Parks will typically have multiple uses, but multiple uses cannot take place in every part of a park without degrading the quality of wildlife habitat. Parks with good habitat, or near such areas, should focus more on sustainable uses such as natural resource protection, while sites with poor habitat potential can be used for human recreational activities.³⁵ But even in areas designed for human use, small steps can be taken towards improving and enhancing the natural resources and operating in a sustainable manner.

It may help to do a small “experiment” first in one area of the park to see how park visitors react, and to see the benefits firsthand. For example, this experiment could involve replacing an infrequently used ball field or other turf grass area with a children’s garden. Once this smaller project is completed, a more comprehensive and labor-intensive project could be done, such as planting a riparian buffer along all the streams in a park. The next step could be to form partnerships with nearby municipality, town, and county park systems to create a chain of high quality habitat sites throughout a region. This will be more effective at protecting natural resources than a single park would, since natural landscapes, and the high quality human recreational uses that rely on these landscapes, are based on natural, not jurisdictional, boundaries.³⁶

The following few suggestions are for parks with limited time, staff and/or budgets. These options can be used alone, or in concert with one another, to make a park more sustainable

- Plant native trees or shrubs that produce food for wildlife. Appendix 1 lists examples of these. Incorporate these plants into a naturalistic landscape design that mimics the surrounding natural habitat.
- Plant a riparian buffer around water bodies. Riparian buffers help protect the water from erosion by stabilizing the banks, and they offer wildlife habitat and discourage nuisance geese. For the best results, the buffer should be at least 35 feet wide on each side of the water body and consist of native warm season grasses, other native herbaceous plants, and/or native trees and shrubs. The wider the buffer, the better the results.
- Minimize impermeable surfaces like roads, parking lots, and paved trails. Consider replacing asphalt and concrete with permeable pavement, mulch paths, gravel lots, and areas of native vegetation. Permeable surfaces will help to recharge ground water, reduce erosion, lessen flooding events, and filter out pollutants before they reach a source of water.
- Prioritize species of invasive plants that are in the park, particularly in areas of otherwise high quality habitat. Remove as much of the population(s) as possible for those priority species. The use of volunteers can aid in the project’s success, and can help with continued monitoring to ensure that when new invasives appear, they are found and controlled right away.

³⁵ “Restoration of Fragmented Landscapes for the Conservation of Birds: A General Framework and Specific Recommendations for Urbanizing Landscapes,” *Restoration Ecology*, Vol. 9 No. 3, pp.280-292.

³⁶ “Using Comprehensive Planning to Conserve Community Forest,” Bill Elmendorf, *Sylvan Communities*, Winter/Spring 2006.

Complete Design Process

The following steps provide park staff with guidance on how to design or enhance a park that focuses on sustainability and natural resource protection. Remember that any step towards natural resource conservation, such as removing invasive species, planting a few native plants that provide food for wildlife, or reducing the amount of turf grass, is better than doing nothing at all.

Step 1: Map the Park

There is a saying, “If you don’t measure, you can’t manage.” It is very important that parks know the extent of their natural and man-made resources: land, flora, geology, waterways, paths, buildings, and roads.² Mapping the park will help with visualizing what already exists, and finding the optimal locations for additions and enhancements. Some factors to consider when mapping out the park include areas of sun and shade, wind direction, slope of the terrain, moisture levels of soil, plants already growing in the area, and soil type (sand, clay, loam). Also be sure to map out existing buildings, utility lines, recreational areas, trails, parking lots, and natural features such as streams, wetlands, brush piles, and fields.

Keep in mind the land surrounding the park as well, because it can influence what should be designed within the park. For example, a neighboring property contains a stream and wetland that run adjacent to the park. It would be highly beneficial to keep recreational uses away from this section of the park, and instead plant a riparian buffer to protect the water quality and enhance wildlife habitat.

Once this is done, map out what will be added to the park. This step in the process may have been done during the natural resource inventory phase. If that is the case, just review the map briefly to make sure any new structures and changes to the natural resources are included.

Step 2: Design Facilities

The addition of structures should be carefully thought out. Their placement should be in areas where they will not have a negative impact on wildlife habitat, geologic hazards, water quality, or scenic vistas. A building should be oriented with its long axis in an east-west direction. The longest wall with the most windows should face the south or southeast, while the number and size of windows on the north and west-facing sides should be minimized because of the prevailing winter winds. This will help to maximize sun exposure and minimize winter drafts.³⁴



The visitor center and park office at Ricketts Glen State Park is certified as a “green building.” It uses a geothermal heating and cooling system, sensed lighting, and recycled-content materials.

Structures should be designed to blend in with the natural surroundings as much as possible, instead of standing in stark contrast to them. For example, choose a color scheme that includes browns, greens, and other neutral colors. Choose buildings that sit low to the

ground and are arranged in groups, rather than being spread throughout the park.

The use of “green” building materials is growing in popularity, and can help reduce a building’s impact on the natural surroundings. Green buildings are more energy efficient and take advantage of recycled materials, thus saving both money and valuable natural resources. For more information on green buildings visit www.greenbuilder.com/general/buildingsources.html.

Step 3: Test the Soil

Different species of plants have different soil nutrient needs: some thrive when the nutrient quality is high, while others prefer low nutrient conditions. For example, most of Pa.’s forests grow in low nitrogen soils. Using plants that can grow under the existing soil conditions can help save money because they will have fewer maintenance needs than those that require soil amendments such as organic fertilizers and supplemental irrigation.

Nitrogen, phosphorus, and potassium are some of the macronutrients that plants might need. The pH level (whether the soil is acidic, basic, or neutral) of the soil is also an important consideration because it determines which nutrients are available to the plants. Certain plants will grow only in acidic soils, while others will grow only in basic soils. Macronutrients are usually less readily available in soils with a low pH. The geology of an area is the key to soil types and chemical characteristics.

To find out the nutrient composition of the soil, a soil test kit can be used. Because soil conditions can vary from one area of a park to another, it is very important to test the soil in multiple locations, in order to determine the availability of nutrients and to figure out what plants to put where. Standard soil test kits are available from local Penn State University Cooperative Extension offices. These tests analyze the pH,

phosphorus, potassium, magnesium, and calcium levels in the soil. The analysis also comes with recommendations on how to improve the nutrient quality of the soil. More specific soil analyses can be ordered through their offices for an extra fee. To find the nearest Extension office, visit www.extension.psu.edu/extmap.html.

Particularly for human-use areas, it is also a good idea to know whether or not there are lead, arsenic, and other toxins in the soil, since they have been shown to have negative impacts on human health, particularly among children and the elderly. These toxins sometimes occur naturally in the soils, or might come from human sources such as lead-based paints and metal ore smelters. For more information on planting in soils with these toxins, read “Gardening on Lead and Arsenic Contaminated Soils,” at <http://cru.cahe.wsu.edu/CEPublications/eb1884/eb1884.pdf>.

Step 4: Landscape the Park

If an outside contractor does the landscaping work, consider choosing a landscape company that uses ecologically sound practices. The Ecological Landscape Association³⁷ (ELA), a nonprofit organization of landscape professionals, can be of assistance in locating such a company. Whether the work is done internally or externally, be sure to follow the guidance on native plants (*see Chapter 2*) and use native plants whenever possible.

People like to see order, even though nature typically does not follow such predictable rules. There is a preference among the public for coherence in a natural scene. Coherence occurs where trees, other vegetation, and natural features are arranged in an orderly fashion with some repeated themes and

³⁷ ELA, (617) 436-5358, www.ela-ecolandscapingassn.org.

unifying textures. People also like to see a lot of complexity, or diversity, in their landscapes.² Balancing these preferences with the desire to create as natural an environment as possible can be challenging, but not impossible.

The key is to create a setting that is both visually appealing to park visitors and appealing to wildlife in terms of finding food and shelter. The diversity part will be easier, since nature abounds with diverse plants and wildlife. Choose a variety of native plants that offer food and shelter to wildlife, as well as provide colorful flowers and foliage for park visitors.



This landscape at Bald Eagle State Park is complex and interesting to people because it contains grasses and wildflowers in the foreground, shrubs such as dogwoods in the middle, and tall trees in the background.

Coherence will in part come from proper siting and selection of the native vegetation. Planting in levels, where low-lying vegetation is arranged in the foreground, and taller shrubs and trees are in the background, can help with coherence (*see the photo above*). In addition, educating the public on the value of “disarray” in the natural landscape will help them understand that nature is not always neat and tidy; and that is ok! Chapter 5 will discuss how to go about the awareness process. Even small degrees of coherence and complexity will make park visitors feel more welcome and comfortable

within the park, and that equals return visits and fewer complaints.

The landscape and layout of the park can encourage exploration, which in turn can make visitors feel more familiar and comfortable in the park setting. A lack of familiarity can breed fear in visitors and cause them not to return. Fears include being attacked by a bear or other dangerous animal, getting lost, and coming across illicit activities. Obstructed views can help fuel these fears, so park design should keep this in mind. Trails through sustainable community parks should provide enough visibility for people to see what is coming up ahead. They should also be compatible with the natural surroundings, as studies have shown that this is what people prefer. Trails that go through open areas with little vegetation and distinguishable features are less preferred, but trails in dark densely wooded areas are not always looked upon favorably either.

A combination of open spaces and wooded areas works best to appease visitors while still providing wildlife habitat. Including some man-made elements in a natural area can also increase the familiarity of the park, such as walkways through meadows, bridges over streams, and fences along trails. To strike a balance with the natural resources, these elements should be made of natural materials like stone and wood, and be designed to blend in with the surroundings as much as possible.²



Wood and earthen steps blend in more naturally with the surroundings than concrete does.

Sustainable maintenance consists of any practice that protects the park's and community's natural resources while providing for visitor and staff safety and recreational opportunities. Maintaining a sustainable community park will be different from a traditional turf dominated park. For instance, some park staff may fear that a reduction in mowing needs will take away from maintenance jobs. However, while less time could indeed be focused on mowing, more time might be spent monitoring for invasive species and maintaining soil nutrient conditions. Maintenance in sustainable community parks is just as important as in other parks because it shows visitors that the park is being properly cared for, and not "abandoned," which will make it a more popular destination. A shift in the types of maintenance duties may take staff and visitors some time to get used to, and may require additional training and awareness campaigns, but it will in no way diminish the importance of the maintenance staff in the park. This section outlines the various elements of a sustainable community park maintenance regime.

Maintaining Soils

Keeping plants healthy depends in large part on the quality of the soil. There are many maintenance practices that can ensure soil nutrients remain in the soil, or are added as needed. The most important step is to retain as much existing soil as possible during construction and planting projects. The best option is to stockpile and reuse the existing topsoil instead of removing it. This soil must be covered by a tarp or non-invasive annual vegetative groundcover in order to prevent erosion by wind and precipitation. Using the existing topsoil not only saves money, but also minimizes disturbance that could encourage the growth of invasive plants.

Bringing in soil from somewhere else not only could upset the nutrient balance but could also introduce invasive seeds. Once invasive plants become established, they can be difficult if not impossible to remove. If fill materials must be used, try to use fill from areas within the park that have the same characteristics as the present setting, or from similar local sources. This will help minimize the chances of introducing a new invasive plant into the area. The use of certified "weed-free fill" is the best choice, but these materials are not yet readily available within Pennsylvania. With continued demand for "weed-free fill," hopefully that will change.

Fertilizing

Most native plants will not need fertilizer once they have established. When fertilizers are used, they should be of the organic or "slow-release" varieties, should be used no more than once or twice a year, and should be used in as small a quantity as possible. The use of too much fertilizer can burn a plant out, and the excess may leach into and pollute groundwater or other water bodies. Excess nutrients can also encourage the growth of invasive and nuisance plants. The Pennsylvania Department of Environmental Protection (DEP) provides some fertilizer guidelines at www.dep.state.pa.us/dep/deputate/airwaste/wm/RECYCLE/DOCUMENT/Letitlay.htm.

To determine whether fertilizers should be used, soil nutrient levels should be tested every three years. Penn State Cooperative Extension offices can perform this service and provide guidance specifically directed toward the soil conditions in a particular area. They also have many publications, like "Planting Ornamentals," (<http://pubs.cas.psu.edu/freepubs/pdfs/uj253.pdf>) that can provide more information. Here are some quick suggestions, however. If the soil pH needs to be adjusted, proper amounts of lime or soil-acidifying materials may be added. Nitrogen levels can be improved by leaving grass clippings on a lawn or by applying compost. If neither of

those suggestions works, vegetable meal or fish emulsion can be used. Adding loam to the topsoil before planting can also be beneficial.

Loam is soil that is made up of sand, silt, clay, and organic matter in evenly mixed particles of various sizes. Loam not only provides beneficial nutrients to the plants, but also holds water more effectively than the soils typically found in developed areas like parks and homes. For more information on loam, visit <http://anlab.umesci.maine.edu/handout/loam.pdf>.

Nutrient uptake can be affected by soil moisture levels, soil physical conditions, nutrient balances, and soil pH, so be sure to take these conditions into consideration before utilizing any soil amendments.

In addition, nutrient requirements vary from plant species to species. Trees, especially, can have drastically different requirements than grasses and flowers. Tree nutrition experts, therefore, strongly recommend that an annual leaf or needle analysis be used in conjunction with a periodic soil test. This analysis can confirm suspected nutrient problems, identify nutrient stress before visual symptoms appear, and offer suggestions on ways to fine-tune fertilization. Penn State University's Extension offices can provide these services along with the soil testing.³⁸

Analysis is a valuable tool in diagnosing problems because once a tree is showing visual nutrient deficiency symptoms, such as smaller-than-normal foliage, off-color foliage, or general lack of vigor, it has been suffering for a very long time. In addition, without the analysis you might treat for the visual symptoms of a disease without getting to the underlying problems associated with nutrient deficiency.³⁸

³⁸ "Correcting Nutrient Problems in Trees," by Scott Anderson, *Sylvan Communities* Winter/Spring 2006

Composting

Compost can improve the nutrient quality of the soil and help retain some of its moisture content. Compost benefits the levels of nitrogen, phosphorus, and potassium in the soil. Compost is the result of a controlled process of decomposition, and can consist of materials such as grass clippings, dead leaves, shredded newspaper, and manure from herbivorous animals (no dog or cat waste).

While invasive plants could be composted, this should not be done once the plants have gone to seed, or for plants that spread through their roots (such as tree-of-heaven and Japanese knotweed). You should also not use meat, dairy products, or oils because of odor issues that could attract pests.

