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Natural Resources Inventory

of

Lower Saucon Township, Northampton County, Pennsylvania

August 28, 2000

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Table of Contents

Acknowledgments 2
Executive Summary 3
Introduction and Background 4
Location 4
Physiography and Geology 4
Hydrology 4
Land Use 7
Survey Methods 7
Important Resources 8
Species of Special Concern 8
Forested Areas 8
Deer Over-abundance 9
Invasive Non-native Species 9
Riparian Corridors 10
Springs and Seeps 10
Vernal Ponds 10
Limestone Wetlands 11
Important Natural Resource Areas 11
General Recommendations 16
Land Protection 16
Riparian Protection and Restoration 16
Township Ordinances 17
Hydrological Study 17
References 18
Appendix A - Fact Sheets on Species of Special Concern
Appendix B - Vernal Pool information
Appendix C - Herpetological Survey Species List
Appendix D - Fish Survey Species List by Stations
Appendix E - Vascular Plants Species List
Appendix F - Guidebook for Riparian Corridor Preservation

List of Figures

Figure 1 Geological Map 5
Figure 2 Watershed Map 6
Figure 3 Important Natural Resource Areas 12

Acknowledgments

We want to thank all the residents of Lower Saucon Township who permitted members of the survey team to enter their properties. Concerned Citizens of Lower Saucon facilitated the process of obtaining landowner permission, Tom and Keri Maxfield and Glen Kern were particularly helpful. Jeffrey Zettlemoyer, Township Zoning officer also assisted in contacting landowners.

Executive Summary

This inventory was undertaken at the request of the supervisors of Lower Saucon Township and under a contract entered into between Lower Saucon Township and the Morris Arboretum of the University of Pennsylvania and dated April 5, 2000. The work was carried out by Drs. Ann F. Rhoads and Timothy A. Block of the Morris Arboretum and subcontractors Reichard's Herpetological Services, who surveyed reptiles and amphibians, and Robert W. Criswell, who surveyed fishes.

Major natural resources of Lower Saucon Township are:

water in the form of springs, seeps, and streams; the Reading Prong is the source of natural stream flow and provides water supply for the township and adjacent municipalities through reservoirs and protected watershed lands;

extensive forested slopes that provide habitat for a diversity of birds and other wildlife, protect water quality and quantity, and provide a prominent green matrix that is important to the quality of life for the people of the township;

vernal ponds and other wetlands that provide habitat for several state endangered plants and a variety of reptiles and amphibians.

No federal endangered species were found, however one bat and six plant species that occur in the township are listed as species of special concern by the Pennsylvania Natural Diversity Inventory (PNDI).

Ten areas were identified in which conservation efforts should be concentrated to protect important natural resources.

1. Black River corridor
2. Cooks Creek tributary headwaters
3. Crestline Road ravine
4. East Branch Saucon Creek headwaters
5. Granite Hill
6. Kohlberg Hill
7. Lehigh River corridor
8. Saucon Creek corridor
9. Silver Creek wetlands (Cooks Creek watershed)
10. Swoveberg Hill

Methods of land protection include zoning, land acquisition (fee simple), purchase or donation of conservation easements. We strongly recommend that the township initiate a program of riparian corridor preservation and suggest that guidelines recently developed by the Montgomery County, Pennsylvania Planning Commission are a good model. In addition we also suggest re-evaluation of the township's weed ordinance.

Introduction/Background

Location

Lower Saucon Township is located in Northampton County, Pennsylvania. The township is bounded on the north by the Lehigh River and the boundaries of the city of Bethlehem and Hellertown Borough. To east lies Williams Township, Northampton County. Bucks and Lehigh counties form the southern and western boundaries respectively. Interstate Route 78 crosses the township from east to west, an extension of Route 33 which will link to Route 78 in Lower Saucon Township is currently under construction. Routes 378 and 412 are prominent north-south roads.

Physiography and Geology

The township includes portions of the Reading Prong of the New England Province, the Great Valley of the Ridge and Valley Physiographic province and a small corner of the Newark Basin of the Piedmont Lowlands. Each of these physiographic provinces has characteristic land forms and associated geology. The Reading Prong is geologically the oldest of these landscapes. It is characterized by gneiss and quartzite hills of the Pochunk, Byram, and Hardyston formations which are Precambrian in age (figure 1). These hills rise 350-600 feet above the adjacent valleys dominating the landscape and providing a forested background. The top of Kirchberg Hill is the highest point in the township at 1006 feet above mean sea level. Other prominent hills include Kohlberg Hill (981 ft.), South Mountain (980 ft.), Swoveberg hill (850 ft.), Focht Hill (811 ft.), and Granite Hill (800 ft.).

The valleys are underlain by Cambrian and Ordivician era limestones and dolomites of the Tomstown, Allentown, Epler, and Rickenbach formations (figure 1). Sinkholes are not unusual. The greatest expanse of limestone lies west of Hellertown extending to the Lehigh County line comprising the drainage basins of Black River and Saucon Creek.

In the southwest corner of the township the Piedmont physiographic province is represented by a small triangular portion of Triassic era quartz fanglomerate (figure 1) which extends south and west into Lehigh and Bucks Counties.

Hydrology

Most of the township lies within the watershed of the Saucon Creek, a tributary of the Lehigh River or its sub-basins Black River, Polk Valley Run, and Silver Creek. The northeastern corner drains directly into the Lehigh River and a small area along the southern boundary of the township is part of the Cooks Creek watershed (see figure 2). Streams originate in headwaters areas of springs and seeps on the gneiss slopes usually at contacts or faults (Miller et al. 1939). Because of the limestone substrate, stream flow in the valleys can suddenly disappear into subterranean voids or sinkholes. A known limestone solution cave (Redington Cave) exists along Bull Run east of Redington.

Surface geology of Lower Saucon Township (fig. 1)

Cambrian and Ordovician limestones and dolomites

- **Allentown Formation**
- **Epler Formation**
- **Leithsville Formation**
- **Rickenback Formation**

Precambrian gneiss and quartzite

- **Hardyston Formation**
- **Granitic Gneiss** (Pochunk)
- **Hornblende Gneiss** (Byram)

Triassic fanglomerate

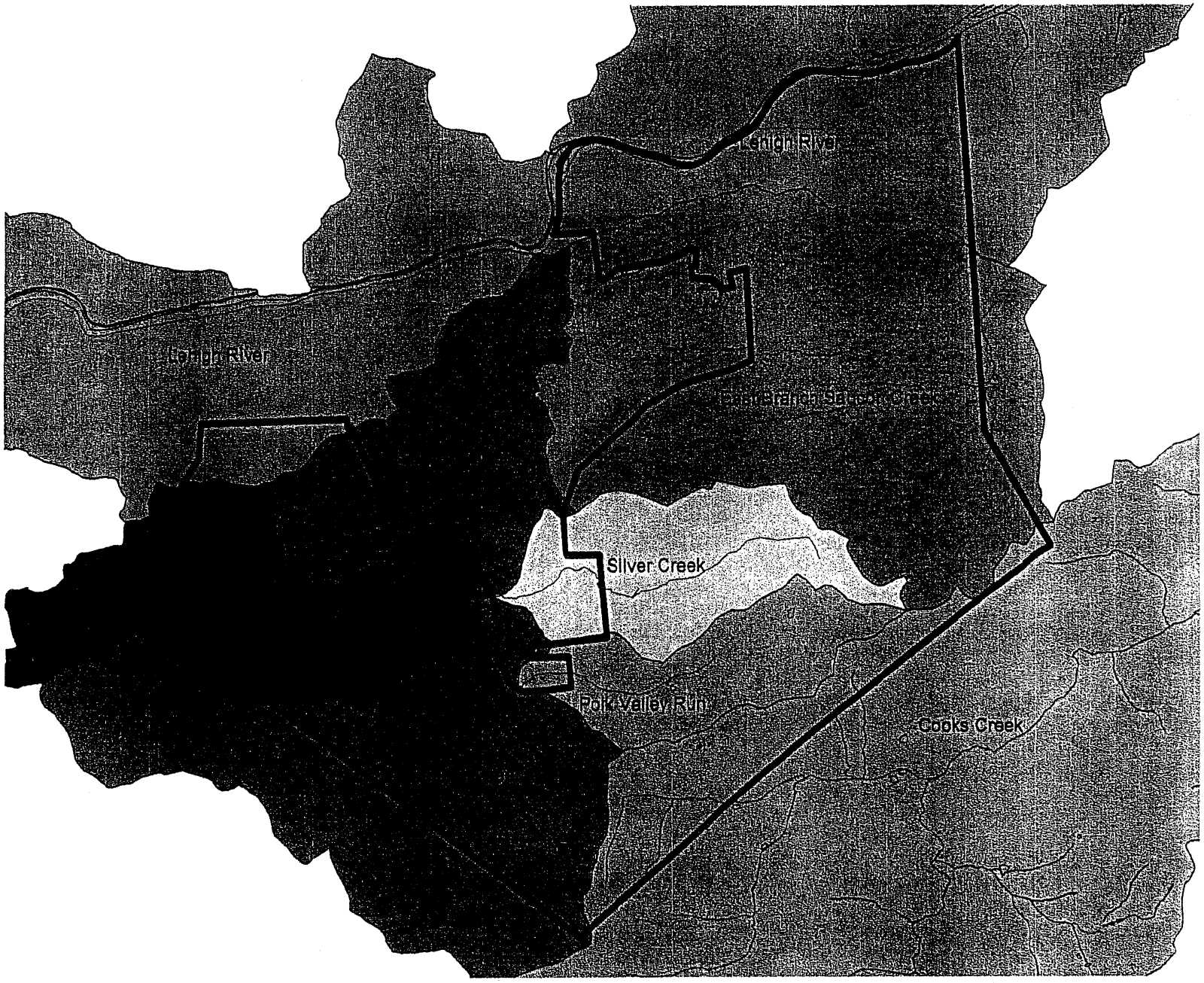
- **Quartz Fanoglomerate**

N

W E

S

Watersheds of Lower Saucon Township (fig. 2)



Land Use

The limestone valleys have been the most intensively used part of the landscape, having been farmed since the earliest days of European settlement. Little farming activity remains in the township, but the stone farmhouses and barns still stand. Many former pastures and farm fields have sprouted houses with manicured lawns, or tangles of multiflora rose. Several large golf courses are located in the township.

