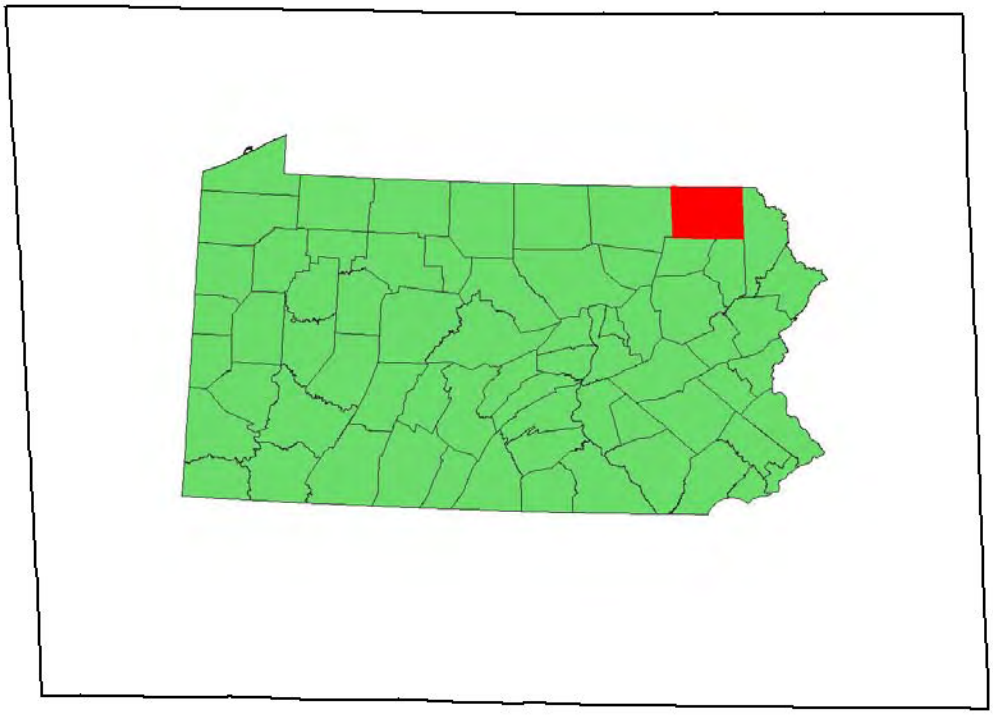
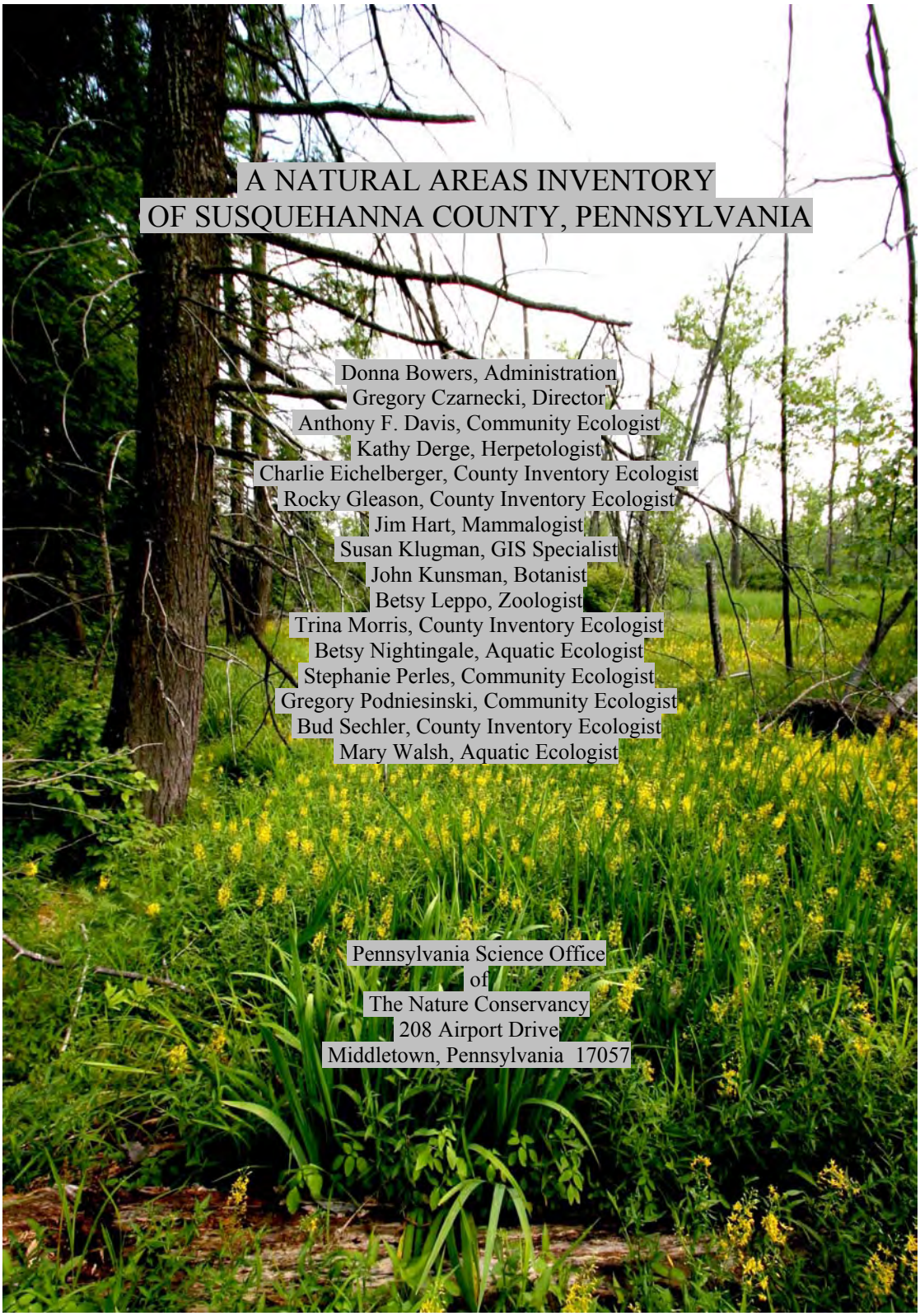
A NATURAL AREAS INVENTORY OF SUSQUEHANNA COUNTY, PENNSYLVANIA 2006