Compost can be made from leaves, some food waste, and other "unwanted" materials.

Compost can be made on-site at the park, or can be brought in from a municipal composting facility (sometimes for free). For a list of these facilities, visit the Professional Recyclers of Pennsylvania (PROP) website at <http://pacompost.org/>. In order to make your own compost, you will need to have a compost bin. These can be purchased from many garden supply stores, or you can make your own out of a trashcan with holes poked in it, a cylinder of chicken wire, or a square bin made from wood pallets. The Pennsylvania DEP provides more information on composting at www.dep.state.pa.us/dep/deputate/airwaste/wm/recycle/compost_sum/home.htm.

The steps to composting are:

1. Add three parts "browns," which can be dead leaves, straw, shredded paper, wood chips, sawdust, and pine needles.
2. Add one part "greens," which can be grass clippings, vegetable and fruit waste, eggshells, coffee grounds and filters, and manure.

3. Mix or layer materials. After every 12 inches add a few shovels of soil.
4. Keep it damp and aerated, and within a few months there will be compost that can be used to “feed” the soil.

Compost should be warm and moist to the touch, but not soggy. To help keep odors down, the compost should be turned regularly to keep it aerated (every three days to six weeks, depending on the thickness of the compost). The more the compost is turned, the faster it will decompose. The compost will be ready after about two to four months, once it has fully decomposed. An easy way to tell if the compost is ready to use is to seal a small amount in a plastic bag for 24 to 48 hours. If there are no strong odors after that time period, the compost is ready to be used.³⁹

When the compost is ready, you can either work in one to three inches of compost into 6 to 12 inches of topsoil into a new planting bed, or add one-quarter to half an inch of compost around existing plants. This should be done every spring and fall. This will help hold in nutrients and water and feed the beneficial soil organisms that aid in plant growth.⁴⁰

Mulching

The use of mulch can do many things: retain moisture in the soil, moderate soil temperature, prevent erosion and the washing away of nutrients, and keep unwanted plants from growing. Mulch should be kept no more than two to three inches deep, because excess mulch can damage plant stems or prevent water from reaching the soil. Insects like termites, and small

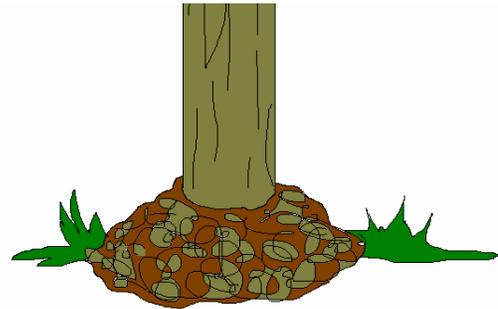
³⁹ “How to Make Compost,” *Pennsylvania DEP* www.dep.state.pa.us/dep/deputate/airwatse/wm/recycle/FAC/CTS/Compost.htm.

⁴⁰ “Green Scaping: The Easier Way to a Greener, Healthier Yard,” *EPA*, www.epa.gov/oppfead1/Publications/catalog/greenscaping.pdf

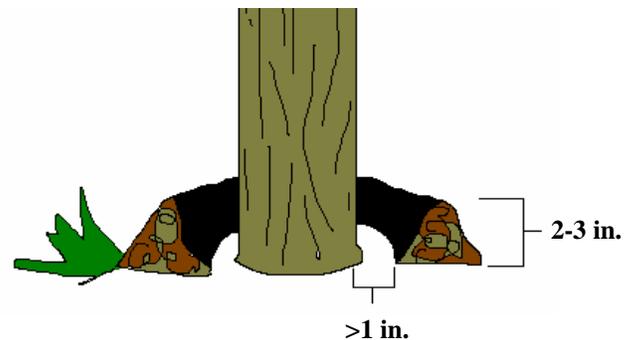
mammals, might be tempted to build their nests in deeper mulch.

Be especially careful when mulching around trees (*see the drawings below*). The wrong way to apply mulch is to push it up onto the sides of the trunk like a mountain slope. The correct way is to make it look like a flat donut, where there are several inches of open space between the mulch and the tree trunk. If you do not leave a space between the mulch and the trunk the decomposing mulch can rot the bark and expose the tree to insect damage, disease, and possible death.

Wrong way to mulch



Correct way to mulch



Next to buildings, ensure that the mulch does not come near wood siding, latticework, and doorframes, because the warmth and moisture of mulch can be attractive to termites. It does not matter what type of mulch is used, since the termites do not actually eat the mulch, but use it

to protect themselves from poor weather conditions.⁴¹

Once a year, preferably during the fall, remove the old decomposing mulch and add fresh mulch on top. If bare spots appear before that time, fill in those areas with new mulch. When mulch decomposes, it can use up the nitrogen in the soil, thus taking it away from plants that may need it to grow. The quicker the mulch degrades, the more the nitrogen is used up. So whenever possible, choose a mulch that lasts longer, such as bark mulch.

There are many different types of mulch available, some of which are described below.⁴² Recycled mulches should be used whenever possible, because they not only cost less than virgin material mulches, but they reduce the amount of materials entering landfills and use up less natural resources in their production. Mulch materials should be certified “weed-free” whenever possible, to ensure that new invasive plants are not brought into the park.

- Bark mulch – This mulch breaks down more slowly than wood chips, so it has less of a negative impact on soil nitrogen levels. Because it lasts longer, it may cost less per year to replace than other types of mulch. Hardwood mulch typically breaks down more quickly than softwood mulch.
- Wood chips – Drawbacks to this mulch include: insects may be attracted to it, chips discolor quicker than bark mulch, and they can deplete the soil of nitrogen, instead of allowing plants to take it into their roots.
- Leaves – Leaves and grass clippings that have been mown over can be used as mulch, but they decompose more quickly than other types, so they will have to be replaced more frequently.

⁴¹ “Protecting Your Home from Termites,” *University of Kentucky Entomology*, www.uky.edu/Agriculture/Entomology/entfacts/struct/ef605.htm.

⁴² “Shoppers Guide to Bark Mulch,” <http://doityourself.com/fertilizer/shoppersguidetobarkmulch.htm>.

They may be useful in small flower and vegetable gardens.

- Newspaper⁴³ – This type can be laid down in sheets and covered with other mulch, or it can be shredded. A drawback with newspaper is that it may blow away quickly. You should never use colored newspaper, as the dyes will bleed into the soil.
- Hay and straw – This mulch is not recommended because it may harbor weed seeds.
- Agricultural by-products – These can include cottonseed, buckwheat, corncobs, cocoa bean and rice hulls. These are typically lower in costs than other mulch, but are usually only available in bulk and during certain times of the year in certain areas of the country. This mulch also breaks down more quickly and can blow away more easily. **A note of caution about cocoa bean mulch:** dogs and other animals are attracted by the chocolate scent of this mulch and can get sick or die if they eat it.⁴⁴ So its use would not be recommended in a park setting.

Water Use and Conservation

When the soil is properly maintained, and plants have been chosen according to the existing moisture, climate, and light conditions of the park, little supplementary water should

⁴³ “Recycling Newspapers for Mulch in Home Gardens,” *West Virginia University Extension Service*, www.wvu.edu/~agexten/wastmang/msw8.pdf.

⁴⁴ “Cocoa Shell Mulch,” *Hershey’s*, www.hersheys.com/mulch/faq.shtml.

be needed, except for the first few years while the plants establish. In areas where water restrictions are common, selecting drought-tolerant species is a good choice. Visit www.bhwp.org/native/native_plant_info_sheets/Native_Plants_for_Dry_Soil_Conditions.pdf for a list of these hardy plants.

In areas where turf grass and newly planted natives are found, be sure to water deeply, especially during the spring and fall growing seasons. This encourages the roots to grow deeper, thus keeping the plants healthy and helping to prevent soil erosion. One inch of water per week is all that is required. The best time to water is during the early morning, although evening is the second best option.

Watering during midday or afternoon is less effective because the sun will evaporate the water much more quickly. Turf grass will let you know when it needs to be watered. If you walk on grass and it remains flat and shows footprints, it needs water. Similarly, shrubs and wildflowers will wilt and droop when they need water. In both cases, remember to water deeply and thoroughly.⁴⁵

The use of a sprinkler system is typically not necessary, considering the amount and frequency of precipitation in Pennsylvania. However, if sprinklers are to be used, also use a rain gauge. This device makes sure that the sprinklers do not come on if it has recently rained. A timing device on the sprinklers will also help save both water resources and money by limiting the length of time that the sprinklers operate.

Alternatives to sprinklers include soaker hoses and drip irrigation systems. These systems may use up to 70 percent less water than conventional irrigation systems.³³ Soaker hoses look like a typical garden hose, except that they are made of a material that

⁴⁵ “BayScaping to Conserve Water: A Homeowner’s Guide,” *Alliance for the Chesapeake Bay*.

allows water to soak out of the entire length of the hose, providing moisture for up to 18 inches of soil on each side of the hose. Drip irrigation systems are similar, except that they have small holes along the length of the hose with which to target specific plants. These hoses are more useful for small flower gardens and plants in rows, rather than large turf areas.

Rain barrels can be placed under gutter downspouts and the water used for irrigating small, vegetated areas around the park. To prevent mosquitoes from breeding in the barrel, either empty the water every 24 to 36 hours (it takes 48 hours or more for mosquito eggs to hatch³⁰) or place a thin layer of vegetable oil on the surface of the water, which will kill any existing eggs. The barrel should be scrubbed once a week to remove any eggs that may be attached.

Maintaining turf grass can be very resource-intensive.

In order to hold more rainwater, a cistern could be used. A *cistern* is an underground storage tank that captures rainwater from roofs and other impervious surfaces for later use. For more information on water use in landscapes, you may refer to www.oca.state.pa.us/cinfo/ConsumerTips/Waterwise%20Gardening%20Consumer%20tips%20_00086499_.pdf.

Grass Maintenance

In a sustainable community park, there could be two types of grasses, each with its own maintenance needs. Cool season turf grass, a staple of traditional parks, should be limited within a sustainable community park to human-use areas such as ball fields and picnic groves. Native cool season grasses, such as Canada and Virginia wildrye, should be used in place of non-native cool season grasses like Kentucky bluegrass and tall fescue.

Turf grass can be maintained in a more environmentally-sustainable way by mowing high (3 inches, not removing more than 1/3 of the blade of grass), mowing during the early morning hours, and leaving the grass clippings on the turf. Longer blades of grass help the roots grow deeply, which in turn will prevent erosion and help the grass obtain more water and nutrients from the soil. Mowing during the heat of midday can contribute to smog and ozone warning days.

Near bodies of water, do not mow the grass right up to the edge of the water. A vegetative buffer around the water will help prevent pollution from entering the water, prevent erosion of the soil, and provide wildlife habitat for some species, while deterring nuisance geese.



Geese can make being outdoors unpleasant when their droppings are concentrated at a site. These droppings may also contribute to high fecal coliform bacteria levels in lakes and ponds, making swimming unhealthy and potentially dangerous. Geese prefer flat, open, mowed grass areas and tend to avoid dense, high grasses and other vegetation. To reduce the number of geese on beaches and other recreational areas, plant and maintain an un-mowed six-foot wide buffer of tall native grasses or a 20 to 30-inch tall hedgerow.⁴⁶

⁴⁶ “Goose-Human Conflicts and Control Techniques,” Michigan Department of Natural Resources, http://www.michigan.gov/dnr/0,1607,7-153-10370_12145_25065-59467--,00.html.

Leaving grass clippings on the turf, or composting them, turns them into a natural fertilizer that will benefit the soil and the grass. If you do choose to leave the clippings on the ground, this process can be facilitated by removing the grass catcher from the lawn-mower, and using a mulching blade that will chop the clippings into finer pieces than a regular mower blade.⁴⁷ If you decide to recycle the grass clippings and/or leaves, locate the nearest yard waste recycling facility at www.dep.state.pa.us/wm_apps/RecyclingLocations/.

Warm season grasses are the second type of grass that could be used in a sustainable community park, and it will be planted for wildlife habitat and as attractive landscaping. Native warm season grasses include big bluestem (*Andropogon gerardii* Vitman), little bluestem (*Schizachyrium scoparium*), and switchgrass (*Panicum virgatum*). These grasses have ecological benefits because they grow in tall thick tufts that offer food and cover benefits for wildlife throughout the year. The photo below shows a meadow of warm season grasses in Chester County, Pennsylvania.



To ensure that these grasses establish and continue to thrive, maintenance of these grasses will be more intense during the first several years after planting. However, time

⁴⁷ “Grasscycling,” Pennsylvania DEP, www.dep.state.pa.us/dep/deputate/airwaste/wm/RECYCLE/DOCUMENT/Letitlay.htm.

spent on maintenance will be considerably lower in subsequent years, especially when compared to the time spent maintaining other types of vegetation.

The document, “A Landowner’s Guide to Native Warm Season Grasses in the Mid-South,” (www.utextension.utk.edu/publications/pbfiles/PB1746.pdf) provides information on, and color photographs of, establishing native warm season grasses. The guide states that some of the biggest problems that arise with establishing these grasses come from planting too deeply, planting too late in the season, and having poor weed control. The best time to plant native warm season grasses is mid-April to early July, at a depth of ¼ inch or less.

Depending on what you are managing for, whether it’s mammals, birds, insects, or a combination, will determine when and how often to mow native warm season grasses. Mowing prior to April 1 and after October 1 is acceptable for mammal and bird habitat. Mowing between those dates can have adverse effects on species breeding, nesting, and rearing. But for insects, mowing during the end of summer and early fall can have a negative impact on their food sources and hiding places. For instance, mowing in September can destroy the common milkweed that monarch and other butterflies depend on for food and places to pupate. Therefore it is suggested that areas should not be mowed until after October 1 for insect habitat.

In terms of how often to mow, once every one to three years is fine for mammal and bird habitat, but for insects the rate is closer to once every five to ten years, but mowing so infrequently can create weed problems. The best option for all wildlife is to have a rotational mowing mosaic, where some patches of grass are mowed in the current year, and then left unmowed for several years, while mowing takes place in other patches. This will ensure that there are always some older-growth patches available for

wildlife, while still helping to deter the growth of invasive plants and slow the succession into forest habitat. For more information on growing and maintaining warm season grasses, visit <http://cropsoil.psu.edu/extension/facts/agfacts29.cfm>.