The hills, due to their steep, rocky character have remained primarily forested although most have been timbered repeatedly. In recent years residential development has resulted in homes being built farther and farther up the slopes and tucked back into the woods. Even in areas that remain mostly forested, the land ownership pattern is highly fragmented. The recent completion of Interstate 78 has resulted in an accelerated rate of development throughout the area. In April 2000, development proposals involving over 500 dwelling units were either approved and awaiting construction, or proposed (338 approved but not yet built, another 208 proposed) according to the draft comprehensive plan update.

The largest single landowner in the township is the Hellertown Borough Authority which maintains 2 reservoirs and 575 acres of associated watershed lands on Swoveberg and Kohlberg Hills. The City of Bethlehem owns a 221 acre tract along the Lehigh River west of Redington.

Abandoned quarries and mine holes dot the landscape reflecting the use of the geological resources of the area as a source of iron ore and limestone for the local iron industry, and limestone for lime and cement operations. In addition sand was quarried from areas of decomposed gneiss in several locations. A large landfill that serves the city of Bethlehem is located in the northern part of the township north of Applebutter Road.

Survey Methods

This inventory of natural resources was carried out by Drs. Ann F. Rhoads and Timothy A. Block of the Morris Arboretum of the University of Pennsylvania. Subcontracts were entered into with Reichard's Herpetological Services for a survey of reptiles and amphibians and Robert W. Criswell for a fish survey.

Procedures utilized included initial review of maps and aerial photographs, survey of earlier environmental reports available through the township engineer's office and the gathering of other relevant published and unpublished literature including the Pennsylvania Natural Diversity Inventory (PNDI) records, Northampton County Natural Areas Inventory (Cameron et al. 1999), Delaware and Lehigh Canal National Heritage Corridor Natural and Recreational Resources Evaluation (Mead et al. 1992), references on birds (Morris et al. 1984), geology (Miller et al. 1939) and flora (Schaeffer 1949) of the Northampton County area.

Local birders were consulted regarding birding hot spots and a general appeal was made to residents for information on important natural resources.

From all the above sources plus observations made while driving around the township, areas were targeted for field surveys. To the extent that permission could be obtained, surveys were carried out between April 22, 2000 and August 11, 2000. Altogether more than 80 sites were surveyed: 30 by Rhoads and Block, 46 sites by Reichard's, and 7 sites by Criswell. Surveyors noted species of special concern (as classified by PNDI), unusual natural communities, areas of high biological diversity, and other features of local or regional significance. Fish surveys were conducted of all significant streams in the township using a Coffelt backpack electrofishing unit. Locations of significant features were recorded using a hand held GPS receiver CMT MC-GPS made by Corvallis Microtechnology, Corvallis, OR.

Important Resources

Several types of features stand out as particularly significant natural resources. These include species of special concern, large forested areas, riparian corridors, water sources including springs, seeps and headwaters streams, limestone wetlands, and vernal ponds with adjacent forested habitat.

Species of Special Concern

Populations of the following plant species of special concern (PNDI 2000, DCNR 1988) were found in the township during the survey (for descriptions of each species see Appendix A):

		official status
ginseng	*Panax quinquefolia*	PA vulnerable
goldenseal	*Hydrastis canadensis*	PA vulnerable
nodding trillium	*Trillium cernuum*	PA undetermined
prairie sedge	*Carex prairea*	PA threatened
waterpod	*Ellisia nyctelea*	PA threatened
Wood's sedge	*Carex tetanica*	PA threatened

No new records of state or federally listed animals were found, however, a previous survey (Cameron 1999) reported the presence of a state-listed bat at Redington Cave.

Forested Areas

Because of the hilly nature of the Reading Prong and the limitations on building on steep slopes, the landscape of Lower Saucon Township still includes a number of extensive forested areas. Most notable are slopes along the Lehigh River, Granite Hill, Kirchberg Hill, Swoveberg Hill and Kohlberg Hill.

Lower slope forests are mostly of the red oak-mixed hardwood type, with successional tuliptree forests present in areas where timber harvesting was done in the past. Upper slopes tend to be of

the dry oak-mixed hardwood type (Fike 1999). Several plant species of special concern were found on forested slopes in these areas during the survey. In addition large forested areas support populations of birds such as Pileated Woodpecker, Worm-eating Warbler, and Yellow Warbler which need unbroken forest habitat. Flying squirrels, red squirrels and an occasional coyote and black bear also frequent these areas.

Forested slopes are also essential to maintain the quality and quantity of water emanating from springs and seeps located on the lower slopes and prevent erosion and siltation of streams. These forested areas are also very important to the visual character of the township, they provide a green background that contributes significantly to the quality of life for area residents.

Deer overabundance - Deer overabundance is a problem in many parts of Lower Saucon Township as it is throughout Pennsylvania and the northeastern and mid-Atlantic states. Loss of natural predators, reduced hunting pressure, and abundant sources of food from agriculture and home landscaping have allowed deer populations to reach abnormally high levels. Browsing by deer is selective initially, with highly preferred plant species sought out for consumption. Even at that early stage the diversity of wildflower and shrub species can be affected. As deer numbers grow the animals begin to feed on everything they can reach creating a visible browse line at about 4.5-5 feet below which little green remains. Continued heavy browsing will completely eliminate the wildflower, shrub, and sapling tree layers of the forest and threaten the ability of the forest to replace aging or harvested trees. Heavily browsed forests also support a lower diversity of birds, as those that nest in the understory and shrub layers are lost. Severely browsed forests with a distinct browse line and severely depleted ground layers are present in many parts of the township. The most severe problem is on South Mountain where the forest floor is essentially bare.

Invasive non-native species - The presence of invasive, non-native species is another factor affecting forest integrity in the township. Competition from non-native species has been described as a serious threat to native biodiversity, second only to incompatible land use. Weedy species that are particularly troublesome in Lower Saucon Township include the shrubs: multiflora rose (*Rosa multiflora*), bush honeysuckle (*Lonicera morrowii*), and autumn olive (*Elaeagnus umbellata*), and herbaceous species: garlic mustard (*Alliaria petiolata*), and stilt grass (*Microstegium vimineum*). Butterfly-bush *(Buddleja davidii)*, a popular landscape shrub that is in the early stages of establishing itself as an invasive weed, was found in several locations throughout the township.

Deer browse intensifies invasive species problems as deer rarely eat the non-native plants but in consuming the native understory, make room for further expansion of the invaders. Outbreaks of gypsy moth may also have allowed species like garlic mustard to spread by opening up the canopy and allowing more light to reach the forest floor. Invasive species are most troublesome in abandoned fields, pastures and other open or formerly open areas. Forest fragmentation facilitates invasion by non-native species as forest edges are vulnerable to colonization.

Riparian Corridors

Although stream valleys have been subject to intensive use over the years, some stream segments that are bordered by trees, shrubs and floodplain woodland or meadow habitat are still rich areas for reptiles and amphibians including frogs, salamanders, turtles, and snakes. Forest types include silver maple floodplain forest and sycamore-river birch-box elder floodplain forest (Fike 1999). Maintaining or restoring natural riparian vegetation and maintaining continuity with adjacent meadow and wetland habitat areas also contributes to stream quality and benefits aquatic organisms.

Springs and Seeps

Water may be the single most important resource in Lower Saucon Township. Springs and seeps located on the lower (and occasionally upper) slopes of almost all of the hills in the township are notable for the amount of water they produce. The springs and seeps, which are primarily in the eastern part of the township, are the headwaters areas for the East Branch of the Saucon Creek, Silver Creek (Saucon Creek tributary), Polk Valley Run, and several tributaries of Cooks Creek including a second stream known as Silver Creek. The Hellertown Authority has recognized the importance of these areas by establishing two reservoirs and 575 acres of associated watershed lands in the township, mainly on Swoveberg and Kohlberg Hills. In addition several township residents draw their domestic water supply directly from surface springs on Swoveberg and Kohlberg Hills and perhaps other areas also. The survey teams observed areas of springs and seeps in numerous locations.

Natural communities present include skunk cabbage-golden saxifrage forest seep (Fike 1999). Springs and seeps are also important habitat for amphibians such as the northern spring salamander, northern two-lined salamander, northern red salamander, and northern dusky salamander, all of which are dependent on good water quality. Protection of up slope watersheds is critical to maintaining water quality and quantity of the springs and seeps.

Vernal Pools

Vernal pools are depressions that are filled with water during the spring and early summer, but usually become dry later in the year, they are classified as wetlands. Vernal ponds, because of their intermittent nature, do not support fish. They are however, critical breeding sites for certain amphibian species including wood frog, spring peeper frog, spotted salamander, and red-spotted newt.

In order for ponds to support breeding populations of frogs and salamanders they must be located in forested surroundings which allow the movement of the amphibians from the breeding ponds where they spend their juvenile period to upland areas where they spend the remainder of their life cycle. Manmade ponds surrounded by mowed turf may be inhabited by a few bullfrogs or green frogs, but they do not substitute for the diversity of wildlife supported by vernal ponds in a woodland setting.

During the survey vernal ponds in appropriate forested surroundings were observed in several areas of the township, usually at the base of a slope. Because of their low elevation locations, vernal ponds are very vulnerable to changes in land use. Recent site preparation for a 22 home development along the East Branch of the Saucon Creek has destroyed several vernal ponds that were located along the south side of the creek.

More information on vernal pools is available from an article in the Summer 2000 issue of Keystone Wildnotes (see appendix B) or from the Vernal Pool Association at www.vernalpool.org. Local high school teacher, Lance Lenhardt, and his students have conducted surveys of vernal pools on Hellertown Authority lands and might be enlisted to do a more comprehensive survey of vernal pool habitat throughout the township.

Limestone Wetlands

Wet meadows and marshes on limestone occur in several areas of the township. These areas are extremely rare throughout the region and provide habitat for several plant species of special concern as well as potential habitat for a wide range of reptiles and amphibians. Continuity between wetland patches in the form of stream corridors or other natural connectors is extremely important for maintaining viable breeding populations of animals such as frogs and turtles that have limited mobility. Small isolated populations are unlikely to be able to survive in the long run.

Important Natural Resource Areas

The ten areas described below were selected for their outstanding natural resource values, see figure 3 for general locations. Sites are arranged alphabetically.

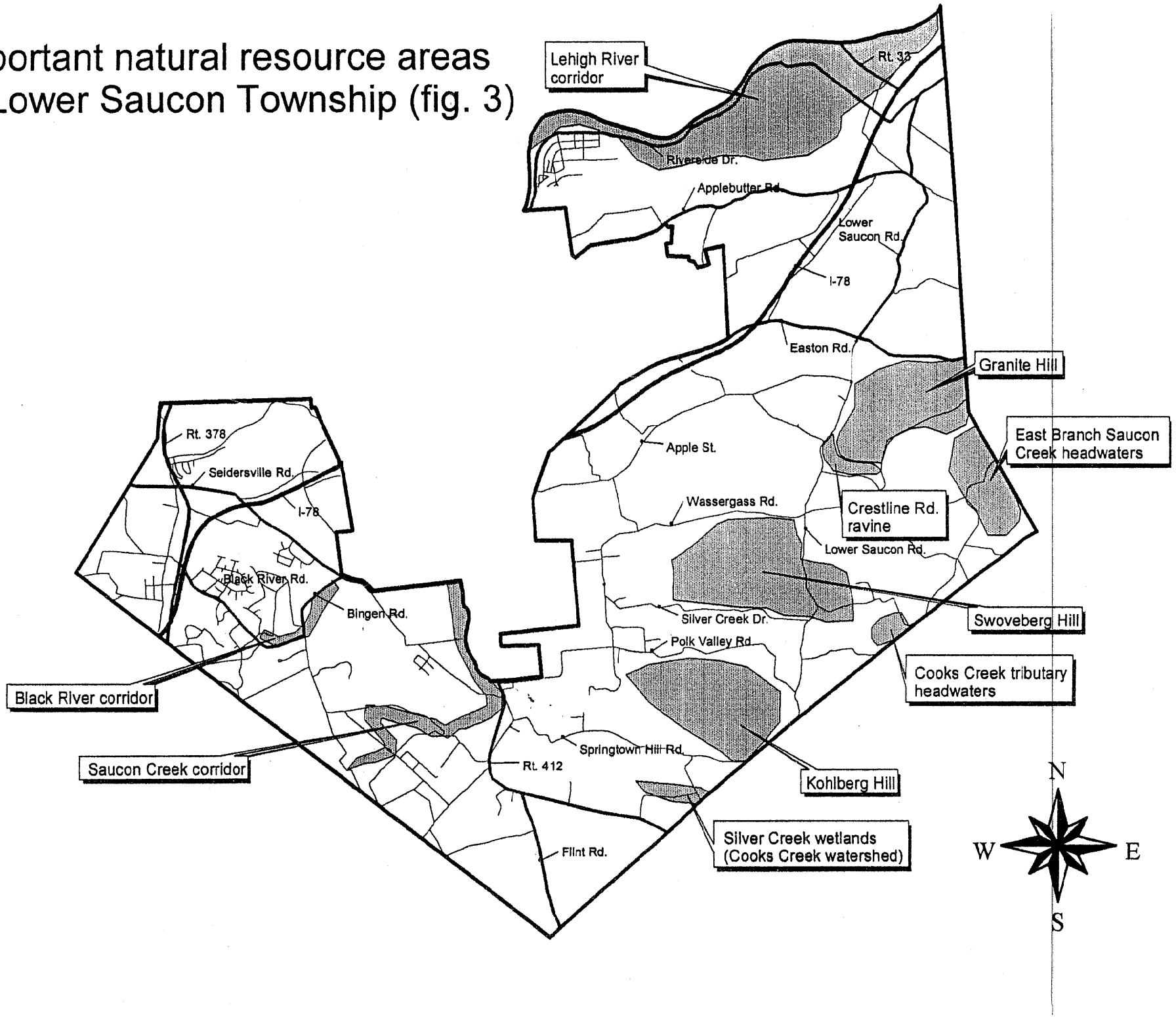
Black River Corridor

Black River flows through a landscape of moderately grazed pastures, meadows, fragments of floodplain forest, and lawns between Surrey Road and the Hellertown Borough boundary. This area yielded the highest number of reptile and amphibian species of any area surveyed with 14 species. The high species richness along this riparian corridor makes it significant. Black River lies in the most heavily developed section of the township, maintaining the continuity and diversity of riparian habitat along the stream corridor is essential to protecting the diversity of reptile and amphibian species in the future.

Cooks Creek, headwaters

This site lies at the headwaters of a tributary of Silver Creek in the Cooks Creek watershed. A rocky, wooded hillside grades into swamp forest from which a tributary of Silver Creek flows down the hill into Springtown. A vernal pond in a woodland setting provides a breeding site for wood frogs, spotted salamanders and other amphibians. A total of 13 reptile and amphibian species and over 100 birds have been observed at the site. Unfortunately the diversity of plant

Important natural resource areas of Lower Saucon Township (fig. 3)



species is being adversely affected by high deer numbers, a browse line is very evident throughout the forested areas. Many shrub and herbaceous species are in a suppressed state and may be extirpated from the site if deer density remains high.

Crestline Road Ravine

An unnamed tributary of the East Branch Saucon Creek forms a rocky ravine at the southwest end of Granite Hill north of Crestline Road. Augmented by springs and seeps, the stream flows through a very scenic wooded valley. Adjacent slopes at the west end of Granite Hill are covered with a red oak-mixed hardwood forest community. Although we were permitted to walk only the lowest part of the ravine, it was clear that this site should be a high priority for preservation.

East Branch Saucon Creek, headwaters

This area, at the eastern edge of Lower Saucon Township, consists of extensive wetlands which are part of the headwaters of the East Branch Saucon Creek. The mosaic of springs, seeps, streamlets, forested wetlands, and intervening upland forest provide a variety of habitats for wood frogs, spring peepers and other amphibians that live and breed in the vernal ponds and wetlands. Wetland community types range from small sedge-dominated wetland openings to forested swamps with a dense ground cover of skunk cabbage. Several natural vernal ponds and manmade ponds are also present.

Granite Hill

Of all the hills in Lower Saucon Township, Granite Hill offers the greatest natural habitat diversity with its rocky spine and extensive north-facing talus slope. Although several houses have been located on the top of the hill, most of the hill remains in a natural condition. The rock-covered upper slopes grade into forested lower slopes that extend to the East Branch of the Saucon Creek below. Despite some timber harvesting in the past, the forest is healthy and intact with a fair diversity of species present in the shrub and wildflower layers. A healthy shrub layer is present as deer browse has not been so severe as to alter the forest structure. The rocky ridge top supports plant species such as Allegheny-vine (*Adlumia fungosa*) and herb robert (*Geranium robertianum*) not seen elsewhere in the township. Forest community types present include: red oak-mixed hardwood forest, dry oak-mixed hardwood forest, and birch-blackgum rocky slope woodland (Fike 1999).

Kohlberg Hill Including Reservoir Park

Kohlberg Hill on the Bucks/Northampton County line includes a large contiguous forested area. Both the north and south sides of the hill also contain important headwaters areas and water sources for municipal use. The south side of Kohlberg Hill is part of the Cooks Creek watershed, several areas of springs and seeps supply water to tributaries of the Silver Creek that joins Cooks Creek in Springtown, Bucks County. Several residents along Springtown Hill Road draw their domestic water directly from springs on the slopes of Kohlberg Hill. The Hellertown Authority owns land, including a site known as Reservoir Park, on the north side of Kohlberg Hill which is in the watershed of Polk Valley Run, a tributary of the Saucon Creek.

Reservoir Park is listed as one of 22 selected birding areas in the Lehigh Valley (Morris et al. 1984). The extensive forested slopes of Kohlberg Hill provide nesting habitat for a high diversity of birds including Ruffed Grouse, Pileated Woodpecker, Acadian Flycatcher, Kentucky and Worm-eating Warblers, Black-billed and Yellow-billed Cuckoos, Oven Bird and Scarlet Tanager. Wetland areas of seeps, tussock sedge marsh, streams, and impoundments provide habitat for a diversity of reptiles and amphibians. Plant diversity is also fairly high, 14 species of ferns were identified in the Reservoir Park vicinity during a May visit. Deer browse has been excessive in some areas but not throughout.

Lehigh River Corridor

Wooded slopes and forested floodplains along the Lehigh River in the northern part of the township should be protected. Although a cleared swath interrupts the continuity where Route 33 will cross the river, this area still represents a significant forested riparian corridor. Downstream lies Hugh Moore Park in Easton and across the river is the wooded corridor along the Lehigh Canal Towpath.

The river corridor is listed as a hot spot for bird diversity in the Lehigh Valley (Morris et al. 1984). Osprey, orioles and many other nesting and migratory species are seen regularly. Other wildlife including river otter also use the area (Bill Sweeney, Environmental Education Specialist, Jacobsburg State Park, personal communication). A variety of riverine turtles were observed along the river bank and islands during the herpetological survey including painted turtle, map turtle, common snapping turtle, and the non-native red-eared slider. A survey of fish species in the river indicated 7 species present in the vicinity of Lauback Island near Steel City, however the diversity may be higher as the depth and current were to great for a comprehensive survey with the equipment available. Redington Cave, which houses a bat colony (Cameron 1999) is located on the east side of Bull Run near its mouth.

The forested slopes support a variety of habitats including rocky outcrops where turkey vultures nest and hillside wetlands of springs and seeps that provide water to Bull Run. Several plants of special concern are present. Other plants that are locally uncommon include stands of the native rosebay rhododendron (*Rhododendron maximum*), the colorful rock harlequin (*Corydalis sempervirens*), and the attractive red and yellow native columbine (*Aquilegia canadensis*).

Bull Run, appears to have been impacted by runoff from Interstate 78 as the lower portion of the creek below the highway crossing is severely scoured compared with the portion of the creek immediately above the I-78 crossing.

Saucon Creek Corridor

Saucon Creek enters Lower Saucon Township from Lehigh County and flows through a golf course, residential area and along agricultural land. From the mouth of Polk Valley Run north to Friedensville Road it forms the township boundary with Hellertown Borough. It is the most substantial waterway in the township other than the Lehigh River. The creek contains fairly good numbers of native brown trout and 13 other fish species making it a popular area for

fishing. Bird diversity is also good, a Great Blue Heron rookery is located along the creek just upstream in Lehigh County and herons forage along the creek throughout the area.

Limestone outcrops are prominent in the vicinity of Old Mill Road and the golf course, where the ruins of lime burning kilns can also be seen. Recent construction activity along Old Mill Road has caused severe erosion and siltation in the creek corridor and may have triggered the recent formation of a new sinkhole in the old mill race.