An alternative to mowing is the use of prescribed burns (*see photo below*). Using fire as a way to manage grasses must be done under the supervision of someone knowledgeable and experienced with prescribed burns, in order to ensure that the fire does not get out of control and/or harm non-target species. Your local DCNR service forester may be able to perform the burn, or put you in touch with someone who can (www.dcnr.state.pa.us/forestry/incont.aspx).

Some invasive plants actually grow more after being burned.



Prescribed burns should take place in the early spring, typically from late March to the first half of May. The fire from prescribed burns removes the previous year’s dead top-growth of the warm season grasses, and also can kill new competing cool season grasses or invasive plants. The fire does not destroy the warm season grasses because their roots grow so deeply, and the next year they will grow in denser and healthier than before.

A note of caution: some invasive plants actually grow more after being burned (tree-of-heaven, for instance), so be sure to know what types of plants are in the area, and how they will

react, before starting a burn. Another consideration to keep in mind is that certain habitats, such as serpentine barrens, derive their unique plant communities from the lack of certain nutrients. In habitats like that, a prescribed burn can be counter-productive because the burn introduces potash and nutrients that will upset the balance and sustainability of the soil chemistry. The key is to know your park's vegetation, geology, and soils before starting a prescribed burn.

Weed and Pest Control

Weeds are plants that are considered unattractive, undesirable, or troublesome in the place where they are growing. Depending on a person's mindset, weeds can be native plants, non-native non-invasives, or invasives. There are many ways to deal with weeds, and the methods will depend on the species, its location, and other pressing management projects in the park. The same applies to pests, a term that could include weeds, unwanted wildlife like white-tailed deer and nuisance geese, insects like hemlock wooly adelgid, and diseases like *Armillaria* root disease. The following suggestions will provide information for controlling and managing for invasive species and other pests.

Invasive Species Prevention

Preventing and controlling invasive plants can sometimes be a complicated project, particularly in areas of heavy infestation. Prevention is the most important step you can take in managing for invasive species, because once an invasive is in the park, it may be too late to easily control it. One prevention method is the washing of maintenance equipment after it has been used (and prior to moving it to another site), particularly in areas of known or suspected invasive species populations.

Invasive weeds and their seeds can become attached to this equipment at one location and moved to a new spot where they may be able to grow. The tires, axles, blades, and other parts of the equipment that come in contact with vegetation and/or soil should

be cleaned before being moved from the location. The same goes for park cars, and trucks that travel through areas where invasives may be present. Further information on road and trail management of invasives can be found through the US Forestry Service's *Backcountry Road Maintenance and Weed Management*, at www.nbc.gov/facilities/presentations/Backcountry.pdf.

Visitors should also be educated on the dangers of invasives so that they can actively prevent their spread (*see Chapter 5 for more on raising awareness*), since people can spread invasives on their shoes, bike tires, clothing, and pet's fur. One idea comes from states like Ohio and Indiana, where they use boot brushes and signs at trailheads to help cut down on this problem.⁴⁸

In terms of aquatic invasives, encourage park visitors and staff to clean off any visible mud and plants from their boats and fishing gear before leaving the area. Hot water or a high-pressure water spray should be used for this. These preventative measures will reduce the likelihood of invasions from zebra mussels, *Hydrilla*, and other aquatic nuisance species (ANS). Visit www.protectyourwaters.net for more information on preventing ANS.

Several of the most problematic invasive insects, like emerald ash borer and *Sirex* wood wasp, can enter a park in firewood. It is therefore very important to inform park visitors of this problem, and make sure that if they do use firewood, they bought it locally. This reduces the chances of bringing in a new pest insect. For more information on emerald ash borer (EAB), visit www.emeraldashborer.info. To learn more about *Sirex*, visit www.dcnr.state.pa.us/FORESTRY/fpm_invasives_woodwasp.aspx.

⁴⁸ www.fs.fed.us/biology/main/wfw_newsletter/jan_wfw_nwes_2006.pdf and www.mipn.org/boot%20brush%20summary.doc.

Another way to prevent invasives from entering your park is to minimize soil disturbances. Soil disturbances can come from bringing in heavy machinery to create new trails and roads, from people recreating on steep slopes and other places where they shouldn't go, and from flooding events. Invasive plants are frequently the first plants to colonize a bare patch of soil. So protecting the soil with native vegetation will help keep out at least some invasives. You should also avoid creating new roads, trails, and parking lots in areas of known infestations in order to prevent their spread.

Invasive Plant Control

For invasive populations that are already established, or where prevention methods were not successful, control methods should be used. To make an invasive control project more feasible, the park should create an invasive species management plan that will prioritize control options for the various invasives, based on their impacts on park management goals. The suggested format for these plans is found at The Nature Conservancy website, <http://tncweeds.ucdavis.edu/products.html>, under the heading "Weed Management Plan Template."

Control efforts might work best if they are targeted towards one or two problem species, or focusing on one or more areas of valuable habitat, instead of taking on the daunting task of controlling all invasives in all areas of the park at the same time, especially since there are so many options for control. Sometimes manual methods like hand-pulling and cutting can work, while other times herbicides are the only method that will get rid of the invasives. The methods used will depend on the type(s) of invasive, the location of the invasive (wetland, fragile habitat, along trail), the time of year, and the resources available to the park. It is very important to match the control method to the invasive species in order to maximize its efficacy. Websites like www.dcnr.state.pa.us/forestry/invasivetutorial/index.htm can provide species specific control options.

Because there are so many choices in terms of invasive plant control, they cannot all be mentioned here. However, the following is a brief description of some manual and chemical methods. In terms of manual control, there are a variety of tools that can be used, such as the weed wrench and root talon. These help pull out shrubs and small trees by providing leverage. The weed wrench comes in four sizes and is made of steel, which makes it durable, but heavy (*see photo below*). The root talon, on the other hand, is made of plastic, so it is cheaper and lighter, but not as durable.



Using the weed wrench to remove an invasive shrub

Machines like flail mowers and brush hogs can mow down invasives that are too big or in too large a quantity to hand-pull. Girdling, a process in which a three to four inch band of bark is cut off from the tree or shrub, is a method that can be used to kill the plant but leave it standing to provide wildlife habitat. **A word of caution about pulling and cutting:** some invasives like autumn olive and tree-of-heaven will actually grow in thicker and more abundant if they are cut or pulled. Therefore, you must use herbicides when trying to control these invasives.

There are many brands of herbicide that may be effective at controlling invasive plants. A description of these chemicals and how to use them can be found at http://rvm.cas.psu.edu/Publications/Herbicides_in_Non-Crop.pdf. If any herbicides are used, it is important to follow the label exactly and take

care to avoid the surrounding native vegetation. Herbicides can be a great tool in controlling invasives, but they can also pose negative impacts to the environment if they are misused.

Herbicides can be applied to the leaves, to the bark, or applied to a cut stem. Spraying it on, painting or wiping it on, or injecting it can do this. There are a variety of tools to do this, including backpack sprayers, handheld squirt bottles, wick applicators, saturated gloves, and EZ-Ject lances. For larger scale infestations you can mount boom applicators and canisters to an ATV or truck.

The types of equipment used will depend in large part on your budget and the size of the infestation. Each method has its benefits and drawbacks – you can learn about these through trial-and-error or by networking with other experienced land managers. For DCNR employees, there is an online infoshare system to discuss invasive control options. This can be accessed at <http://intradcnr/invasiveinfoshare/>.

No matter which control method(s) you choose, remember that timing is critical, that each invasive plant reacts differently to the various control methods, and that many herbicides must be applied by a certified pesticide applicator. If no one in your park is certified, you can hire a professional, or contact the Pennsylvania Department of Agriculture to become certified (www.agriculture.state.pa.us/agriculture/cwp/view.asp?a=3&q=128271).

Integrated Pest Management

When someone controls pests with chemicals, all of the beneficial and benign creatures could be killed along with the pests. In addition, there is the possibility of negative side effects to the environment from the chemical's use. While there are some situations where pesticides must be used to control invasives, many times alternatives can be used that are targeted towards the specific pest and are more environmentally-sound.

Integrated Pest Management (IPM) is a more effective and longer-lasting ecologically-based approach that minimizes pest problems by maintaining healthy plants. IPM is the “integration of various management strategies – including biological, cultural, and chemical methods – into a comprehensive program of pest control.”⁴⁹

IPM is used in conjunction with proper planting techniques, and may consist of choosing pest-resistant plants, quarantining suspected plants and insects, releasing sterile male pests to inhibit breeding, using traps to catch pests, releasing predator insects to eat the pests, and choosing chemicals, like pheromones, that target specific pest species. An example of an IPM biocontrol insect is shown below. This is a photo of the *Galerucella* beetle, which has been introduced to feed on the invasive purple loosestrife plant.



Biocontrol is one option for managing invasives

The Pa. Integrated Pest Management Program (<http://paipm.cas.psu.edu/>) states that IPM techniques typically cost less money than traditional pest control methods, but they can involve more work up-front. There are six steps to IPM: identify the pest, understand its life cycle and the food it eats, figure out how many pests there are, determine how many are too many, choose the control methods, and evaluate whether the method(s) worked.

⁴⁹ “Integrated Pest Management: A Homeowner’s Guide,” *Alliance for the Chesapeake Bay*.

White-tail Deer Management

In many areas of Pennsylvania, white-tailed deer are so abundant that they have completely destroyed the forest understory and reduced the vegetated ground-cover to ferns and invasive species. Aerial surveys of over 460,000 miles of DCNR and Game Commission lands have shown that average deer densities range from 8 to 18 deer per square mile, but some areas have as many as 126 deer per square mile.⁵⁰ Deer densities over 20 per square mile have been shown to limit the forest ecosystem's chances for regeneration. Higher deer densities can also lead to greater potential for increases in car accidents and cases of Lyme disease, as the deer are forced to move into populated areas to find sources of food.⁵¹

In any park, too many deer can be a nuisance, but in a sustainable community park the damage could theoretically be even worse, considering there will be more native vegetation for the deer to eat. Luckily there are ways to manage for deer. One step is to choose plants that are “deer-proof,” meaning that deer will not eat them unless there is absolutely nothing else for them. These plants include big bluestem grass, switchgrass, milkweeds, and spicebush. A list of these plants is on the site, www.bhwp.org/native/native_plant_info_sheets/Deer_Tolerant_Resistant_Native_Plants.pdf.

Another option is to spray deer repellent around vegetation and any other area where you want to keep deer out. These repellents work by giving off a bad odor or taste that will repel all but the hungriest of deer. They will need to be re-applied after precipitation, however. Noise repellents have a very short-term efficacy, as deer become accustomed to the noise within a week, so their use is not recommended. The use of fencing can help keep deer out, and would be especially beneficial for tree saplings and areas of high habitat value. In order to

⁵⁰ “Final Aerial Deer Survey Results,” *DCNR News Release*, www.dcnr.state.pa.us/news/newsreleases/2006/0606-aerialdeer.htm

⁵¹ “Look out for Lyme Disease,” *University of Connecticut*, www.hort.uconn.edu/ipm

be effective, fencing should be eight feet tall.

More deer damage management information is available at

www.dnr.cornell.edu/deerpeopleparks/. To learn what the Pa. Game Commission is doing to manage the deer population in Pennsylvania.: www.pgc.state.pa.us/pgc/cwp/view.asp?a=465&q=161556.

Minimizing the Risk of Deer Ticks⁵¹

- Deer and white-footed mice predominantly spread deer ticks. Both of these animals need to be present in order for deer ticks to thrive.
- Deer ticks can spread Lyme disease if they bite and remain on a person for 12 hours or more.
- Ticks tend to live in dense shrubs and tall grasses. If deer are a problem in your park, plant heavily used areas with “deer-proof” vegetation and educate the public on how to identify and properly remove ticks.
- The best protection from Lyme disease is to inspect yourself frequently while outdoors, and then again once inside. There are also a variety of tick repellent products available.
- The use of pesticides should be considered only in severe tick infestations, as they can have negative effects on beneficial species.
- Sustainable community parks will not necessarily have deer ticks, but be aware of the possibility.

Public Relations

Because sustainable community parks differ from traditional recreation-focused parks in many ways, the average park user may not initially appreciate or understand the changes. Therefore, before any sustainable community park is designed and constructed, information should be obtained to find out about the public's concerns, wishes, and ideas. The public should be included in every stage of the design process in order to gain their buy-in and involvement. The goal should be to have a park that not only protects natural resources and is environmentally-sustainable, but also is appealing to park visitors with diverse active and passive recreational needs. In order to do that, you need to know what the people's needs and knowledge base are. Information exchange and an established public relations campaign will be essential for determining that.

The public should be included in the design process as early on as possible. Increased participation in the early stages of a project increases the chances that the public can have a real impact on the outcome, and that they will agree with the final results. The public will welcome the chance to have their opinions heard, particularly if they know it can actually lead to direct action or change. You will get better results if you show them photos or models of various alternatives, and have them pick or rank the design(s) they like the best, rather than asking them, "What do you want in this park?" because they will usually either have no opinion, or have unrealistic desires. This process can take place at public meetings, community festivals, through mail and phone surveys, or through other means.² The design that secures the most votes should be the one that is chosen - with minor modifications to fit budgetary and space constraints, if necessary.

Once a new sustainable community park is designed and constructed, or once changes to an existing park are made, the public relations and education process will still need to continue. Park visitors that are accustomed to ball fields and large facilities may need a little extra information and encouragement to see the beauty and importance of a sustainable community park. This can be accomplished through a variety of means, one of them being the development of educational materials. The following section describes a variety of educational materials and programs that could be implemented in your park to enhance visitors' experiences and knowledge.

Educational Materials and Programs

When conveying information to the public, keep in mind that people often resent being told something they already know, but will be appreciative of new information that helps expand on their previous knowledge. Relating this new information to what they already know will help them understand it more fully and remember it better. The serious mistake made most often is giving so much information to people that they cannot retain and understand it all. Using visual information along

with bulleted sentences or phrases usually helps to get a point across much more effectively.²

You have to find a way to overcome these communication roadblocks when dealing with park visitors because making the switch to a sustainable community park may create situations that upset some people. As was mentioned earlier, for instance, creating a riparian buffer limits the areas where people can access the water. Fishermen may not find that

situation appealing, so you must find a way to show how the change benefits them - more vegetation around the water body means better habitat for aquatic insects, which translates to more fish.