The presence of a riparian buffer of native, or partially disturbed native vegetation is an important feature of the Saucon Creek corridor. Although impacted by non-native invasive species including multiflora rose (*Rosa multiflora*), shrub honeysuckle (*Lonicera morrowii*), obtuse-leaved privet (*Ligustrum obtusifolium*), Japanese knotweed (*Polygonum cuspidatum*), garlic mustard (*Alliaria petiolata*) and dame's rocket (*Hesperis matronalis*), the vegetated buffer strip also contains many native floodplain plants and functions to filter runoff form adjacent lands and protect the stream banks. Between Walnut Street and Friedensville Road, protected lands on the west side of the creek lie opposite Hellertown Marsh, the site of an important natural wetland community noted in the county natural areas inventory (Cameron 1999). Every effort should be made to protect and/or restore a forested riparian buffer along the entire length of the Saucon Creek in the township.

Silver Creek Wetlands (Cooks Creek watershed)

Located along Silver Creek in the Cooks Creek watershed is an area of open sedge fen/marsh/wet meadow characterized by tussock sedge (*Carex stricta*), sweet flag (*Acorus calamus*), cat-tail (*Typha latifolia*), and scattered clumps of willow (*Salix sericea*) and shrub dogwoods (*Cornus amomum* and *C. racemosa*). Spring, seeps and associated rivulets flow through the downstream part of the site, closer to Orchard Road, recent ditching along the road may have affected the flow of water in the marsh by creating a channel directly into the creek.

The site, which extends into Bucks County, contains populations of two state threatened plants. It also provides habitat for a diversity of reptiles and amphibians, 5 species were recorded during surveys. An important feature of this site is the connectivity it offers with marsh and wet meadow habitat located downstream in Bucks County. Too often wetlands like this become separated from similar habitat with the result that isolated reptile and amphibian populations are too small to be viable breeding units over the long term.

Swoveberg Hill

Native red oak-mixed hardwood forest covers most of the rocky slopes of Swoveberg Hill. Although the shrub layer has been somewhat browsed, a multilayered forest structure is present except where the forest is still recovering from a recent timber harvest, suggesting that hunting pressure is sufficient to prevent severe over browsing. The Hellertown Water Authority owns land on the south slope of Swoveberg Hill including a reservoir surrounded by conifer plantations. Several vernal ponds are also located on the water authority lands which extend across Lower Saucon Road and on the south side of Banko Lane.

The north side of the hill contains several areas of springs and seeps which are the headwaters of Silver Creek in the Saucon Creek watershed. An artificial pond fed by springs is located mid-slope, outflow streamlets join tributaries of Silver Creek. Several vernal ponds and wet depressions are located along the base of the hill on the north and east sides.

The forest on the north side contains an excellent stand of native red oak-mixed hardwood forest grading into successional tuliptree forest in some areas and a dry oak-mixed hardwood forest in the steepest, rockiest parts. Portions of the forest are gradually recovering from a timber harvest about 10 years ago. Three plant species of special concern are present on the forested lower slopes on the northeast side of the hill however selective deer browse threatens one of them.

General Recommendations

Land Protection

An effort should be made to preserve the forested matrix that defines the character of Lower Saucon Township. Forest protection will also help to protect the hillside springs and seeps that are the basis for important water resources and wetland habitat.

Strategies for land protection are many and varied. Many counties and townships in eastern Pennsylvania have initiated referenda to authorize bond issues or taxes dedicated to open space protection. In some cases these programs may provide local matching funds required under state Growing Greener grant programs or vice versa.

Other possibilities include programs to encourage owners of larger properties to sell or donate conservation easements to protect all or part of their properties from future development. Conservancies and land protection organizations such as the Wildlands Conservancy, Heritage Conservancy, Natural Lands Trust, other local or regional land trusts may be helpful in identifying additional sources of assistance.

Land protection is made more challenging by the fragmented pattern of land ownership that prevails in the township. The formation of watershed groups or other alliances of land owners would help to coordinate land protection efforts.

Riparian Protection and Restoration

In order to stabilize stream banks, prevent erosion and siltation, and reduce non-point source pollution, existing riparian vegetation should be protected by a buffer zone along all creeks including headwaters streams. A guidebook for riparian corridor preservation published by the Montgomery County, Pennsylvania Planning Commission recommends a riparian buffer of at least 75 feet (Anonymous 1996). A copy is included in Appendix B. Restoration of riparian vegetation should be encouraged in areas where the land has been cleared to the creek banks.

Watershed assessments and development and implementation of watershed protection plans and

restoration projects are major emphases of the Pennsylvania Department of Environmental Protection's Growing Greener Program (www.GrowingGreener.org).

Township Ordinances

Several township ordinances have a direct bearing on natural resource protection. In addition to ordinances dealing with noxious weeds and forestry which are discussed separately below, the town council and or planning commission may wish to explore alternatives to current standards for detention basins and road widths that would provide some flexibility when applied to forested sites.

Chapter 59 Lower Saucon Township Noxious Weed and Visual Obstruction Ordinance - Although the ordinance appears to be directed at legitimate health and safety issues, the list of prohibited plants is unrealistic. Many of the species targeted, such as buckhorn plantain, mouse-ear and common chickweed, purslane, wild carrot, lamb's quarters, and several of the hawkweeds, are such common lawn, garden, and roadside weeds that they could not realistically be eliminated from the township.

The list also includes several native plants and could potentially conflict with the regulations protecting rare species under PA Code Title 17, Chapter 45 Protection of Pennsylvania Native Wild Plants as it includes all species of *dodder (Cuscuta),* bedstraw *(Galium),* and hawkweed *(Hieracium).* Several species in each of these genera are classified as endangered or threatened species in the state (DCNR 1988, PNDI 2000). Oxeye daisy, another prohibited plant, is routinely included in PennDOT roadside wildflower plantings. Perhaps a more defendable approach would be to reference the list of plants cited in Act 1982-74 Pennsylvania Noxious Weed Control Act and subsequent amendments.

Another potential outcome of the township weed ordinance is to force the premature mowing of fields that might otherwise provide habitat for a diversity of birds, butterflies, and other wildlife. Grassland birds are declining throughout Pennsylvania due to habitat destruction. Mowing too early in the season while nesting is still underway is a serious problem (Crossley 1999). Butterflies too depend on the herbaceous vegetation of old fields where milkweeds provide the larval food plant for monarchs, black swallowtails use wild carrot and its relatives, and the goldenrods and asters of late summer and fall provide nectar for adults of many species.

Forestry - The impact of deer overabundance on forests should be considered in evaluating proposals to harvest timber. The traditional reliance on natural regeneration to regenerate forest tree cover is not applicable in heavily browsed areas. A forestry plan must include an evaluation of the potential for deer impact to prevent or severely restrict regrowth of trees.

Hydrological Study

Water is clearly an important natural resource in Lower Saucon Township, not only for the

residents of the township, but also for Hellertown Borough, portions of Bethlehem and the Springtown area in Bucks County. The Pennsylvania Municipalities Planning Code, in provisions addressing zoning and subdivision ordinances, permits measures to "assure the availability of reliable, safe and adequate water supplies to support intended land uses within the capacity of available water supplies" and "to promote, protect and facilitate ...preservation of...aquifers" (Municipalities Planning Code 603(d), 503(10).

A hydrological study should be undertaken to define recharge areas and other aquifer parameters affecting water quality and quantity as an important step toward a more comprehensive plan for the protection of Lower Saucon Township's water resources. The Hellertown Borough Authority and the Springtown Water Company in Bucks County should be partners in such an effort.

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Appendix A
Descriptions of Plant Species of Special Concern

Ginseng
Panax quinquefolia, Ginseng Family
Status: Pennsylvania vulnerable

Ginseng was once widely distributed in Pennsylvania's forests, however unsustainable harvesting in many areas has nearly eliminated it. The market for ginseng roots is still strong, however, interstate and international sale of the plant is closely regulated under the Convention on International Trade in Endangered Species of Wild Flora and Fauna treaty (CITES) in an effort to prevent it from becoming totally extinct.

Ginseng is an herbaceous perennial that grows in rich deciduous forests from Quebec to Minnesota and South Dakota and south to Georgia, Louisiana, and Oklahoma. It has become rare throughout its range. The plants, which are 8 to 24 inches tall, bear small greenish-white flowers in June that are followed later by a cluster of red berries.

Goldenseal
Hydrastis canadensis, Buttercup Family
Status: Pennsylvania vulnerable

Goldenseal is an herbaceous perennial about 10 to 15 inches tall that bears a small greenish-white flower in April or May followed by a raspberry-like red berry. Its name refers to the root which is a deep golden yellow inside. It grows in rich deciduous forests. In Pennsylvania it is found mainly in the southern half of the state.

Goldenseal is believed to have medicinal properties, native Americans used it to treat a range of ailments. The plant has been widely collected from the wild for use, leading to its decline in some areas. Although occasionally locally abundant, it needs to be protected from unsustainable harvesting. It occurs from Vermont to Michigan and Minnesota and south to North Carolina, Tennessee and Arkansas.

Nodding trillium
Trillium cernuum, Lily Family
Status: proposed for listing

Nodding trillium is an herbaceous perennial of moist deciduous forests which often grows at the edges of forest wetlands. In Pennsylvania it is found mainly in the southeastern portion of the state , but even there it is infrequent.

Like many forest wildflowers in Pennsylvania it is threatened by deer overabundance. Trillium

is especially vulnerable as deer seem to seek out members of the Lily Family. With its three leaves clustered at the top of the stem, one bite removes them, stopping growth for an entire season. Overall, nodding trillium ranges from Newfoundland and Quebec to Maryland and Delaware.

Prairie sedge
Carex prairea, Sedge Family
Status: Pennsylvania threatened

This plant is an herbaceous perennial of calcareous marshes and fens. It flowers and fruits in late May and June. As with Wood's sedge, its dependence on limestone wetlands is part of the reason for its rarity in Pennsylvania as much of that habitat has been destroyed. Historically prairie sedge was known from 17 or 18 sites in the state, today it is limited to small populations in just a few locations.

Considered secure globally, prairie sedge extends from Quebec to Saskatchewan and south to New Jersey, Ohio, and Iowa. As its name suggests, in the Midwest it is a plant of the prairies.

Waterpod, Aunt Lucy
Ellisia nyctelea, Waterleaf Family
Status: Pennsylvania threatened

This plant is an herbaceous annual known from only six other locations in Pennsylvania, and apparently gone from nine additional sites in the state where it once grew. It grows on river and canal banks and in moist alluvial woods. The small white flowers are produced in late April and May on plants that reach a height of 8 to 15 inches. By mid-June the plants have completed their yearly life cycle.