When creating written educational materials to hand out to the public, there are several steps you can use to make sure that the maximum amount of information is received and understood by the majority of people. The first step is to figure out what you hope to accomplish through the educational material. Who is your target audience, and why do you expect them to be interested in your message? What subject matter will you cover? Once you determine these elements, it's time to decide what type(s) of educational materials you want to create. The following is a small sampling of the types of educational materials that could be used by parks to get their natural resource protection messages across to the general public. For more information on crafting communication strategies and publications, read "Life. Nature. The Public. Making the Connection," available at www.biodiversityproject.org/commhandbook.htm.

Brochures

When writing a brochure, the key is not to include too much information. The more words there are, the more unlikely people are to read it. Use bulleted phrases and graphics to break-up the text. Make sure the language is basic enough for most people to understand. Technical terminology will turn many people off. It also helps to incorporate the public's knowledge, fears, and concerns in the document so that they can relate to what is being said.²

Your key message should be prominently displayed on the front of the brochure. This way, even busy people who quickly scan the front of the brochure will take away the gist of your message. There should also be a unifying theme throughout your educational materials that will "hook" the reader. This hook should emphasize why your message is unique, and how that uniqueness benefits the reader.

For example, your park recently planted a large butterfly garden that attracts numerous butterfly varieties not normally seen in a traditional recreation-based park. Your unifying theme could be "Rare and Beautiful Butterflies are a Sight to Behold." The brochure would show people some of the butterfly varieties, as well as people enjoying the butterfly watching from the comfort of a park bench or picnic table.

A brochure is meant to spur someone to action, whether it's volunteering to help out in your park, creating wildlife habitat in their own backyard, donating money to your park's friends' group, or simply learning more about a subject. If the brochure isn't increasing the number of people getting involved in your park in one way or another, the brochure isn't doing its job.



Brochures, posters, and a knowledgeable educator can help to inform the public of various subjects.

Fact Sheets

There are already a wide variety of fact sheets on various subjects available. For example, a *Google* search for "invasive species" and "fact sheet" will return 125,000 hits. Therefore, you may find what you are looking for

without having to re-create it. A good source of invasive species fact sheets is available on the DCNR online invasive species tutorial for land managers at www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm. A source of plant fact sheets (both native and non-native) can be found through the USDA at http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi. If you are looking for wildlife fact sheets, the Pennsylvania Game Commission's *Wildlife Notes* could come in handy (www.pgc.state.pa.us/pgc/cwp/view.asp?a=458&q=160464).

If you want to create your own fact sheets, (using songbirds in your park, as an example) be sure to clearly understand what you want your audience to know and understand, and make this information clear and easy for people to find. Fact sheets should focus on the big picture and not get bogged down in the fine details. The message should be straightforward and the language simple: don't use acronyms or technical jargon unless absolutely necessary. And if you do use that terminology, define it.



Factsheets should be easy to read, colorful, and brief.

Just like in brochures, include colorful pictures and drawings, and write in a bulleted format. You want to keep a fact sheet to just that, one sheet. To cut down on the amount of information,

Educational materials should be written in an easy-to-read and colorful manner to attract as many people as possible.

include web links for people who want to learn more.

Newsletters

Factors that can determine whether or not a newsletter is successful include: a commitment of staff time, the quality and quantity of written material available for inclusion, and the printing budget. Newsletters occur on a regular basis, whether monthly, bimonthly, quarterly, etc. You will need to decide in advance which schedule will work best. Each issue should be published on the same day of the month to establish credibility and good readership.

The content and format of the newsletter is where the creativity and uniqueness can come in. Make the newsletter a reflection of your park and all that it has to offer to park visitors. Articles describing the various natural resources, educational programs, staff expertise, and upcoming events are just a few of the items you could include in a newsletter. You can involve readers by asking them to send in questions and opinions. They could even contribute photos and articles on their experiences in the park. The more they feel connected to the newsletter, the more likely they will be to continue reading future issues.

Educational Curriculum

You don't have to be a professional educator to teach, although it certainly helps. Some parks are fortunate enough to have environmental educators on staff, while others will have to rely on volunteers and other staff members to implement any educational programming. This section is for those people who do not have a formalized background in education.

This is a very quick and generalized overview of what is needed to run educational programs in a

park. Much teaching is accomplished through trial-and-error, determining what works and what doesn't. Lessons will constantly evolve and be adapted to suit different age levels, subjects, and lessons learned.

Once you have an idea of the subject(s) you want to teach and the audience(s) you want to reach, you will develop an original lesson plan, or find existing lesson plan that will fit your needs. A quick, yet detailed step-by-step guide to creating lesson plans is available at http://www.au.af.mil/au/awc/awcgate/af/af_safety_ctr_dev_lesn_plans.doc. According to the authors of this document, the steps in lesson plan development are as follows:

1. Determine the objective(s)
2. Research the topic
3. Select the appropriate instructional method(s)
4. Identify a usable lesson planning format
5. Decide how to organize the lesson
6. Choose appropriate support materials
7. Prepare the beginning and ending of the lesson
8. Prepare a final outline

Like fact sheets, there are probably already one or more lesson plans in existence that you could tailor to your specific educational programming needs. Why create something from scratch if it can be easily modified for your particular park and subject matter? Some of the numerous free lesson plan sites that may be of use include, www.lessonplanspage.com, www.lessonplanz.com, and www.lessonplansearch.com. An Internet search will bring up thousands of other pages that are equally helpful.

Interpretive Displays

Interpretive displays are temporary or permanent posters or signs that provide information to people. Typical display panels in parks include hiking trail maps, park hours of operation, and rules and regulations. Others are more educational, and “interpret” what the visitor will see in the park.



Colorful, informative displays can quickly educate visitors

Sustainable community parks can use interpretive displays to educate their visitors about the differences between their parks and traditional parks. They can highlight the variety of wildlife and plants found within the park. If an invasive species control project is underway, the display can let people know about what is being done, and why it's being done. This helps to cut down on visitors saying, “Why are you cutting those trees down?” or “Why is that guy spraying chemicals on those plants?” An interpretive display will help to educate visitors when there are no staff or volunteers around to answer questions.

Volunteer Programs

Involving the public in every step of the process is key: from park design to management and maintenance. Planting natives, removing invasives, stabilizing streambanks, and leading nature hikes are just a few of the projects local volunteers can be involved in. But while having volunteers can be a great help to parks, it is not without its challenges. The park will need a certain level of organization and leadership to be able to coordinate the volunteers and keep them motivated. With all the other management concerns in a park, keeping up an active volunteer group can easily fall by the wayside.

The use of volunteers for work in a park typically falls into one of three categories: one-time events, often using a large number of volunteers focused on one issue; regular volunteer work days, typically once a month on the same day; and independent, well-trained volunteers who come in on a regular basis to work on one or more issues. The amount of staff time and resources a park has will determine which category(s) to use.⁵²



These volunteers helped build deer exclosures to protect native plants in Pittsburgh's Schenley Park.

⁵² "Citizen's Guide to the Control of Invasive Plants in Wetland and Riparian Areas," *Alliance for the Chesapeake Bay*, www.acb-online.org/pubs/projects/deliverables-251-1-2005.pdf.

One-time events require a lot of up-front planning and coordination. One or more staff should be dedicated towards planning the event. One-day events are good for removing large amounts of invasives, planting large areas with trees and other vegetation, or trash clean-ups. However, these events should not be used for every site and situation. In areas prone to erosion, in places with valuable native vegetation, or in places that may be hazardous to volunteers, large groups should not be used, as they may create more disturbance that could further spread invasives or increase erosion. An ideal rule-of-thumb is to have a ratio of no more than 10 volunteers for each supervisor, when working in the field, to ensure that all volunteers are working in a safe and effective manner.⁵²

Regular volunteer work days are more appropriate for long-term maintenance and control of invasive plants and garden upkeep. This type of volunteer commitment requires the continued involvement of at least one dedicated staff member to ensure that volunteers remain interested in the effort. The use of trained independent volunteers works well for monitoring large control areas over an extended period of time, landscaping, and leading educational programs for the general public. Again, however, you will need a staff member to train these volunteers and keep them motivated.⁵²

Motivation and retention of your volunteers will depend on many factors, some within your control, others not. People volunteer for many reasons. Some may have grown up going to your park and do not like how the invasives have taken over, while others like to garden but don't have a yard of their own. Still others are retired school teachers looking for a way to reconnect with children and learning. Whatever their reason for volunteering, it is key that you keep them happy and feeling appreciated for the work they do for you.

One simple thing is to make sure to communicate the importance of the volunteers' work as part of a larger purpose: that of making the park a nicer place. Show them how their individual work adds up to something spectacular. There is almost nothing worse than feeling bored and having nothing to do. Therefore make sure that you give your volunteers enough to do so that they feel that they are not wasting their time. And whether these volunteers are just there for the day or come in every week, give them a sincere "thank you" in person, followed by a note or certificate for their involvement. If the budget allows, giving out t-shirts or other small tokens of appreciation can do wonders for volunteer morale.

Recognize also that weather can have a major impact on volunteer spirit. Extremely hot or cold days, as well as rainy ones, can put a damper on a volunteer day. Planning ahead for such weather situations can mean the difference between happy, efficient volunteers (with plenty of water in the summer, and ponchos for the rain) versus grumpy, sluggish volunteers (getting dehydrated or frostbitten).

Another option, other than using local volunteers, is to get Americorps or Student Conservation Association (SCA) members to do work around your park. Americorps State programs offer grants to help non-governmental and governmental organizations hire Americorps members to perform direct services for unmet community needs in education, public health, and the environment. A team of Americorps members can come to your park for full- or part-time work for up to one year.

Members have been involved in park improvements and recruiting community volunteers to expand the reach and effectiveness of programs for the organizations they serve. Pennsylvania State Parks like Raccoon Creek, as well as other park systems in states such as Delaware, Florida, Maryland, and Michigan, have used Americorps volunteers to remove invasive plants and restore native habitats.

More information on starting an Americorps program can be found at, www.dli.state.pa.us/landi/cwp/view.asp?a=143&q=207609.

The National Park Service, the US Fish and Wildlife Service, and park agencies in states such as Pennsylvania, Florida and New York have used the Student Conservation Association (SCA) environmental stewards for hands-on projects in the field. You can hire either one intern, or a whole crew, that specializes in construction, maintenance, and/or restoration projects. For more information on SCA, visit www.thesca.org. For more general information on running volunteer programs, visit www.volunteertoday.com.

Staff and Volunteer Training

The management and maintenance of sustainable community parks will differ in some respects from traditional turf and facility-focused parks. Therefore, your staff and volunteers will need to be trained and educated on the differences, in order to be effective and efficient in their jobs. Using this guidebook is a great first step in educating your staff. Use the information presented in the book during training sessions and staff meetings, as well as during everyday duties and responsibilities. Communicate with nearby parks to find out what has and has not worked for them, and share your ideas as well.



Know your audience when planning a training session.

The following are four recommendations for designing a training program:⁵³

1. Assess the learning needs of the anticipated participants. The content of the training should be built around the difference between what the staff and/or volunteers need to know to successfully do their jobs and what they already know.
2. Once you know the main topic(s) of the training, specify the key learning objectives, which deal with knowledge, skills, and attitudes. These objectives describe what a participant should be able to know or do at the end of the training.
3. Choose a moderate level of content, as opposed to throwing in everything you know, where everything is rushed and little is remembered. Be selective – choose the “need to know” before the “nice to know.”
4. Provide printed resources (handouts, training manual, fact sheets). These will enhance the learning, as long as they are closely tied to the presentation.

A typical sequence of training events is as follows: In the beginning, go over the training’s purpose, learning objectives and key concepts, and then do an ice breaker. The bulk of the training will then focus on learning the objectives and key concepts. A variety of activities exist to get the concepts across: lectures, role playing, Power Point presentations, panel discussions, brainstorming, case studies, and hands-on demonstrations. Breaks should be included after any activity that will last 90 minutes. To end the training, summarize the content, have participants discuss how the training will affect the way they do their jobs in the future, and hand out evaluation forms.

⁵³ “Training Design and Content,” *Energize Inc.*, www.energizeinc.com/art/atra.html.

Conclusion

With just a few modifications to design and maintenance practices, parks can find balance between recreational uses and natural resource protection. And this balance will provide park visitors and the surrounding community with many benefits like lower crime rates, positive health effects, and stronger social ties. The environment will benefit from reduced flooding and erosion, reduced air pollution, and protection of biodiversity.

How can you achieve this level of “sustainable community” for your park? Following the principles outlined in this guidebook is a good beginning: enhance wildlife habitat, conserve and protect water resources like wetlands and riparian areas, remove invasives and use native plants when landscaping, use green building materials, reduce the use of chemical fertilizers and pesticides, and get the community involved through volunteer programs and education. Only your imagination and available resources of time and money limit where you go from there.

In the next and final chapter are five examples of parks in Pennsylvania that have begun moving in the “sustainable community park” direction. These examples are included to provide ideas and lessons learned for those wishing to transform some, or all, of their park. As you will see, there is no one set standard for “sustainable community parks.” Instead, a variety of things can be done to make recreation more compatible with natural resource protection. The key is to plan ahead, have goals in mind, and get the community involved in the process.

1. Groff's Mill Park Streambank Restoration - Montgomery County, Pennsylvania

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Every time a restoration project is undertaken it can be counted on to generate at least one, or possibly many, stories. The story of how a project was conceived, assembled, implemented and then how it survived the onslaughts of nature out of balance and human overuse are often more telling than viewing the "before" and "after" photographs that are generated. The act of restoring nature is still being learned and much of the learning is better told in story format than scientific reporting. Unfortunately, the "failures" of a project are often kept quiet, partly because of the mindset that if one breakdown or unmet goal is admitted then the entire project will become known as a failure. Perhaps this is flawed thinking.

The story of the Groff's Mill Park stream bank stabilization project on the East Branch Perkiomen Creek offers a good example of a design entering into uncharted waters. The following story details only a few of the aspects of this project and does not attempt to completely describe what was done. However, it does provide a few learning experiences for those who would dig into them.

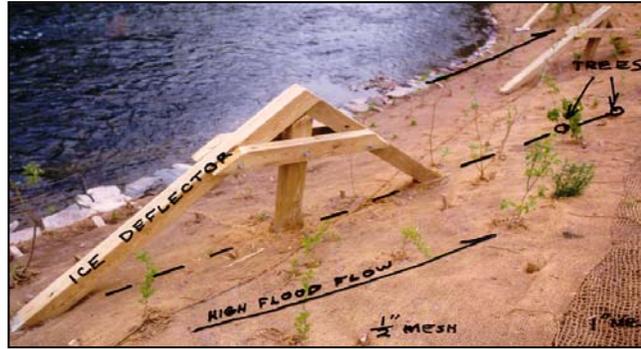
As an ecological restoration project designer and professional instructor in bioengineering, John Munro was distressed to find that there were no serious local (or even regional) examples of how plant-based techniques are used to correct serious erosion problems on moderately sized streams. However, John discovered that a local watershed organization and the Natural Resource Conservation Service (NRCS) were interested in doing such a project. He offered his professional services for design, permitting and project supervision on a pro-bono basis, as long as funding for materials would be donated and as long as the project involved the use of bioengineering (bio-structural) design and not "hard engineering" methods (riprap and concrete). Groff's Mill Park offered an opportunity, since the stream was quickly eroding a narrow portion of the park, and the park road and access to the upstream portion of the park was soon to be cut off if the erosion was not stopped.

The ecological restoration model for the site was to re-establish native floodplain forest cover as would have been the original (pre-colonial) condition. The use of swamp white oak, black willow, silver maple, sycamore, river birch and native shrubs was planned since those species can tolerate varying degrees of ice pounding and survive it. The Township parks board unfortunately could not be convinced to allow the planting of trees along the entire length of the restoration work since they did not want to obscure the view of the creek. All parties agreed to the project as planned and it was carried out.

The project area consisted of a 400-foot long, rapidly eroding stream bank that was four feet to six feet high. There were two very large known hazards looming over the design of the stream bank stabilization project. One was fast flow velocities during floods that could reach eight feet above normal water levels, and the second was the fact that large ice blocks and tree trunks were known to travel in some quantity with the flow during floods. When this was confronted during the design process, the need to provide some means of

protection for the tree and shrub plantings was obvious. The basic wedge-shaped design (*see photo below*) was adopted for the protection structure, along with a strong vertical support, a downstream buttress and bolted reinforcement timbers, not to mention concrete filled footer holes. They were designed to allow a 1-ton block of ice or a large log, floating at about 10 feet per second, to hit the deflector and slide to a stop or be pushed aside. The intent was to prevent the debris from shearing off the trees planted immediately downstream of the deflector and to allow them to grow to a size large enough for them to absorb direct

The photo-diagram of an ice deflector taken during installation shows the orientation of the deflector to current direction and the location of protected tree plantings.



damage, before the deflector would deteriorate. Trees planted without this protection could, with a high degree of certainty, be expected to be sheared off by ice.

Well, the six deflectors took a beating. Within two years only one remained. That remaining one still protects a 15-foot swamp white oak, nine years after installation. What went wrong with the others? The deflector size, material and design were apparently sufficient to withstand the pounding, but:

- If the deflectors were not lined up exactly parallel to the high-water current direction they would be toppled sideways (and some were).
- The direction of current flow changed during high water, and was not predicted well in the area where the floodwaters left the channel and spread onto the floodplain.
- Turbulence, created in part by sticks, leaves and branches caught on the deflector, caused the deflector to vibrate, which gradually fluidized the soil around the footing and allowed the deflector to be pushed right out of its holes, concrete and all.
- Volunteers installing the deflectors paid less attention to the specified details than appropriate and could not be supervised sufficiently, which resulted in oversized excavation, insufficient concrete detailing and inadequate soil compaction. This produced inconsistent deflector installation.

A portion of the stream bank project was extended a short way onto the floodplain in an area where a wide "outlet swale" was excavated to allow floodwaters to exit the creek and flow onto the floodplain without scouring-off the top of the stream bank during floods, as it had done previously. A vegetation cover of tall native grasses and riparian shrubs was planned and planted. The grasses, both seeded and plug-planted, grew well and gained a height of about 36 inches by the end of the first full growing season. During initial planning, the use of "NO MOW" signs was proposed but rejected by the parks board as un-necessary because the Township did not use that kind of sign.

At the end of summer, the Township's annual mowing of meadows is typically done. The mower operator knew about the project and the new plantings but decided on his own that he should just mow the area as he always had. Within a week of this mowing, the new "tall grass" meadow and shrub patches had been

reduced to a height of two inches. Luckily this mistake became a golden opportunity for the project. The Township officials were embarrassed at what their own staff had done and readily agreed to pay for new plant stock. More importantly, "NO-MOW" signs were purchased and placed within the park. In addition, the mowing policy for tall-grass and wildflower meadow areas of several other parks was clarified, and mowing crews were sternly advised to stop mowing at the established lines.



The installation of no-mow signs followed an embarrassing mowing of original native grasses and shrubs. No mowing in the restored area has occurred since the signs were installed.

The success or failure of an ecological restoration project should not be assessed as either absolute success or absolute failure. Generally there is a measure of both, and that should be openly recognized. With all that can happen in nature, some successes can be entirely unpredictable. Therefore, the assessment of this project should be broken down as follows:

- The site is stable and well vegetated with native plant communities.
- Much was learned from observing the site since the initial installation.
- The park road is no longer threatened.
- The native riparian vegetation is thriving and is typical of model conditions.
- The demonstration project provided an excellent "first" in the region for high-energy site stream bank stabilization using bio-structural methods.
- As a "demonstration" project, the site is being used as an educational location for professional training classes and universities.
- Where failures occurred, corrections were accomplished.
- Design elements worked well and have been used in many other projects.



Before (left) and after construction (right)



2. Emmaus Community Park Stream Restoration – Lehigh County, Pennsylvania

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This restoration project was undertaken on a quarter-mile stretch of stream located in the Borough of Emmaus Community Park. The project was undertaken to demonstrate a number of objectives. The first was to re-grade the steep eroding stream banks and plant a native riparian buffer. The second objective was to establish fish habitat improvement structures by installing single and double-log cross vanes and stone deflectors to narrow the low-flow channel. A fish ladder was constructed to deepen the flow on a section of the concrete that was impossible to remove. This allowed fish to travel both up and downstream through the channel, and also decreased the warming of the water that flowed over the hot concrete that occurred during the warm summer months.

Besides the stream improvements, other aspects of the project extended into areas of the park that had rarely been used prior to the improvements. One area of mowed turf grass was converted into a wildflower meadow for bird watchers, in conjunction with the installation of a new footbridge and walking trail. New fencing to



Community Park before the stream bank improvements. Note the erosion and lack of vegetation.

protect the native plantings in the high-use area was installed, along with a series of interpretive signage to educate the public on the scope of the project. To compliment the project and enhance its educational value, a series of educational signs and brochures were developed by the Lehigh County Conservation District and the Borough of Emmaus for middle school students who use the park as an outdoor classroom. Each year, all eighth grade students in the district use the facility for the Annual Watershed Awareness Day.

Another element of the project that was successfully completed was the modifications to the wire gabion baskets. The Borough Council identified these as an “eyesore” and requested that they be made less unsightly. After considerable thought, the gabions were planted, using soil “pillows” sewn onto the tops of the baskets to enhance their appearance. Shortly after their installation, the pillows withstood the impact of Hurricane Ivan with minimal damage. This successful application warrants consideration in other stream bank restoration projects.

During the project construction, several upstream landowners, who were experiencing similar erosion problems, approached the project partners and requested that their properties be included in the restoration. Through a collaborative effort with the borough, excess plant and seed materials were used on these properties, extending the project well over 200 feet. The project was further enhanced by the placement of bird boxes that were made by a local Boy Scout troop. One of the boxes provided a home for a pair of red-tail hawks that raised two young in the new meadow.

All the project's successes were due to the excellent relationship between the project partners. From the beginning, the Conservation District provided the Borough with a very clear picture of how the process would unfold, so no aspects came as a surprise. In addition, the project had overwhelming positive public support. The project went as planned, with all the original problems addressed in the intended ways. Stream bank erosion has been eliminated, the native plantings are doing well, and the educational aspects of the project have been very successful in informing the community about the stream and its needs.

Community Park after the restoration. Note the stabilized banks and abundance of vegetation.



3. Lardner’s Point Park Greenway Project – Bucks County, Pennsylvania

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* *Ms. Wallis is now an employee of DCNR – Bureau of Recreation and Conservation*

The eleven-mile stretch of the North Delaware Riverfront, defined as the area north of Penn Treaty Park in Center City Philadelphia to Bucks County and east of I-95 to the river, represents an enormous development asset for the City of Philadelphia. This stretch of the riverfront offers the potential for continuous riverfront green space for recreation and outdoor activities, habitat restoration, parks and open space, new housing communities and extensions of existing neighborhoods, new commercial development, continued operation of a diverse mix of port and riverfront manufacturing, utility and service industries - all anchored by one of the most powerful natural amenities in the region.

A proposed North Delaware Riverfront Greenway of approximately 300 acres is anticipated to include public open space and parkland, a new meandering, environmentally friendly and traffic calming river drive, a continuous bicycle and pedestrian trail that would be a key section of the national East Coast Greenway, as well as fishing and boating facilities and restoration of the riverbank habitat. The greenway would be the key “green infrastructure” to provide a new “front door” on the riverfront for future private residential and commercial development that would redevelop hundreds of acres of vacant and underutilized properties. The greenway would also reconnect the surrounding neighborhoods - Bridesburg, Wissinoming, Tacony and Holmesburg/Torresdale - to the river.

Existing conditions along the North Delaware Riverfront. The project will improve vegetation along the riverbanks to make it more visually appealing and ecologically-sensitive.



Lardner’s Point Park is a key seed project of the new public greenway. It is presently a 5-acre City-owned parcel along the river in front of a Philadelphia Water Department facility, the Lardner’s Point Pump Station, which is one of the largest pump stations in the country. The site was formerly used as a storage location and landing site for coal for the pump station, as well as the landing for the former Tacony Palmyra ferry to New Jersey. The site is directly south of the stately Tacony Palmyra Bridge that connects Pennsylvania and New Jersey. At the other end of the site is the new Palmyra Nature Cove Environmental

Center that features programs and exhibits about the Delaware River ecology. The future riverfront bike trail that will wend its way along the riverfront on an abandoned Conrail rail track traverses the future park site. This site was chosen for a park since it is easily accessible from the riverfront neighborhoods, is publicly-owned, and is a welcome “node” along the bike trail for a rest stop, picnic area, fishing location and a gateway for the Delaware River Heritage Trail (a bi-state bike trail that will run over the Tacony Palmyra Bridge and then extend north through the City’s riverfront and into Bucks County).

The Pennsylvania Environmental Council (PEC) sought funding from the Pennsylvania Department of Environmental Protection (DEP) and the Coastal Zone Management Program (CZM) to create engineered plans to develop this site as an ecologically-sensitive public park and a model for the ecological restoration that could be pursued along the entire riverbank. Biohabitats, Inc., an ecological restoration landscape design firm, was selected to develop the park plans, along with Field Operations who had developed the City’s vision plan for the entire North Delaware Riverfront. A subcommittee of a larger Riverfront Task Force was organized to review the plans and provide technical input.

The final design includes a combination of green building amenities such as solar lighting, permeable pavement, ecologically-sensitive restoration, public recreation amenities, and interpretive signage that educates visitors to both historical and environmental facts and features. The design features include: a river overlook; restoration of the riparian buffer and riverbank forest, in addition to new meadow plantings with native trees and shrubs; repair of the finger pier for fishing and sitting, and removal of the bulkhead and boat ramp; creation of two picnic areas; creation of new freshwater high marsh and low marsh intertidal wetlands and marsh meadows; a pedestrian path along the river; K & T bike and pedestrian trail that traverses the site (also part of the national East Coast Greenway trail and trailhead for bi-state Delaware River Heritage Trail); plus interpretive signage. Amenities will include solar lighting, compost restroom, drinking fountain, sitting area around the overlook, pedestrian walking path, and large trail map.

Debris, such this concrete, will be removed from the brownfield site.

Since the site was a brownfield, the design includes building up the grading, rather than excavating, removing old concrete ramps and pads, and removing concrete that was placed along the riverbank for stabilization. The tides make it difficult to put in extensive planting, so through the process of a tide gauge and evaluating the tide flow, the tidal wetland – both high marsh and low marsh plants – was designed. It is anticipated that there will be lots of trash that will get washed up, but hopefully will not interfere with the wetland function.



PEC also received a DEP Growing Greener grant to begin the riverbank restoration while final plans were still being completed. Initially, it was envisioned that some of the riverbank forest restoration could be done, as well as planting native shrubs along the riverbank. It was intended to get the project started, keep up the momentum of community engagement, and see some results and change on the riverfront. However, due to the major growths of Japanese knotweed, Japanese honeysuckle vine, and shrub honeysuckles on the site, the funding from DEP was largely used for invasive species management. With some of the funds,

PEC was able to conduct a volunteer tree planting day on an adjacent parcel south of the park, using native trees and shrubs provided by DCNR's TreeVitalize Program. Volunteers from the community Task Force, Fairmount Park Commission, Philadelphia Water Department, local elected officials, PEC, and local high schools came together to plant these trees.



Note the Japanese knotweed infestation along the riverbank. Funds from DEP were used to manage these plants.

The next step in the park's progress is to move forward with construction. The bike trail portion is in the design and engineering phase, so construction of the park and trail will need to be carefully coordinated. There is a study being completed to address access to the trail and park from the Tacony Palmyra Bridge, as well as the adjacent neighborhoods, for pedestrians, cyclists and automobile visitors. The site will be graded up, some trees removed and most trimmed, and new meadows and shrubs planted – hopefully, with no issue of invasive species to interrupt the growth of the new plantings. The plan designates some areas to be mowed in a meandering path through the understory and scrub, so that visitors can walk, sit and enjoy the landscape without it being lawn or requiring more meticulous maintenance.

One of the issues that have been encountered in this park development is the length of time it has taken to work with all of the City and community partners on developing a design that can be a pilot for future work and a model that is the “flagship” of public access and recreation along the riverfront. To this end, PEC worked closely with staff from the Fairmount Park Commission, DEP, and DCNR on selecting the amenities such as solar lighting and compost restrooms that can hopefully become standard items throughout the Fairmount Park system. Collaborating with the stakeholders and taking the time to work through a process of engaging partners may take time, but should prove, in the long run, to create a solid base of support for the park. Collaboration will also help the project become a model of ecological restoration and riverfront recreation that will set the standards for the riverfront greenway implementation to follow.

Maintenance of this park will be done by a new public/private entity being formed to lead the implementation of the greenway and private redevelopment along the riverfront. Crews will need to be trained in how to “manage” a mostly natural landscape, as well as the compost restroom and other features that are totally new to current Fairmount Park staff. It may be a challenge to set out new behaviors and pave new ground, but one that is manageable and worthwhile.