Waterpod is primarily a plant of the Midwest, it ranges from Michigan and Indiana to Saskatchewan and the western mountains. In the east it occurs irregularly from New York to Virginia. It is considered secure globally, but endangered in Pennsylvania due to the small number of sites and its decline at a number of previous locations.

Wood's sedge
Carex tetanica, Sedge Family
Status: Pennsylvania threatened

Wood's sedge is an herbaceous perennial. Like other species of the genus Carex, it produces its inconspicuous flowering heads in late May and June.

This state threatened sedge grows in wet meadows and swales on limestone, a habitat that was never abundant in Pennsylvania and has declined over the years as wetlands were filled or drained. Because limestone wetlands are so scarce, this species and the natural community of

which it is a part needs protection. Although known historically from approximately 30 sites in eastern, south central, and western Pennsylvania, today it is present at only six or eight locations, three of them in Northampton County.

The total range of Wood's sedge extends from Massachusetts to New Jersey and west to Minnesota, Nebraska, and Alberta. It is considered secure at the global level.

Appendix B
Vernal Pool Information

WRCF takes the creepy out of the crawlies

Educating public is first step to conservation

WHEN the Wild Resource Conservation Fund was formed in the early 1980s, the head of the Fish Commission, Ralph Abele, declared that the new organization had the toughest teaching job in the state. "You've got to educate the people," the late Abele said, "about the creepy crawlies of Pennsylvania."

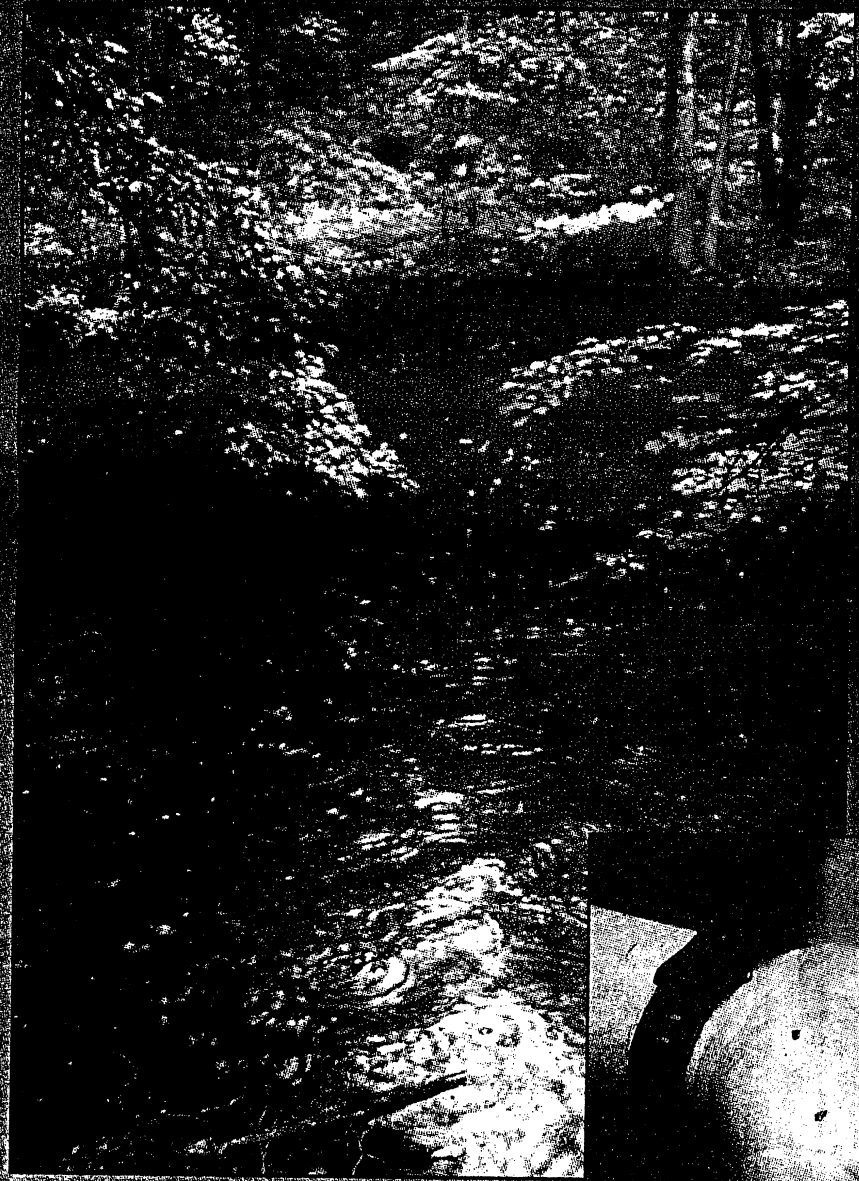
The fund, after all, doesn't deal with majestic game species such as deer, bear or trout. Nor does it manage vast woodlands or parks.

Its domain is highlighted by the likes of fungi, snakes, woodrats, with some butterflies and birds mixed in. The Fund supports research on the species that are neither hunted nor fished. That's the vast majority of Pennsylvania's 63 species of mammals; about 380 birds, 77 reptiles and amphibians; 159 fish; 2,500 native plants; and unknown numbers of fungi, lichens, bryophytes and insects.

That includes many species — such as bats and snakes — that people fear. So the Fund, which was legally prohibited from receiving money from the state General Fund, was in the position of collecting donations to study species many people loathed.

It responded by adopting the strategy once stated by former Gov. Gifford Pinchot who advised that if you're trying to do something that is right, but the public "won't stand for it," there

EDUCATION continues on page 6



Vernal ponds, [end]angered by pool-elevated, created by snow melt and spring rains, dry up most summers. Any salamander that hasn't metamorphosed into a ground-crawling adult will shrivel up along with the pond. Species that depend on these ponds include [top to bottom] the spotted, Jefferson and marbled salamanders.

Wet & Wild

Eat or be eaten ... pond inhabitants

READY? asked John Marcy, as he pitched his green net into the pond. Joe Wilson nodded in the affirmative. Marcy said. Both began methodically [illegible] long-handled nets into the bottom, periodically pulling them up to clear the [illegible] see what they had collected.

[illegible] Marcy, a biology professor at Shippensburg University.

"No tadpoles," replied Wilson, a graduate [illegible] of salamanders."

[illegible] they waded to the shore [illegible] that they had four newts, [illegible] salamander larvae and 14 spotted [illegible] larvae before releasing their catch [illegible] to the next pond, they measured [illegible] each specimen from snout to vent; [illegible] doesn't matter. It's pretty common to find some of them missing a chunk of tail that

PONDS continues on page 4

PONDS from page 1

somebody bit off," Wilson said.

This is the world of the vernal pond, where many of the inhabitants are in a race against time. Vernal ponds are temporary pools of water created by snow melt and spring rains (hence the name "vernal," which is derived from the Latin word for spring). In most years, they dry up during the summer. Any salamander that hasn't metamorphosed into a ground-crawling adult will shrivel up along with the pond.

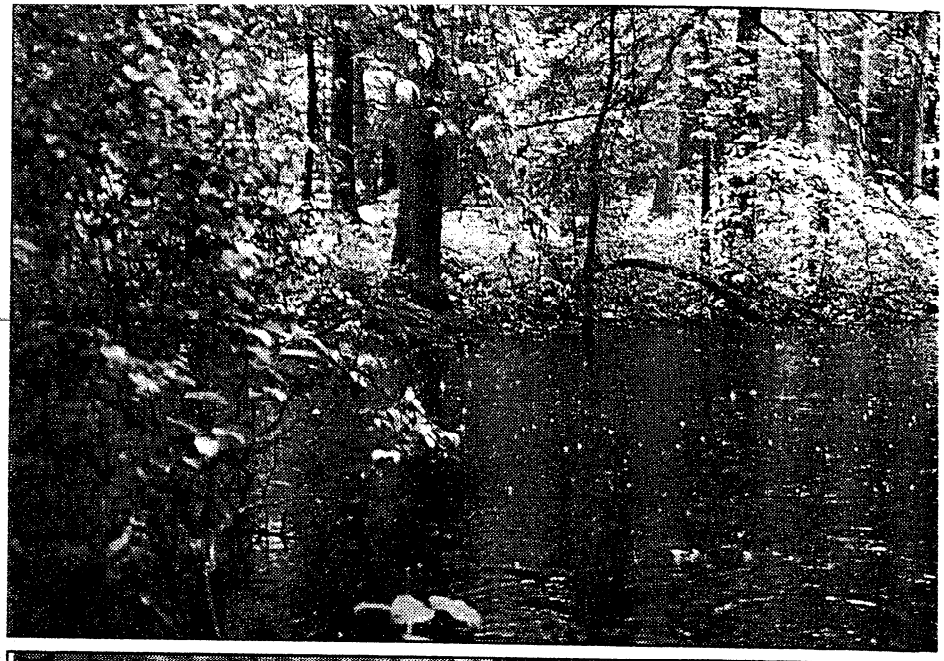
Salamanders are carnivorous to begin with. But some, to increase their chance of survival, will even eat their brothers and sisters. "The cannibals grow fast," Maret observed.

As part of a project supported by the Wild Resource Conservation Fund, Maret and Wilson are working to document the abundance and survival of amphibians in a group of vernal ponds in Michaux State Forest in Southcentral Pennsylvania. One way they do that is by taking standard five-minute samples in each pond, checking to see what they catch; if the makeup of their catch changes over time, it could signal a change in the pond environment.

Harsh as pond life may sound, vernal pools are actually good places for many species of salamander. Because vernal ponds go dry, they don't support fish that would devour young salamanders. Most pools don't support big, predatory bullfrogs, either. Bullfrogs need a pool to be continuously filled for three years before they can metamorphose into adulthood.

Certain species breed nowhere else. Vernal ponds are essential for mole salamanders such as the spotted, Jefferson and marbled salamanders. They live most of their lives underground in holes or burrows dug by other animals — hence the name mole — but migrate exclusively to vernal ponds to lay masses of eggs. The pools are also the only breeding sites for wood frogs, and are full of tiny fairy shrimp — so-called "sea monkeys." The shrimp drop eggs which remain dormant in the sediment for months — even years — until the pond refills.

While mole salamanders, fairy shrimp and wood frogs depend on vernal ponds, the pools are also important for a host of other wetland dwellers. Dragonflies, damselflies, and other insects are abundant, as well as some species of snakes and turtles. Waterfowl are often seen stopping at them. Sometimes rare species turn up: Last year, Maret found northern leopard frogs, which are declining in the region. "Vernal ponds are best known for their amphibians," he said, "but they have all sorts of unique organisms."



Despite their importance, no one knows how many vernal ponds are in Pennsylvania where they are located. Tim Maret, a biology professor at Shippensburg University, studying how forestry practices affect vernal ponds.

Despite their importance, no one knows how many vernal ponds are in Pennsylvania or where they are located. Because of their temporary nature, they can go unnoticed — and therefore unprotected — by wetland regulatory programs.

"They are the underdogs of wetlands," said Mike McCarthy, a biologist with the U.S. Fish and Wildlife Service. "They are easily overlooked and easily destroyed. By definition, they are small and isolated from other waterbodies, and at certain times of the year some of them dry up, making them unrecognizable. That is why these habitats need some special protection."

In places where people have made estimates, the losses can be staggering. In California, it thought that less than 7 percent of the state's original vernal ponds remain.

They can be built upon, bulldozed paved over without anyone knowing tl ponds are present. Developers ha sometimes turned the natural depre sions into stormwater ponds, directir runoff from nearby roads and parkir lots into them. "That," McCarthy sai "will not be very good for them Rainwater is not only unnaturally heate when it hits pavement, it also picks u pollution and carries it along.

Protecting something no one know about is difficult. Some states are deve oping volunteer programs, often usin high school biology classes, to fin ponds. In Massachusetts, wher McCarthy was once a high schoc teacher, an entire manual has been devel oped which students use to locate pond and certify — based on the species foun

there — that they are indeed vernal pools.

More than 1,000 vernal pools in the state are now certified and get special protection. The program, initiated by Reading Memorial High School biology teacher Leo Kenney, has not only provided the state with valuable information, it has been a hit with students and become a model for other programs across the nation. "Students are so well-trained because of the efforts of Leo Kenney and others," McCarthy said, "that they are training teachers to go out and certify."

Vernal pond habitat can be destroyed even if the pond itself is never touched. Pennsylvania's vernal ponds are found almost exclusively in woodlands, and the trees that surround the pools are essential for shading the water, reducing evaporation and controlling silt runoff into the pools. "Siltation is very hard on the eggs," Maret said. "They can suffocate." Caterpillars falling from the trees into the water seem to be an important food for some species, especially marbled salamanders.

When trees are cut around a pond, pool habitat can be destroyed. Direct sunlight can cause the ponds to dry faster, reducing the chance that larval amphibians will emerge as adults. This is especially critical for spotted salamanders, which are the last to enter the pond and breed, leaving their larvae in the tightest race to mature.

Part of Maret's study is aimed at better understanding how forestry practices affect vernal ponds. A decade ago, a clear cut exposed several of the ponds he is studying. Though trees are regrowing, the ponds remain largely exposed to the sun. In many of the more open ponds they have looked at, Maret has seen no spotted salamanders escape during the past two summers.

"The mortality rates seem to be very high, probably because the animals aren't getting out before the ponds dry," Maret said. "One thing that will be interesting to see will be what happens as these forests recover." He suspects the ponds will stay wet longer, and more salamanders will survive.

In Pennsylvania, the Department of Conservation and Natural Resources' Bureau of Forestry today requires a "no-cut" buffer within 100 feet of vernal ponds, and cutting is limited for an additional 100 feet beyond that. "One thing we have to give the Bureau of Forestry credit for is that even in the absence of regulations, they have decided to leave a buffer," Maret said.

Still, the vast majority of vernal ponds in the state are probably on private lands, and don't get that kind of protection. In areas where they provide

PONDS continues on page 5

PONDS from page 4

habitat for the northeastern bulrush, which is listed federally as an endangered species, the U.S. Fish and Wildlife Service protects the ponds under the Endangered Species Act.

But for most ponds, McCarthy said, the best form of protection is probably education. "If they are on private lands," he said, "it's going to require a full-time education project just to alert people to even the minimum level of environmental education, which is awareness."

Indeed, even the experts can be challenged at finding the temporary ponds, which are rarely mapped. "The easiest time to find these ponds is in the spring, when the wood frogs are calling and then to track down the wood frogs," Maret said, slinging his net over his shoulder and heading for another of the more than 30 ponds he's monitoring.

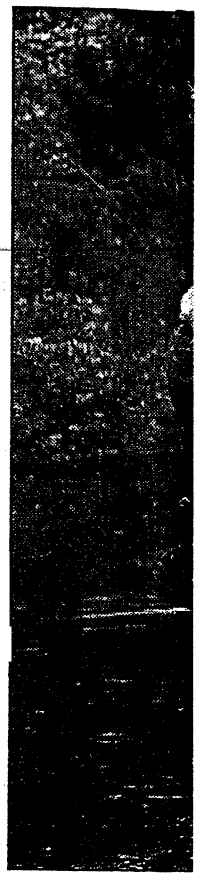
Over time, the work of Maret, Wilson and a colleague, Randy Cassell, who is studying adult salamanders on vernal ponds, will help to determine how important buffers are to ponds; perhaps even how wide they should be. Wilson's work has already indicated that ponds with wider buffers generally have more species.

Beyond that, it provides the start of what Maret hopes will be a long-term examination of an understudied Pennsylvania habitat. Besides the cutting of trees and development, vernal ponds could face other threats. One concern, Maret said, is acid rain. Although vernal ponds tend to be naturally acidic, the ponds he is studying — in a region hard-hit by acid rain — are even more acidic than expected, which may be threatening eggs or larvae.

Maret's five-minute pond surveys don't tell scientists every species that is present. But over time, the systematic sampling will tell them if the abundance, or the types of species using the ponds, begins to change. Then they can begin searching for reasons.

Concern about vernal pond habitat, and the species that use them, is likely to increase in the future. There are growing worries about amphibians in general, which appear to be undergoing a worldwide decline, and some think it could be a sign of broader environmental problems. The cause is unclear. Contributing factors could include everything from thinning ozone layers affecting their sensitive skins, loss of habitats, disease, pollution — the list goes on.

The problem seems less severe in the Eastern United States than elsewhere. But because amphibians have not been



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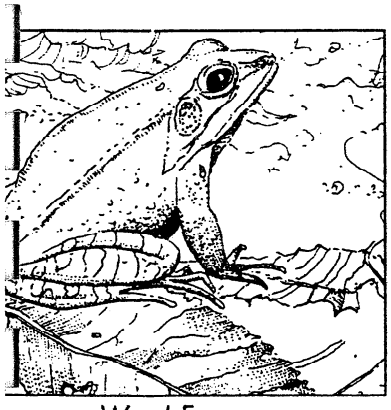
Tim Maret [left] and Joe Wilson are documenting the abundance and survival of amphibians in a group of vernal ponds in Michaux State Forest. They do that by taking standard five-minute samples in each pond and checking to see what they catch; if the make-up of their catch changes over time, it could signal a change in the pond environment.

OBLIGATE SPECIES IN REGIONAL VERNAL PONDS

ıny species use temporary
but a true "vernal" pond is
ed though the presence of
gate" species which must use a
pond during parts of their life
In this region, those species
:

MOLE SALAMANDERS: These get
ame from their spending most
r lives living in burrows on the
floor. But each year, on certain
nights, they make mass migrations to the area where they were hatched to mate and lay masses of eggs, returning to their upland habitat within a few days. The eggs produce larvae which must develop into adults and begin their life as terrestrial animals before the pools dry.

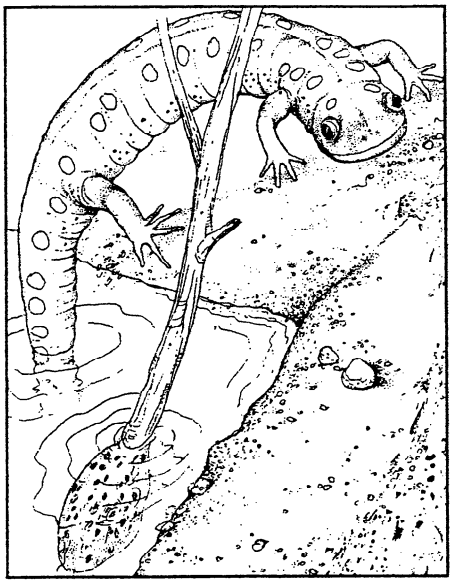
Mole salamanders in the region include the spotted salamander, the Jefferson salamander, and the marbled salamander.



Wood Frog

❑ WOOD FROGS: They live in upland forests, but venture to vernal pools in early spring to lay masses containing hundreds of eggs before returning to the woodland for the remainder of the year. Tadpoles grow in the pool and eventually follow the adults to the adjacent woods. If the pool dries too soon, the tadpoles will become food for birds, reptiles and passing mammals.

❑ FAIRY SHRIMP: These are small crustaceans that spend their entire lives, no more than a few weeks, in a vernal pool. Eggs may hatch in late winter or early spring, with adults — growing to about an inch in size — seen in the spring. Females drop an egg case on the pool bottom, where it can remain dormant for months, or even years, until water returns to the pool.



Spotted Salamander

ıo one can be certain.
erm information is important
amphibian populations are
s for wide fluctuations. The
year left egg masses that were
an last year. Maret speculated that could be the lingering effects of the drought that hit the region last summer. Sorting out what is causing changes, he acknowledged, is a "statistical nightmare." But, he added, "we won't know anything if we don't start collecting the information now."