4. Black Rock Sanctuary Interpretive Trail - Chester County, Pennsylvania

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Chester County's Black Rock Sanctuary project initially began in the 1800's with the advent of the industrial revolution and the discovery of coal as a fuel source. With these events, the Commonwealth chartered the Schuylkill Navigation Company in 1815 to build a slack-water canal system between the coalfields of Schuylkill County and Philadelphia. The system consisted of dams and locks to create a deep shipping channel that allowed the coal to get downstream around the dam areas while compensating for the river's water elevation changes.

By 1900, waste from upstream coal operations was contributing over 3,000,000 tons of silt to the river annually. By 1930 so much silt had built up behind the dams and in the river that navigation ceased, flooding increased, recreation use came to an end, and the river's value as a water supply was being threatened. In 1945, after passing a series of laws to mitigate the build-up of silt in the state's waterways, the Commonwealth undertook the Schuylkill River Project to dredge the river and remove the silt to strategically located basins. The basins were constructed by relocating indigenous soil and rock to create long clay-filled berms about twenty feet high just off the river's edge. In the case of the Black Rock, the 8,000 feet long berm created an 80-acre basin. After construction was completed, the river was dredged and the slurry was pumped into the basins to dry. Later, sand, gravel and coal were removed for mineral recycling, leaving the site desolate and pockmarked. Over the intervening years, regenerating and invasive species provided a young but substantial forest.

In 1990, the Pennsylvania Bureau of Mines declared the Black Rock, Linfield, and Sanatoga basins surplus and sold the land to Chester County for wildlife conservation and recreation uses. The County's vision for the basins was to develop a truly different environmental park by taking advantage of their location along the Atlantic Coast Flyway to create and interpret breeding and nesting habitat for rare and endangered migrating waterfowl species.

The County then sought and received funding from private, county, state and federal sources. All together, five grants from different agencies were obtained from the Chester County Board of Commissioners, DCNR, DEP, the William Penn Foundation, and the United States Fish and Wildlife Service (USFWS). The County also received funding assistance from the Land and Water Conservation Fund, the U.S. Department of the Interior, DCNR's Bureau of Recreation and Conservation, and the Keystone Recreation, Park and Conservation Fund.



Black Rock Sanctuary Interpretive Trail – Station 8

The goals for Chester County’s Black Rock Sanctuary were to (1) form a comprehensive network of high quality wetlands by enhancing existing and creating new wetlands to support the breeding and nesting of migratory waterfowl; (2) create a highly interactive interpretive trail designed to explore and explain the complex biological interconnections and interactions of the man-nature natural landscape; and (3) use and reuse materials found within the site to create the trail and many of the interactive exhibits and activities.

The wetland construction portion of the project was completed in November 2002. In all, over 27 acres of new wetlands were created bringing the total wetland acreage to over 46 acres on the site. The wetland construction techniques included: grading to return portions of the area to pre-basin grades; creating mounds and pools to provide “temporary islands” for nesting sites; excavating to create vernal pool areas for amphibian breeding; enhancing deep water areas for fish as a source of food for birds and animals; and removing invasive plant species.

The 121-acre Black Rock Desilting Basin project site in Phoenixville, Pennsylvania, is part wildlife sanctuary for migratory waterfowl, part educational facility, and lastly a recreational facility. The education component is a thematically charged Americans with Disabilities Act (ADA) compliant interpretive trail that will lead visitors through the basic needs of wildlife survival such as habitat, food, and water. Visitors will learn how plants and animals such as amphibians and birds rely on these building blocks of life in their own unique way for their survival. The Interpretive Trail provides a series of interpretive displays, including: vernal pools to demonstrate the delicate balance in maintaining a healthy amphibian population; adaptations of waterfowl species; an interactive display to demonstrate watersheds; and a biofilter to demonstrate the difficulties of dealing with surface water runoff and chemical pollution

Interpretive stops along the trail include stations that take advantage of the site’s unique natural features. The *Welcome Station* introduces visitors to the site and tells them of the industrial history of the Schuylkill River. *Habitat World* informs visitors of the basic needs of animals, shares how habitats are formed, and

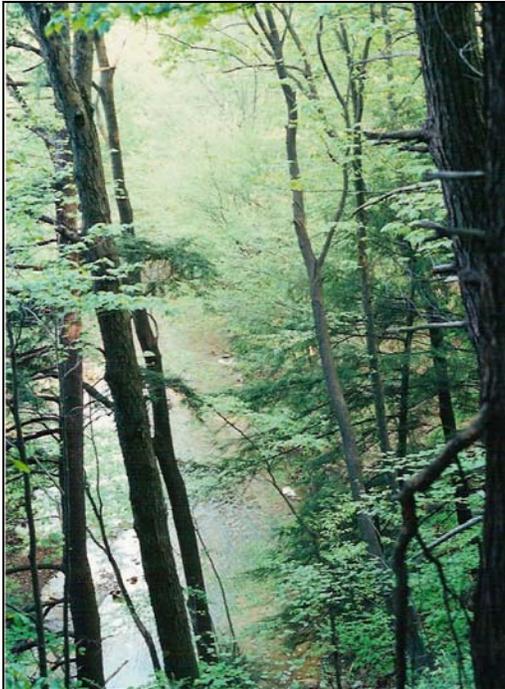


Black Rock Sanctuary Interpretive Trail – Station 1.

invites visitors to do the “Habitat Hop.” *Geo World* explains the various types of rocks found on the property and invites people to become a “rock detective.” *Amphibian World* explains what an amphibian is and illustrates the difference in vernal ponds throughout the year. *Plant World* talks about how plants are producers and providers, and shows the different types of plants that grow in the area. *Bird World* talks about bird adaptations and allows visitors to view birds from an over-sized bird nest. *Meadow World* talks about the warm-season grass meadows, how the County manages them, and shows how this former industrial site is being returned to nature.

5. Duff Park's Native Wildflowers and Trees – Westmoreland County, Pennsylvania

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Turtle Creek

Less than 20 miles east of Pittsburgh, Duff Park is an extraordinary place. As Murrysville's first community park, this 147-acre conservation-oriented park occupies a forested hillside above the stretch of Turtle Creek that runs parallel and very close to Pennsylvania State Route 22. Situated behind this commercial corridor, Duff Park is separated from the businesses along the south side of SR22 by a railroad line and the creek itself. In spite of its location not far from a busy highway, the park is a sanctuary of great natural diversity and beauty.

Duff Park came into being via a partnership between the state, Murrysville, community organizations, and various individuals. Franklin Township, Murrysville acquired the park's land in 1968, making use of Pennsylvania Project 70 ("the conservation bond project") funding matched by the Municipality. Three parcels were combined to form the park, which was named for the Duff family who owned the largest of the parcels. The park's development as a nature reserve immediately followed, thanks to the effort and contributions of many community organizations (including the Lions Club, Garden Club, Jaycees, Boy Scouts and Girl Scouts), the high school, community businesses, and plenty of volunteers. Over the years, additional parcels and rights-of-way have been donated to extend the park.

Today Duff Park is many things to Murrysville: a reminder of our community's history, a nature preserve containing an important old-growth deciduous forest, a popular destination for walkers and hikers, a refuge widely recognized for the abundance of its wildflowers and birds, and from time to time a rallying point for community attention, investment, and effort.

Overlooking the forest, around the park pavilion, is a grand old white oak tree that has lived through all these events; its height exceeding 107 feet and its age estimated at over 300 years. In addition to this venerable tree, Duff Park contains one of Pennsylvania's few remaining deciduous old growth forests; its age estimated at 215 to 240 years.

Over five miles of trails have been developed in the park, most of them hiking trails built with minimal impact upon the land, situated to permit access without disturbance to the park's many colonies of wildflowers. Some trails cross steep slopes and provide thrilling views over hillsides. Park improvements

have been limited to these trails - discreet signs, benches, a pavilion with picnic tables, a drinking fountain, and one trail of crushed limestone running alongside Turtle Creek.

This trail, the William Funk Bikeway, was named for the individual who built much of it. It is wider than Duff Park's other trails, as it was built to accommodate cyclists and larger numbers of walkers. In 1990, the upgrade of two Bikeway crossings over Turtle Creek was executed in dramatic fashion when the Air National Guard made use of a helicopter to set new bridges in place. With Turtle Creek running along one side of most of the Bikeway and a steep forested hillside on the other, this inviting trail is now Murrysville's most-used recreational facility unrelated to organized sports.

If trail names such as Violet, Trillium, and Hepatica conjure up images of idyllic settings, it is rightfully so, for Duff Park bears a collection of wildflowers exceptional in variety and numbers (*see photos below*). In 2001, Murrysville's Environmental Advisory Council published a list of over 60 wildflowers in Duff Park and their approximate times of bloom. Early volunteer activities in the park included planting trees, shrubs, and flowers, but today the park is maintained strictly as a nature reserve, with volunteer efforts directed to maintaining trails and removing invasive plants. Led by a staunch champion of native plants, every year dedicated individuals devote hundreds of hours to this work to protect the park's wildflowers.



Indian Pipe, Virginia Bluebells, Trout Lily, and Red Trilliums are just some of the many native plants found in Duff Park.

Over the years, Duff Park has drawn the people of Murrysville together – first to acquire it, then to develop it, catalogue and document its many resources, enjoy it, and when necessary protect it. Shortly after it was acquired, the park was vigorously defended by many in the community against the prospect of its loss to a rerouting of SR22. Subsequent threats to the park's natural preservation have included consideration of logging, construction of gas lines, and the intrusion of invasive plants.

Duff Park has provided immeasurable benefits to Murrysville, but its maintenance is not without challenges. Intense deer pressure has led to a visible reduction in the population of many wildflowers and an increase in the presence of exotic invasives, some of which spread every year in spite of the hard work of park volunteers. From time to time there are conflicts between groups of park users, with those protecting native plants worrying about the potential damage walkers, cyclists, and dog owners may inflict on the vegetation. Turtle Creek carries pollution from upstream mine drainage, and over the years the creek has shifted, occasionally flooded, and significantly eroded its banks as its channel has been narrowed and straightened with surrounding development. With a busy highway nearby, it is not known whether airborne pollution from exhaust fumes may eventually harm the park environment. Finally, maintenance costs for the Bikeway are high, mostly due to streamside erosion, at a time of increasingly tight Municipal budgets.

In spite of – *or maybe because of* – these challenges, Duff Park continues to draw people together. Controlled hunting in the park has helped to contain the deer population. Conscientious volunteers continue to nurture and protect the park, and ongoing efforts are made by Murrysville’s Parks and Recreation Departments to accommodate park users in ways that do not threaten native plant populations. For bank mitigation and pollution abatement, the Turtle Creek Watershed Association has coordinated many corrective initiatives.

In some ways, the grand old oak near Duff Park’s pavilion is similar to the park itself. The oak’s height and the spread of its branches reveal that it once grew alone, and that the forest grew up around it. Likewise, the land of Duff Park witnessed the early history of Murrysville, and the community grew up all around it. Just as the old oak is appreciated for its beauty and age, Duff Park is valued for its beauty and the age of its forest.

Over the years, the great oak has encountered stress, possibly due in part to the proximity of a gravel trail and park pavilion. Correspondingly, Duff Park has met stress from surrounding development, manifest in such things as today’s deer pressure and waterborne pollution. For the white oak, in 2002 an attentive Murrysville resident recognized a need and stepped forward to sponsor its trimming and professional care. This effort, in the best tradition of community spirit, is representative of that of so many since Murrysville’s acquisition of the park, with many organizations and individuals contributing to the conservation of this great natural resource for the enjoyment of all.

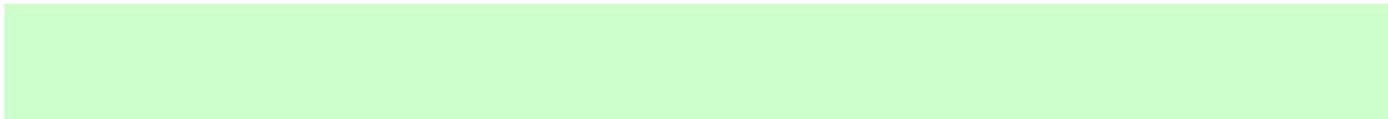
Looking to the future, prospects are good for Duff Park to be joined to a larger greenway running along the Turtle Creek corridor. Development of a Greenway Plan for Westmoreland County is now underway. The Westmoreland Heritage Trail chapter of the Regional Trail Corporation is planning a trail that will pass through Murrysville, which is likely to run along the Turtle Creek corridor. This trail will serve as a link in a regional trail that will run from Saltsburg, northeast of Murrysville, to Trafford, to the southwest. Its construction will connect Murrysville with neighboring Export, Salem Township, and Monroeville. These plans bring the likelihood of enhanced access to Duff Park. The park will serve as a fine diversion for trail users, who will also delight in this extraordinary sanctuary of sylvan grace.



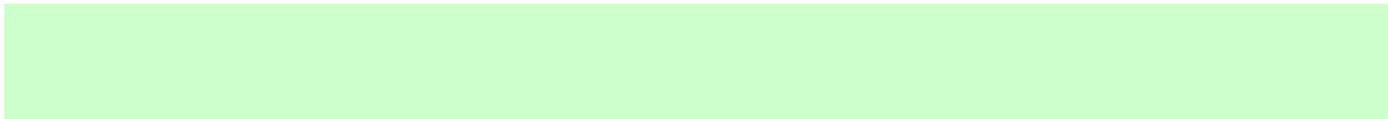
Turtle Creek, flowing through Duff Park.

Adapted from "Landscaping with Native Plants," a DCNR publication available at www.dcnr.state.pa.us/forestry/wildplant/native.aspx.