For information about vernal pools, visit the Vernal Pool Association web site at www.vernalpool.org

Appendix C
Herpetological Survey Species List

prepared by Reichard's Herpetological Sevices

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Lower Saucon Township Herpetological Survey

SPECIES LIST
Amphibians and Reptiles Recorded During 2000 Survey

Caudata-Salamanders

Ambystoma maculatum	Spotted Salamander
Desmognathus fuscus	Northern Dusky Salamander
Eurycea bislineata	Northern Two-lined Salamander
Eurycea l. longicauda	Longtail Salamander
Gyrinophilus p. porphyriticus	Northern Spring Salamander
Notophthalmus v. viridescens	Red-spotted Newt
Plethodon cinereus	Northern Redback Salamander
Plethodon glutinosus	Northern Slimy Salamander
Pseudotriton r. ruber	Northern Red Salamander

Anura-Frogs

Bufo a. americanus	American Toad
Hyla versicolor	Gray Tree Frog
Pseudacris c. crucifer	Northern Spring Peeper
Rana catesbeiana	Bullfrog
Rana clamitans melanota	Green Frog
Rana palustris	Pickerel Frog
Rana sylvatica	Wood Frog

Testudine-Turtles

Chelydra s. serpentina	Common Snapping Turtle
Chrysemys p. picta x marginata	Painted Turtle (hybrid)
Clemmys guttata	Spotted Turtle
Clemmys insculpta	Wood Turtle
Graptemys geographica	Common Map Turtle
Sternotherus odoratus	Common Musk Turtle
Terrapene c. carolina	Eastern Box Turtle
Trachemys scripta elegans	Red-eared Slider

Serpentes-Snakes

Coluber c. constrictor	Northern Black Racer
Diadophis punctatus edwardsii	Northern Ringneck Snake
Elaphe o. obsoleta	Black Rat Snake
Lampropeltis t. triangulum	Eastern Milk Snake
Nerodia s. sipedon	Northern Water Snake
Storeria d. dekayi	Northern Brown Snake
Thamnophis s. sirtalis	Eastern Garter Snake

Appendix D
Fish Survey Results and Sampling Station Descriptions

prepared by Robert W. Criswell

Lower Saucon Twp.
Northampton County
Fishes By Station

NAME	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
American eel (Anguilla rostrata)	U	C		R		R	
Rainbow trout (Onchorhynchus mykiss)		R					
Brown trout (Salmo trutta)	C	C		U	C		
Creek chub (Semotilus atromaculatus)			A	U	C		A
Blacknose dace (Rhinichthys atratulus)	C	C	U	U	A		A
Longnose dace (R. cataractae)		U					
Cutlips minnow (Exoglossum maxillingua)						R	
Common shiner (Luxilus cornutus)	R	R		C	C		
Spotfin shiner (Cyprinella spilopterus)						R	
Satinfin shiner (C. analostanus)						R	
White sucker (Catostomus commersoni)	C	A	A	U	A		C
Banded killifish (Fundulus diaphanus)	C						
Margined madtom (Noturus insignus)	R						
Rock bass (Ambloplites rupestris)	U	U				U	
Redbreast sunfish (Lepomis auritis)	A	C				C	U
Green sunfish (L. cyanellus)	U						
Bluegill (L. macrochirus)			R		U		
Pumpkinseed (L. gibbosus)	R						
Tesselated darter (Etheostoma olmstedi)	C	C			C	R	

A = abundant
C = common
U = uncommon
R = rare

STATION DESCRIPTIONS
Lower Saucon Township – Northamption County

Station 1: Saucon Creek – at Bingen Rd. (SR 3003) bridge. 300 meters upstream.

Hard-bottomed section w/substrate of boulder/rubble – some areas impacted with silt and sand. 70% pool – 20% run – 10% riffle. Mean width approx. 7m. Total fish numbers relatively low. 12 species present. Electrofishing time = 15'56". Lat/Long: 40-34-41 & 75-19-22.

Station 2: Saucon Creek – at Meadows Rd. bridge. 300 meters – both upstream & downstream.

Hard bottom – cobble/boulder with gravel/cobble riffles. Mean width approx. 7m. Total fish numbers fairly good. 10 species present. Electrofishing time = 15'44". Lat/long: 40-33-55 & 75-20-26.

Station 3: Black River – at bridge on Bingen Rd. near intersection with Black River Rd. (SR 3002). 200 meters upstream.

Hard bottom of cobble/rubble impacted with silt and sand. Low flow. Mean width approx. 2m. Total numbers relatively high. 4 species present. Electrofishing time = 8'09". Lat/long: 40-34-25 & 75-22-11.

Station 4: Polk Valley Run – at SR 412 (Main St.) bridge. 100 meters upstream.

Hard bottom of cobble/rubble impacted with silt & sand; pools silted. Mean width approx. 1.5m. Total numbers relatively low. 5 species present. Electrofishing time = 9'39". Lat/long: 40-34-05 & 75-20-24.

Station 5: East Branch Saucon Creek – along SR 2006 (Easton Rd.) just downstream of intersection w/Lower Saucon Rd. (SR 2001). 250 meters.

Pools & runs with cobble/ rubble and sand substrate. Somewhat impacted with silt. Coarse woody debris provides additional cover. Mean width approx. 4m. Water cold. Total numbers fairly high. 7 species present. Electrofishing time = 13'57". Lat/long: 40-36-23 & 75-17-09.

Station 6: Lehigh River – at Laubach Island, Steel City. 450 meters.

Hard bottom of boulder/rubble and bedrock. Primarily one long run w/some riffle habitat. Flow moderately high. Total numbers low. 7 species present. Electrofishing time = 28'34". Lat/long: 40-37-48 & 75-19-54.

Station 7: Silver Creek – upstream of Reservoir Rd. bridge. 60 meters. Hard bottom of cobble/rubble w/some silt. Mean width approx. 1.4m. Water cold. Total numbers moderate. Station abbreviated due to impenetrable vegetation. 4 species present. Electrofishing time = 6'09". Lat/long: 40-34-41 & 75-19-22.

Appendix E
Lower Saucon Township
Vascular Plants Species List
**** denotes non-native species***

Acer negundo	box-elder
**Acer platanoides*	Norway maple
Acer rubrum	red maple
Acer saccharinum	silver maple
Acer saccharum	sugar maple
Acer spicatum	mountain maple
**Achillea millefolium*	yarrow
**Acorus calamus*	sweetflag
Actaea pachypoda	doll's-eyes
Adiantum pedatum	maidenhair fern
Adlumia fungosa	allegheny vine
Aesculus glabra	Ohio buckeye
Agrimonia parviflora	agrimony
Agrostis perennans	autumn bent
**Ailanthus altissima*	tree-of-heaven
Alisma subcordatum	water-plantain
**Alliaria petiolata*	garlic mustard
Allium canadense	wild onion
**Allium vineale*	field garlic
Alnus serrulata	smooth alder
Alopecurus aequalis	short-awned foxtail
Amelanchier arborea	shadblow, serviceberry
Amphicarpa bracteata	hog-peanut
Anemone quinquefolius	wood anemone
**Anthoxanthum odoratum*	sweet vernal grass
Aquilegia canadensis	columbine
Arabis canadensis	sicklepod
Arabis laevigata var. *laevigata*	smooth rockcress
Aralia nudicaulis	sarsaparilla
Aralia racemosa	spikenard
**Arctium minus*	burdock
**Arenaria serpyllifolia*	thyme-leaved sandwort
Arisaema triphyllum	jack-in-the-pulpit
Aristolochia serpentaria	Virginia snakeroot
Aronia arbutifolia	red chokeberry
Aronia melanocarpa	black chokeberry
**Arrhenatherum elatius* var. *elatius*	tall oatgrass
Asarum canadense	wild ginger
Asclepias tuberosa	butterfly weed
Asplenium platyneuron	black-stemmed spleenwort

Aster acuminatus	wood aster
Aster divaricatus	white wood aster
Aster lateriflorus	calico aster
Aster macrophyllus	big-leaf aster
Aster puniceus	purple-stemmed aster
Athyrium felix-femina	lady fern
**Barbarea verna*	spring cress
**Berberis thunbergii*	Japanese barberry
Betula lenta	sweet birch
Betula nigra	river birch
Betula populifolia	gray birch
Boehmeria cylindrica	false nettle
Botrychium virginianum	rattlesnake fern
Brachyelytrum erectum	brachyelytrum
**Buddleja davidii*	butterfly-bush
Callitriche heterophylla	water-starwort
Callitriche terrestris	water-starwort
Caltha palustris	marsh marigold
**Cardamine hirsuta*	hairy bittercress
Cardamine pensylvanica	Pennsylvania bittercress
Cardamine rotundifolia	mountain bittercress
Carex abscondita	a sedge
Carex aestivalis	a sedge
Carex aggregata	a sedge
Carex albicans	a sedge
Carex amphibola	a sedge
Carex annectens	a sedge
Carex appalachica	a sedge
Carex blanda	a sedge
Carex bromoides	a sedge
Carex cephalophora	a sedge
Carex communis	a sedge
Carex crinita var. *crinita*	a sedge
Carex digitalis	a sedge
Carex glaucodea	a sedge
Carex gracilescens	a sedge
Carex gracillima	a sedge
Carex granularis	a sedge
Carex grayi	a sedge
Carex grisea	a sedge
Carex hirsutella	a sedge
Carex hirtifolia	a sedge
Carex intumescens	a sedge
Carex laxiculmis	a sedge
Carex laxiflora	a sedge

Carex lupulina	a sedge
Carex lurida	a sedge
Carex nigromarginata	a sedge
Carex normalis	a sedge
Carex pallescens	a sedge
Carex pellita	a sedge
Carex pensylvanica	a sedge
Carex prairea	prairie sedge
Carex prasina	a sedge
Carex radiata	a sedge
Carex rosea	a sedge
Carex scabrata	a sedge
Carex squarrosa	a sedge
Carex stipata	a sedge
Carex striatula	a sedge
Carex stricta	a sedge
Carex swanii	a sedge
Carex tetanica	Wood's sedge
Carex trichocarpa	a sedge
Carpinus caroliniana	ironwood, hornbeam
Carya cordiformis	bitternut hickory
Carya glabra	pignut hickory
Carya ovata	shagbark hickory
Castanea dentata	American chestnut
**Catalpa speciosa*	catalpa
**Celastrus orbiculatus*	oriental bittersweet
Celtis occidentalis	hackberry
Cephalanthus occidentalis	buttonbush
**Cerastium fontanum*	mouse-ear chickweed
**Chaenorrhinum minus*	dwarf snapdragon
**Chelidonium majalis*	greater celandine
Chelone glabra	turtlehead
Chenopodium album	lamb's-quarters
Chimaphila maculata	pipsissewa
Chrysosplenium americanum	golden saxifrage
Cimicifuga racemosa	black snakeroot
Cinna arundinacea	wood reedgrass
Circaea lutetiana	enchanter's nightshade
**Cirsium arvense*	Canada thistle
Claytonia virginica	spring beauty
Clematis virginiana	virgin's-bower
Collinsonia canadensis	horse-balm, stoneroot
**Commelina communis*	blue dayflower
Conopholis americana	squawroot
Cornus alternifolia	alternate-leaved dogwood