	Common Name	Scientific Name	Bloom Period	Wildlife Value	Height	Hardiness Zone	Water	Light
Medium to Large Trees	Red maple	<i>Acer rubrum</i>	Mar-Apr	very high	40-60 ft	5-6		
		Notes: Red flowers; adaptable; fall color						
	Sugar maple	<i>Acer saccharum</i>	Apr-May	very high	60-75 ft	5-6		
		Notes: Yellow flowers in spring; fall color; maple syrup						
	Yellow birch	<i>Betula alleghaniensis</i>	Apr-May	very high	60-80 ft	5		
		Notes: Catkins in winter						
	Black birch	<i>Betula lenta</i>	Apr-May	very high	45-55 ft	--		
		Notes: Catkins in winter						
	River birch	<i>Betula nigra</i>	Apr-May	very high	60-80 ft	--		
		Notes: Catkins; striking bark; grows in eastern & central PA						
	American beech	<i>Fagus grandifolia</i>	Apr-May	high	50-70 ft	5-6		
		Notes: Beautiful tree; edible nuts; attractive bark						
	White ash	<i>Fraxinus americana</i>	Apr-May	intermediate	50-80 ft	6		
		Notes: Fast growth; fall color						
	Green ash	<i>Fraxinus pennsylvanica</i>	Apr-May	intermediate	30-50 ft	--		
		Notes: Fast growth; fall color						
	Tulip poplar	<i>Liriodendron tulipifera</i>		intermediate	75-100 ft	6		
		Notes: Green flowers in early summer; fast growth						
	Black-gum	<i>Nyssa sylvatica</i>	Apr-May	high	30-60 ft	6		
		Notes: Outstanding fall color						
Eastern white pine	<i>Pinus strobus</i>		very high	50-80 ft	5-6			
	Notes: Evergreen conifer							
Sycamore	<i>Platanus occidentalis</i>	Apr-May	low	75-100 ft	--			
	Notes: Showy bark; drops fruits							
White Oak	<i>Quercus alba</i>	Mar-Jun	very high	50-100 ft	6			
	Notes: Edible nuts; majestic							
Chestnut Oak	<i>Quercus montana</i>	May-Jun	very high	40-75 ft	6			
	Notes: Fall color; nuts attractive to wildlife							
Pin Oak	<i>Quercus palustris</i>	Apr-May	very high	60-70 ft	6			
	Notes: Common ornamental street trees; fall color							
Red Oak	<i>Quercus rubra</i>	Apr-May	very high	60-80 ft	5-6			
	Notes: Hardy and long-lived tree; fall color							



	Common Name	Scientific Name	Bloom Period	Wildlife Value	Height in Feet	Hardiness Zone	Water	Light
	Sassafras	<i>Sassafras albidum</i>	April	high	30-50 ft	6		
		Notes: Edible and medicinal uses; fall color						
	Basswood	<i>Tilia americana</i>	May-Jun	very low	60-80 ft	5-6		
		Notes: Flowers aromatic, with herbal uses; multiple trunks						
	Canada hemlock	<i>Tsuga canadensis</i>		high	40-70 ft	5-6		
	Notes: Evergreen conifer; PA state tree							
Small Trees and Shrubs	Smooth alder	<i>Alnus serrulata</i>	Mar-Apr	high	6-10	6		
		Notes: Yellow catkins; multi-stemmed; needs wet soil						
	Serviceberry	<i>Amelanchier arborea</i>	Mar-May	high	15-25	6		
		Notes: White flowers in spring; edible berries; fall color						
	Black chokeberry	<i>Aronia melanocarpa</i>	Mar-Jul	intermediate	3-6	--		
		Notes: White flowers; multi-stemmed; berries; fall color						
	New Jersey tea	<i>Ceanothus americanus</i>	May-Sep	intermediate	< 3	6		
		Notes: White flowers; multi-stemmed; tough; fixes nitrogen						
	Buttonbush	<i>Cephalanthus occidentalis</i>	Jun-Sep	intermediate	6-15	6		
		Notes: White flowers; multi-stemmed; interesting fruit						
	Redbud	<i>Cercis canadensis</i>	April	very low	20-35	--		
		Notes: Purple flowers in spring; fixes nitrogen						
	Alternate-leaved dogwood	<i>Cornus alternifolia</i>	May-Jun	very high	15-25	5-6		
		Notes: White flowers in early summer; blue berries						
	Silky dogwood	<i>Cornus amomum</i>	May-Jul	very high	6-12	6		
		Notes: White flowers in summer; blue berries; multi-stemmed						
	Flowering dogwood	<i>Cornus florida</i>	Apr-Jun	very high	10-30	6		
		Notes: White bracts in spring; red berries; diseases						
	Witch-hazel	<i>Hamamelis virginiana</i>	Sep-Nov	low	20-30	5-6		
		Notes: Yellow flowers; multi-stemmed; fragrant; medicinal						
Wild hydrangea	<i>Hydrangea arborescens</i>	Jun-Jul	low	3-5	6			
	Notes: White blooms in mid-summer; multi-stemmed							
Winterberry	<i>Ilex verticillata</i>	May-Jun	high	6-10	6			
	Notes: Showy berries in winter; multi-stemmed							

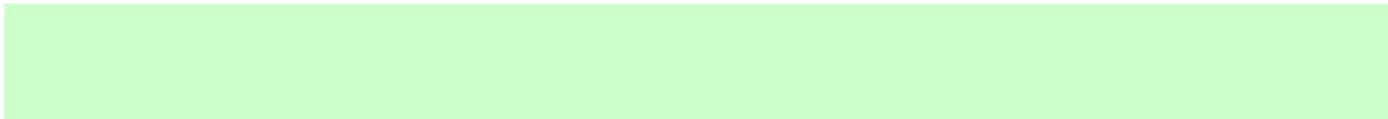


	Common Name	Scientific Name	Bloom Period	Wildlife Value	Height in Feet	Hardiness Zone	Water	Light
	Mountain laurel	<i>Kalmia latifolia</i>	May-Jul	very low	7-15	6		
		Notes: White flowers; evergreen; multi-stemmed; PA state flower						
	Spicebush	<i>Lindera benzoin</i>	Mar-May	high	6-12	6		
		Notes: Berries and foliage in fall; multi-stemmed; herbal uses						
	Ninebark	<i>Physocarpus opulifolius</i>	May-Jul	intermediate	5-10	6		
		Notes: Pink flowers; papery bark; multi-stemmed						
	Wild plum	<i>Prunus americana</i>	Apr-May	high	15-25	6		
		Notes: White flowers; edible fruit; multi-stemmed						
	Rosebay	<i>Rhododendron maximum</i>	Jun-Jul	very low	10-30	--		
		Notes: Rose flowers; evergreen; multi-stemmed						
	Pinxter-flower	<i>Rhododendron periclymenoides</i>	May-Jun	low	4-8	6		
		Notes: White-pink flowers; multi-stemmed						
	Black willow	<i>Salix nigra</i>	Apr-May	intermediate	30-50	6		
		Notes: Catkins in spring; needs wet to moist soil						
Small Trees and Shrubs	Silky willow	<i>Salix sericea</i>	May	intermediate	< 12	5-6		
		Notes: Catkins; needs wet conditions; multi-stemmed						
	Elderberry	<i>Sambucus canadensis</i>	Jun-Jul	very high	6-15	5-6		
		Notes: White flowers; multi-stemmed; edible berries & flowers						
	Lowbush blueberry	<i>Vaccinium angustifolium</i>	May-Jun	very high	1-2	--		
		Notes: White flowers; multi-stemmed; edible berries						
	Highbush blueberry	<i>Vaccinium corymbosum</i>	May-Jun	very high	6-12	--		
		Notes: White flowers; multi-stemmed; edible berries; fall colors						
	Maple-leaved viburnum	<i>Viburnum acerifolium</i>	May-Jun	intermediate	4-6	5-6		
	Arrow-wood	<i>Viburnum recognitum</i>	May-Jun	very high	3-15	--		
		Notes: White flowers in late spring; multi-stemmed						
	Virginia creeper	<i>Parthenocissus quinquefolia</i>	July	high	10-40	--		
	Notes: Fall color; berries important for wildlife; considered a vine							

	Common Name	Scientific Name	Bloom Period	Bloom Color	Height	Hardiness Zone	Water	Light
Grasses	Big bluestem	<i>Andropogon gorardii</i>	Jun-Sep		3 - 5 ft	--		
		Notes: Clump forming; attractive, with winter interest						
	Lurid sedge	<i>Carex lurida</i>	Jun-Oct		1 - 2 ft	5-6		
		Notes: Wetland plant; interesting seeds						
	Bottlebrush grass	<i>Elymus hystrix</i>	Jun-Aug		2 - 4 ft	6		
		Notes: Grass which grows in shade						
	Riverbank wild-rye	<i>Elymus riparius</i>	Jul-Sep		3 - 5 ft	5-6		
		Notes: Good for streambank conditions						
	Virginia wild-rye	<i>Elymus virginicus</i>	Jul-Sep		2 - 4 ft	5-6		
		Notes: Grass which tolerates a wide range of conditions						
	Switch grass	<i>Panicum virgatum</i>	Aug-Sep		3 - 6 ft	--		
		Notes: Clump grass; can help control erosion						
Little bluestem	<i>Schizachyrium scoparium</i>	Jul-Sep		2 - 4 ft	6			
	Notes: Clump grass; tolerates poor soil; winter interest							
Indian grass	<i>Sorghastrum nutans</i>	Aug-Sep		3 - 6 ft	--			
	Notes: Clump grass; tall with beautiful flowers							
Ferns	Maidenhair fern	<i>Adiantum pedatum</i>			1 - 2 ft	5-6		
		Notes: Grows in clumps; delicate texture; herbal uses						
	Evergreen shield fern	<i>Dryopteris marginalis</i>			1 - 3 ft	5-6		
		Notes: Evergreen; clump-former; attractive						
	Interrupted fern	<i>Osmunda claytoniana</i>			2 - 4 ft	5-6		
		Notes: Grows in clumps; distinctive fronds						
Christmas fern	<i>Polystichum achrostichoides</i>			1 - 2 ft	5-6			
	Notes: Evergreen; grows in clumps							
Showy Flowers	Doll's eyes	<i>Actaea pachypoda</i>	Apr-Jun	white	1-3 ft	5		
		Notes: Interesting berries						
	Wild columbine	<i>Aquilegia canadensis</i>	Apr-Jun	red & yellow	1-3 ft	5-6		
		Notes: Commonly cultivated; spreads by seed; hummingbirds						
Jack-in-the-pulpit	<i>Arisaema triphyllum</i>	Apr-Jun	green-purple	1-3 ft	5-6			
	Notes: Unusual flower; bright red berries							

Common Name	Scientific Name	Bloom Period	Bloom Color	Height	Hardiness Zone	Water	Light
Wild ginger	<i>Asarum canadense</i>	Apr-May	maroon	< 1 ft	5-6		
	Notes: Edible and herbal uses						
Swamp milkweed	<i>Asclepias incarnata</i>	Jul-Aug	rose	2-4 ft	6		
	Notes: Butterfly plant; needs wet-moist soils						
Common milkweed	<i>Asclepias syrica</i>	Jun-Aug	pink	2-6 ft	5-6		
	Notes: Butterfly plant; interesting seed pods						
Butterfly-weed	<i>Asclepias tuberosa</i>	May-Sep	orange	1-3 ft	6		
	Notes: Butterfly plant; tolerates dry conditions; taproot						
New England aster	<i>Aster novae-angliae</i>	Aug-Oct	purple	2-6 ft	6		
	Notes: Showy and frequently cultivated						
Turtlehead	<i>Chelone glabra</i>	Jul-Sep	whitish	1-3 ft	5-6		
	Notes: Tolerates wet; strong grower; herbal uses; hummingbirds						
Joe-Pye weed	<i>Eupatorium fistulosum</i>	Aug-Sep	purple	3-6 ft	6		
	Notes: Good for insects in the garden; herbal uses						
White snakeroot	<i>Eupatorium rugosum</i>	Jul-Oct	white	2-3 ft	6		
	Notes: Tough plant; can grow in dry shade; cultivars available						
Gaura	<i>Gaura biennis</i>	Jul-Sep	white	1-6 ft	6		
	Notes: Attractive flowers						
Wood geranium	<i>Geranium maculatum</i>	Apr-Jul	rose	1-2 ft	5-6		
	Notes: Adaptable plant; long bloom time; spreader; herbal uses						
Common sneezeweed	<i>Helenium autumnale</i>	Aug-Oct	yellow	2-6 ft	6		
	Notes: Tolerates wet areas; showy flowers; herbal uses						
Sunflowers	<i>Helianthus sp.</i>	Jul-Sep	yellow	4-6 ft	6		
	Notes: Perennials; often aggressive; showy flowers; good for birds						
Oxeye sunflower	<i>Heliopsis helianthoides</i>	Jul-Sep	yellow	1-5 ft	6		
	Notes: Long bloom time; butterfly plant						
Alum-root	<i>Heuchera americana</i>	May-Aug	greenish	1-2 ft	6		
	Notes: Long bloom time; many cultivars and hybrids						
Cardinal flower	<i>Lobelia cardinalis</i>	Jul-Sep	scarlet	2-5 ft	6		
	Notes: Long bloom time; butterfly and hummingbird plant						
Great blue lobelia	<i>Lobelia siphilitica</i>	Jul-Oct	blue	1-3 ft	6		
	Notes: Long bloom time; white cultivars; hummingbirds<						

	Common Name	Scientific Name	Bloom Period	Bloom Color	Height	Hardiness Zone	Water	Light
Showy Flowers	Monkey-flower	<i>Mimulus ringens</i>	Jul-Sep	violet	2-3 ft.	5-6		
		Notes: Grows in moist places; interesting flowers						
	Partridge-berry	<i>Mitchella repens</i>	Jun-Jul	white	< 1 ft.	5-6		
		Notes: Evergreen; ground cover; berry edible and showy						
	Bee-balm	<i>Monarda didyma</i>	Jul-Aug	red	2-5 ft.	5		
		Notes: Showy flowers; aromatic; butterfly plant; herbal uses						
	Bee-balm	<i>Monarda fistulosa</i>	Jul-Aug	violet	2-5 ft.	--		
		Notes: Aromatic; tolerates dry soils; herbal uses						
	Sundrops	<i>Oenothera fruticosa</i>	Jun-Sep	yellow	1-3 ft.	6		
		Notes: Bright flowers; long bloom time						
	Sundrops	<i>Oenothera perennis</i>	Jun-Aug	yellow	1-2 ft.	5-6		
		Notes: Bright flowers; long bloom time						
	Beard-tongue	<i>Penstemon digitalis</i>	May-Jul	white	2-5 ft.	6		
		Notes: Colored cultivars; hummingbirds						
	Phlox	<i>Phlox divaricata</i>	May-Jun	lilac	1-2 ft.	--		
		Notes: Aromatic; butterflies						
	Phlox	<i>Phlox maculata</i>	Jun-Sep	purple	1-3 ft.	6		
		Notes: Aromatic; showy flowers; butterflies						
	Phlox	<i>Phlox paniculata</i>	Jul-Oct	pink	2-5 ft.	6		
		Notes: Aromatic; showy flowers; butterflies						
	May-apple	<i>Podophyllum peltatum</i>	May	white	1-2 ft.	6		
		Notes: Ground cover; edible fruit; mottled foliage						
	Jacob's Ladder	<i>Polemonium reptans</i>	Apr-Jun	blue	1-2 ft.	--		
	Notes: Attractive flowers; slow spreader; herbal uses							
Solomon's seal	<i>Polygonatum pubescens</i>	Apr-Jun	yellow	1-3 ft.	6			
	Notes: Not fussy; blue berries; herbal and edible uses							
Black-eyed Susan	<i>Rudbeckia hirta</i>	May-Sep	orange	2-3 ft.	5-6			
	Notes: Bright daisy-like flowers; long bloom time; many cultivars							
Cutleaf coneflower	<i>Rudbeckia lacianata</i>	Jul-Sep	yellow	2-6 ft.	5-6			
	Notes: Tall daisy; tolerates wet soil; herbal							
Bloodroot	<i>Sanguinaria canadensis</i>	Mar-May	white	< 1 ft.	6			
	Notes: Red juice; herbal uses							