Cornus amomum	red-stemmed dogwood, kinnikinik
Cornus florida	flowering dogwood
Cornus racemosa	silky dogwood
Corydalis sempervirens	rock harlequin
Corylus americana	American hazelnut
Corylus cornuta	beaked hazelnut
Crataegus sp.	hawthorn
Cryptotaenia canadensis	honewort
Cynoglossum virginianum	wild comfrey
Cyperus strigosus	false nutsedge
Cystopteris fragilis	fragile fern
Cystopteris tenuis	fragile fern
**Dactylis glomerata*	orchard grass
Dennstaedtia punctilobula	hayscented fern
Deparia acrostichoides	silvery glade fern
**Descurainia sophia*	herb-sophia
Desmodium glutinosum	sticky tick-clover
Desmodium nudiflorum	naked-flowered tick-trefoil
Diervilla lonicera	bush-honeysuckle
Dioscorea villosa	wild yam
Dryopteris carthusiana	spinulose wood fern
Dryopteris cristata	crested wood fern
Dryopteris goldiana	Goldie's wood fern
Dryopteris intermedia	evergreen wood fern
Dryopteris marginalis	marginal wood fern
**Elaeagnus umbellata*	autumn olive
Eleocharis obtusa	tubercled spike-rush
Eleocharis tenuis	slender spike-rush
Ellisia nyctelea	waterpod, Aunt Lucy
Equisetum arvense	field horsetail
Equisetum sylvaticum	woodland horsetail
Erigeron annuus	daisy fleabane
Erythronium americanum	trout lily
Eupatorium fistulosum	Joe-pye-weed
Eupatorium perfoliatum	boneset
Eupatorium purpurea	Joe-pye-weed
Eupatorium rugosum	white snakeroot
Euthamia graminifolia	grass-leaved goldenrod
Fagus grandifolia	American beech
Festuca obtusa	nodding fescue
**Festuca trachyphylla*	hard fescue
Floerkea proserpinacoides	false mermaid
Fraxinus americana	white ash
Fraxinus pensylvanica	green ash
Galearis spectabilis	showy orchis

Galium aparine	bedstraw, cleavers
Galium circaezans	wild licorice
Galium lanceolatum	wild licorice
Geranium maculatum	wood geranium
Geranium robertianum	herb-robert
Geum canadense	avens
**Glechoma hederacea*	ground ivy
Gleditsia triacanthos	honey locust
Glyceria striata	fowl mannagrass
Hackelia virginiana	beggar's-lice
Hamamelis virginiana	witch-hazel
Hepatica nobilis var. *obtusa*	round-leaved hepatica
**Hesperis matronalis*	dame's-rocket
**Hieracium sabaudum*	hawkweed
**Holcus lanatus*	velvet grass
Huperzia lucidula	shining clubmoss
Hydrastis canadensis	goldenseal
Hydrocotyle americana	marsh pennywort
Hydrophyllum virginianum	Virginia waterleaf
Hypericum punctatum	spotted St. John's-wort
Hypoxis hirsuta	yellow-eyed grass
Hystrix patula	bottlebrush grass
Ilex verticillata	winterberry holly
Impatiens capensis	jewelweed
Iris versicolor	blue flag
Juglans cinerea	butternut
Juglans nigra	black walnut
Juncus effusus	soft rush
Kalmia latifolia	mountain laurel
Laportea canadensis	wood nettle
Leersia virginica	whitegrass
**Lepidium campestre*	fieldcress
**Ligustrum obtusifolium*	obtuse-leaved privet
**Ligustrum vulgaris*	common privet
Lilium superbum	turk's-cap lily
Lindera benzoin	spicebush
Liriodendron tulipifera	tuliptree
Lobelia cardinalis	cardinal flower
**Lonicera japonica*	Japanese honeysuckle
**Lonicera maackii*	Amur honeysuckle
**Lonicera morrowii*	Morrow's honeysuckle
Luzula multiflora	wood-rush
Lycopus virginicus	water horehound
Lysimachia ciliata	fringed loosestrife
**Lysimachia nummularia*	moneywort

**Lythrum salicaria*	purple loosestrife
Maianthemum canadense	Canada mayflower, false lily-of-the-valley
Malus sp.	apple, crabapple
Marrubium vulgare	common horehound
Medeola virginiana	Indian cucumber-root
Menispermum canadense	moonseed
Mentha sp.	mint
Mertensia virginica	Virginia bluebells
**Microstegium vimineum*	stiltgrass
Mimulus ringens	monkey flower
Mitchella repens	partridgeberry
Moehringia lateriflora	blunt-leaved sandwort
Monotropa uniflora	Indian pipes
**Morus alba*	white mulberry
*Myosotis arvensis	forget-me-not
**Myosotis scorpioides*	forget-me-not
**Nasturtium officinale*	watercress
Nyssa sylvatica	blackgum
Onoclea sensibilis	sensitive fern
**Ornithogalum umbellatum*	star-of-Bethlehem
Oryzopsis racemosa	ricegrass
Osmorhiza claytonii	sweet-cicely
Osmorhiza longistylis	anise-root
Osmunda cinnamomea	cinnamon fern
Osmunda claytoniana	interrupted fern
Osmunda regalis	royal fern
Ostrya virginiana	hop hornbeam
Oxalis stricta	common yellow wood-sorrel
Panax quinquefolius	ginseng
Panax trifoliatus	dwarf ginseng
Panicum microcarpon	panic grass
Parietaria pensylvanica	pellitory
Parthenocissus quinquefolius	Virginia creeper
**Paulownia tomentosa*	empress tree
Pedicularis canadensis	wood betony
Penthorum sedoides	ditch stonecrop
Phalaris arundinacea	reed canary grass
Phegopteris hexagonoptera	southern beech fern
Phlox divaricatus	blue phlox, wild sweet william
**Phragmites australis*	common reed
Phryma leptostachya	fog fruit
Phytolacca americana	pokeweed
**Picea abies*	Norway spruce
Pilea pumila	clearweed
**Pinus pungens*	table mountain pine

Pinus strobus	white pine
**Plantago major*	broad-leaved plantain
Platanus occidentalis	sycamore
Poa alsodes	woodland bluegrass
**Poa trivialis*	rough bluegrass
Podophyllum peltatum	mayapple
Polygonatum pubescens	solomon's-seal
Polygonum arifolium	halberd-leaf tearthumb
**Polygonum caespitosum*	low smartweed
**Polygonum cuspidatum*	Japanese knotweed
Polygonum sagittatum	tearthumb
Polygonum scandens	climbing false buckwheat
Polygonum virginianum	jumpseed
Polypodium virginianum	rockcap fern
Polystichum acrostichoides	Christmas fern
Potentilla simplex	cinquefoil
Prenanthes sp.	rattlesnake-root
**Prunella vulgaris*	heal-all
**Prunus avium*	European bird cherry
Prunus serotina	wild black cherry
Prunus virginiana	chokecherry
Pteridium aquilinum	bracken fern
Quercus alba	white oak
Quercus coccinea	scarlet oak
Quercus montana	chestnut oak
Quercus palustris	pin oak
Quercus rubra	red oak
Quercus velutina	black oak
Ranunculus abortivus	small-flowered crowfoot
Ranunculus caricetorum	northern swamp buttercup
Ranunculus recurvatus	hooked crowfoot
Rhododendron maximum	rosebay rhododendron
Rhododendron periclymenoides	pinxter-flower azalea
Rhus typhina	staghorn sumac
Ribes americana	wild black currant
Rosa carolina	pasture rose
**Rosa multiflora*	multiflora rose
Rosa palustris	swamp rose
Rubus allegheniensis	blackberry
Rubus occidentalis	blackcap
Rubus odoratus	flowering raspberry
**Rubus phoenicolasius*	wineberry
**Rumex crispus*	curly dock
**Rumex obtusifolius*	obtuse-leaved dock
Sagina sp.	pearlwort

Salix discolor	pussy willow
Salix nigra	black willow
Salix sericea	silky willow
Sambucus canadensis	black elderberry
Sanguinaria canadensis	bloodroot
Sanguisorba canadensis	American burnet
Sanicula canadensis	snakeroot
Sanicula odorata	yellow-flowered sanicle
Sassafras albidum	sassafras
Saxifraga pensylvanica	Pennsylvania saxifrage
Saxifraga virginiensis	rock saxifrage
Scirpus cyperinus	wool-grass
Scrophularia sp.	figwort
Scutellaria latifolia	mad dog skullcap
Sisyrinchium montanum	blue-eyed-grass
Sisyrinchium mucronatum	blue-eyed-grass
Smilacina racemosa	false solomon's seal
Smilacina stellata	starflower
Smilax herbacea	carrion-flower
Smilax rotundifolia	greenbrier
**Solanum dulcamara*	purple nightshade
Solidago arguta	forest goldenrod
Solidago caesia	bluestem goldenrod
Solidago canadensis	Canada goldenrod
Solidago flexicaulis	zigzag goldenrod
Solidago rugosa	old field goldenrod
Sparganium americanum	bur-reed
Staphylea trifoliata	bladdernut
**Stellaria alsine*	bog chickweed
**Stellaria media*	field chickweed
Symplocarpus foetidus	skunk cabbage
Teucrium canadense	germander
Thalictrum dioicum	early meadow-rue
Thalictrum pubescens	tall meadow-rue
Thalictrum thalictroides	rue anemone
Thelypteris noveboracensis	New York fern
Thlaspi arvense	field pennycress
Tiarella cordifolia	foam flower
Tilia americana	basswood
Toxicodendron radicans	poison ivy
Trillium cernuum	nodding trillium
Tsuga canadensis	Canadian hemlock
Typha angustifolia	narrow-leaved cat-tail
Typha latifolia	broad-leaved cat-tail
Ulmus americana	American elm

Urtica dioica	stinging nettle
Uvularia perfoliata	bellwort
Uvularia sessilifolia	sessile-leaved bellwort
Vaccinium angustifolium	lowbush blueberry
Vaccinium corymbosum	highbush blueberry
Vaccinium pallidum	lowbush blueberry
Veratrum viride	false hellebore
Verbascum thapsus	common mullein
Verbena hastata	blue vervain
Verbena urticifolia	white vervain
Veronica anagallis-aquatica	water speedwell
Veronica arvensis	corn speedwell
Viburnum acerifolium	maple-leaved viburnum
Viburnum opulus	guelder-rose
Viburnum prunifolium	blackhaw
Vicia sativa	common vetch
Viola cucullata	blue marsh violet
Viola labradorica	dog violet
Viola palmata	early blue violet
Viola pubescens	downy yellow violet
Viola rostrata	long-spurred violet
Viola sororia	common blue violet
Viola striata	striped violet
Vitis sp.	grape