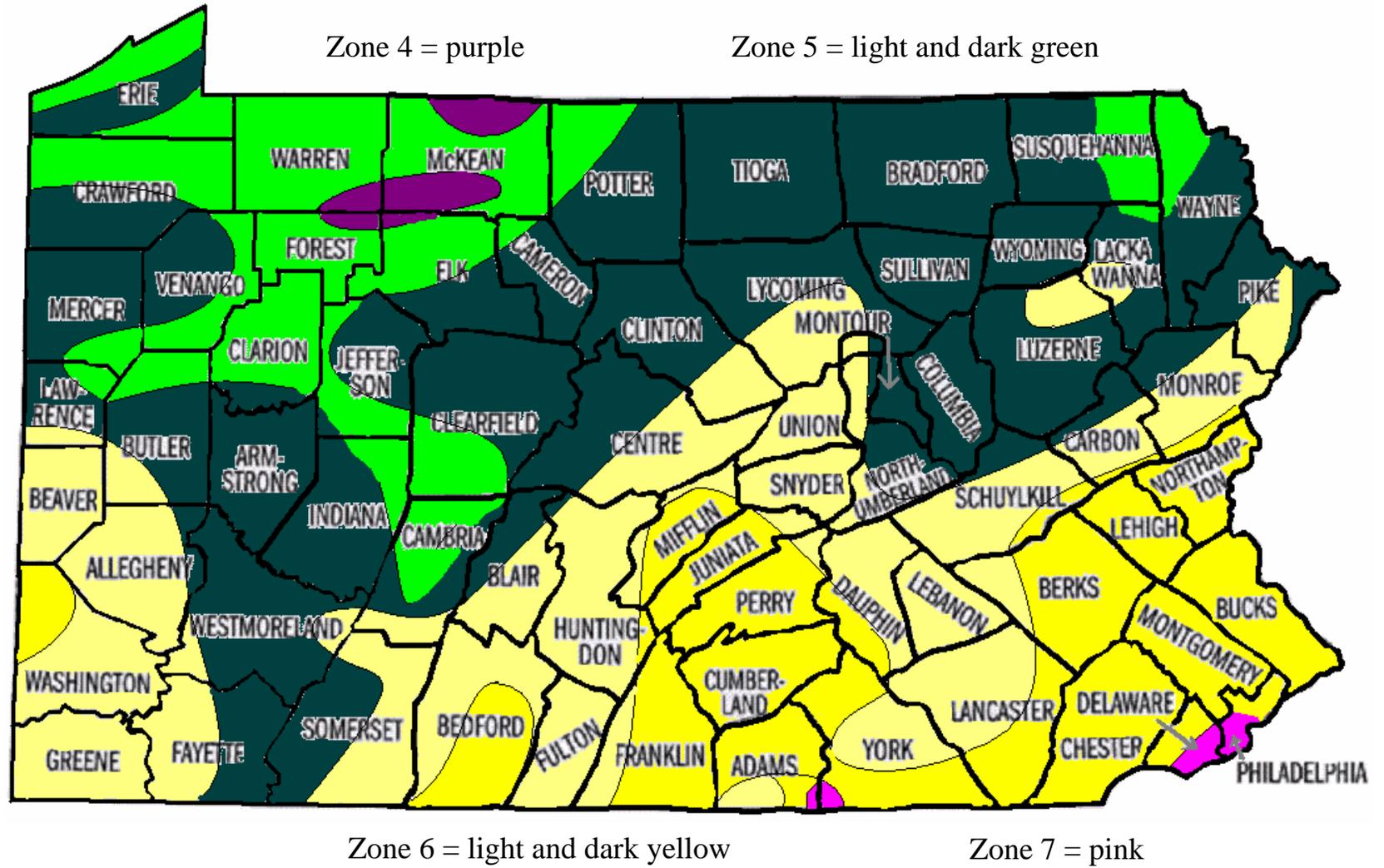
	Common Name	Scientific Name	Bloom Period	Bloom Color	Height	Hardiness Zone	Water	Light
	Golden ragwort	<i>Senecio aureus</i>	May-Jul	yellow	1-2 ft.	6		
		Notes: Wetland plant; long bloom time; early daisy-like flowers						
Showy Flowers	False Solomon's seal	<i>Smilacina racemosa</i>	May-Jul	white	1-2 ft.	5-6		
		Notes: Plume like flower; red berries; herbal uses						
	Wrinkle-leaf goldenrod	<i>Solidago rugosa</i>	Jul-Nov	yellow	2-6 ft.	5-6		
		Notes: Aggressive; tough plant; butterflies						
	Nodding ladies-tresses	<i>Spiranthes cernua</i>	Aug-Oct	white	1-2 ft.	--		
		Notes: Likes moist, acid soils; orchid flowers; herbal uses						
	Tall meadow-rue	<i>Thalictrum pubescens</i>	May-Jun	white	2-8 ft.	5-6		
		Notes: Wet to moist soil; tall plant; delicate flowers						
	Foamflower	<i>Tiarella cordifolia</i>	Apr-Jun	white	< 1 ft	5		
		Notes: Attractive, long-blooming flower; many cultivars						
	Trillium	<i>Trillium grandiflorum</i>	Apr-Jun	white	1-2 ft.	--		
		Notes: Showy flowers; common in western PA						
	Blue vervain	<i>Verbena hastata</i>	Jun-Sep	blue	2-5 ft.	5-6		
		Notes: Wet-moist soils; bright flowers; herbal uses						
	New York ironweed	<i>Veronica noveboracensis</i>	Jul-Sep	purple	3-6 ft.	6		
		Notes: Tall plant of wet-moist soils; brilliant flowers						
American dog violet	<i>Viola conspersa</i>	Apr-May	violet	< 1 ft.	6			
	Notes: Delicate plant and flower; edible							
Common blue violet	<i>Viola sororia</i>	Apr-May	violet	< 1 ft.	6			
	Notes: Delicate plant and flower; edible							
Golden-Alexanders	<i>Zizia aurea</i>	Apr-Jun	gold	1-2 ft.	--			
	Notes: Not fussy; attracts good insects							

SYMBOL KEY

Scientific Name: Scientific name from Rhoads and Klein, 1993, *The Vascular Flora of Pennsylvania*

Zone Preference: Pennsylvania is generally divided into two horticultural zones: USDA Zone 5 in the northern half of the state and higher elevations where the average minimum temperature may reach -10 to -20F. USDA Zone 6 is in the southern half of the state and lower elevations where the average coldest temperature is 0 to -10F. A dash (--) indicates the plant grows partially in both zones, but not throughout the entire area.

Water: - Wet - Moist - Dry
Light: - Full Sun - Medium Sun - Shade



Adapted from “Invasive Plants in Pennsylvania,” a DCNR publication available at www.dcnr.state.pa.us/forestry/wildplant/invplants.aspx.

SERIOUS INVASIVE THREATS

Scientific Name	Common Name	Plant Form	
<i>Alliaria petiolata</i>	Garlic mustard	Flower	
Notes: Invasive in many states; spreading aggressively in woodlands by seed			
<i>Carduus nutans</i>	Musk thistle	Flower	
Notes: PA noxious Weed			
<i>Cirsium arvense</i>	Canada thistle	Flower	
Notes: PA noxious Weed			
<i>Cirsium vulgare</i>	Bull thistle	Flower	
Notes: PA noxious Weed			
<i>Datura stramonium</i>	Jimsonweed	Flower	
Notes: Sometimes cultivated; spreads by seed, PA Noxious Weed			
<i>Galega officinalis</i>	Goatsrue	Flower	
Notes: PA and Federal Noxious Weed, on location in SE PA			
<i>Heraclium mantegazzianum</i>	Giant hogweed	Flower	
Notes: PA and Federal Noxious Weed, sap can cause burning blisters			
<i>Lythrum salicaria, L. virgatum</i>	Purple loosestrife	Flower	
Notes: Garden escape which has become invasive in many states; PA noxious Weed			
<i>Microstegium vimineum</i>	Japanese stilt grass	Grass	
Notes: Annual grass; invasive in many states; spreading through woodlands by seed			
<i>Phragmites australis</i>	Common reed	Grass	
Notes: Native and introduced strains; wetland grass which can form huge colonies			
<i>Polygonum (Falopia) cuspidatum</i>	Japanese knotweed	Flower	
Notes: Invasive in many states; difficult to control; spreads by roots and seeds			
<i>Sorghum bicolor ssp. drummondii</i>	Shattercane	Grass	
Notes: Grass; PA noxious Weed			
<i>Sorghum halepense</i>	Johnson grass	Grass	
Notes: Grass; PA noxious Weed; spreads by roots and seeds			
<i>Elaeagnus umbellata</i>	Autumn olive	Shrub	
Notes: Escaped from plantings and invasive in many states; rapidly spread by birds			
<i>Lonicera maackii</i>	Amur honeysuckle	Shrub	
Notes: Escaped from plantings; seeds spread by birds			
<i>Lonicera morrowii</i>	Morrow's honeysuckle	Shrub	
Notes: Escaped from plantings and invasive in many states; seeds spread by birds			
<i>Lonicera standishii</i>	Standish honeysuckle	Shrub	
Notes: Escaped from plantings; seeds spread by birds			

<i>Lonicera tartarica</i>	Tartarian honeysuckle	Shrub	Notes: Escaped from plantings; seeds spread by birds
<i>Rosa multiflora</i>	Multiflora rose	Shrub	Notes: Invasive in many states; seeds spread by birds; PA noxious Weed
<i>Acer platanoides</i>	Norway maple	Tree	Notes: Commonly planted and escaped; invasive in many states; wind spreads prolific seeds
<i>Ailanthus altissima</i>	Tree-of-heaven	Tree	Notes: Invasive in many states; wind spreads prolific seeds
<i>Celastrus orbiculatus</i>	Oriental bittersweet	Vine	Notes: Escaped from cultivation and invasive in many states; spreading rapidly (by birds)
<i>Lonicera japonica</i>	Japanese honeysuckle	Vine	Notes: Invasive in many states
<i>Polygonum perfoliatum</i>	Mile-a-minute vine	Vine	Notes: Range expanding; PA Noxious Weed
<i>Pueraria lobata</i>	Kudzu	Vine	Notes: Invasive in many states; PA Noxious Weed

MODERATE INVASIVE THREATS

Scientific Name	Common Name	Plant Form	
<i>Aegopodium podagraria</i>	Goutweed	Flower	Notes: Commonly planted in the past and escaped; spreads aggressively by roots
<i>Bromus tectorum</i>	Cheatgrass	Grass	Notes: Annual grass; very invasive throughout the west; spreads by seed
<i>Hesperis matronalis</i>	Dame's rocket	Flower	Notes: Planted in gardens; escaped and naturalized along roads; spreads by seed
<i>Myriophyllum spicatum</i>	Eurasian water-milfoil	Flower	Notes: Invasive in many states; aquatic
<i>Ornithogallum nutans, umbellatum</i>	Star-of-Bethlehem	Flower	Notes: Common garden plant which has widely escaped
<i>Pastinaca sativa</i>	Wild parsnip	Flower	Notes: Found commonly along roadsides; widespread and abundant; spread by seed
<i>Perilla frutescens</i>	Beefsteak plant	Flower	Notes: Garden escape; widespread mostly along roadsides; spread by seed
<i>Phalaris arundinacea</i>	Reed canary grass	Grass	Notes: Aggressive wetland grass; native and introduced strains; widespread and abundant
<i>Ranunculus ficaria</i>	Lesser celandine	Flower	Notes: Spreads by roots and shoots; can be very aggressive in wetlands
<i>Berberis thunbergii</i>	Japanese barberry	Shrub	Notes: Escaped from cultivation and invasive in many states; spread by birds
<i>Berberis vulgaris</i>	European barberry	Shrub	

Notes: Escaped from cultivation; spread by birds

Elaeagnus angustifolia Russian olive Shrub

Notes: Escaped from plantings and invasive in many states; spread by birds

Ligustrum obtusifolium Border privet Shrub

Notes: Escaped from cultivation; seeds spread by birds

Ligustrum vulgare Common privet Shrub

Notes: Planted very commonly in the past and escaped; invasive in many states

Lonicera morrowii x tatarica Bell's honeysuckle Shrub

Notes: Escaped from cultivation

Rhamnus catharticus Common buckthorn Shrub

Notes: Becoming a problem in PA

Rhamnus frangula Glossy buckthorn Shrub

Notes: Becoming a problem in PA

Rubus phoenicolasius Wineberry Shrub

Notes: Common bramble; not cultivated; spread by seed

Ulmus pumila Siberian elm Tree

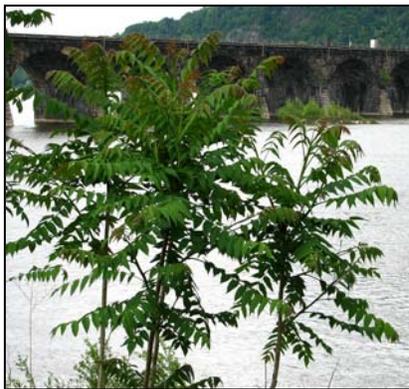
Notes: Escaped from cultivation

Akebia quinata Fiveleaf akebia Vine

Notes: Escaped from cultivation

Ampelopsis brevipedunculata Porcelain-berry Vine

Notes: Escaped from cultivation



**Tree-of-heaven
(*Ailanthus altissima*)
on the left, and
Amur's honeysuckle
(*Lonicera maackii*) on
the right, are both
widespread in
Pennsylvania.**



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