Submitted to:
Susquehanna County Planning Commission
31 Public Avenue
Montrose, PA 18801

Prepared by:
Pennsylvania Science Office
The Nature Conservancy
208 Airport Drive
Middletown, Pennsylvania 17057

This project was funded in part by a state grant from the DCNR Wild Resource Conservation Program. Additional support was provided by the Department of Community & Economic Development, the U.S. Fish and Wildlife Service through State Wildlife Grants program grant T-2, administered through the Pennsylvania Game Commission and the Pennsylvania Fish and Boat Commission.



A NATURAL AREAS INVENTORY OF SUSQUEHANNA COUNTY, PENNSYLVANIA

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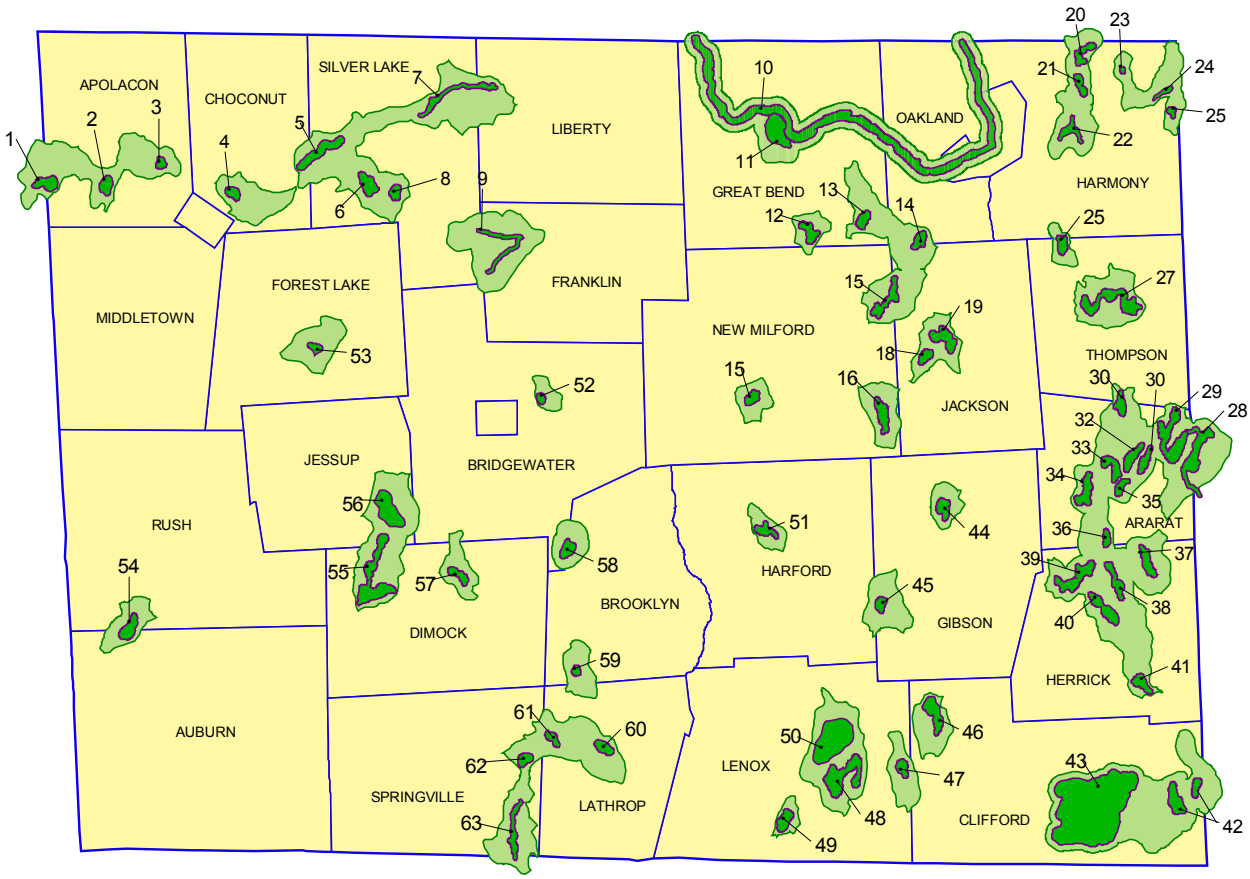
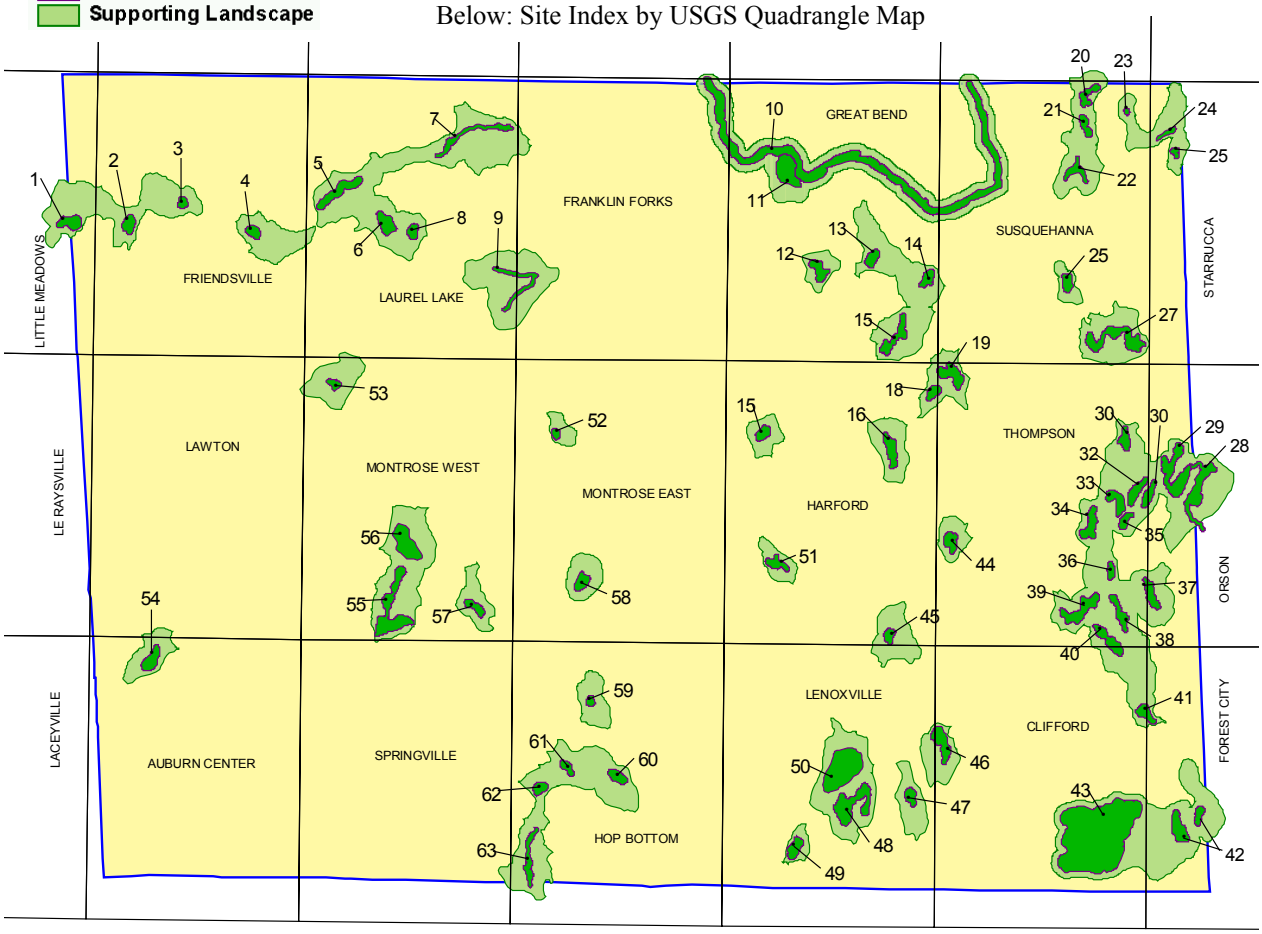
Susquehanna County NAI Site Index



Core Habitat
Supporting Landscape

Above: Site Index by Township
Below: Site Index by USGS Quadrangle Map



Index to Susquehanna County Sites—Listed by Site Number

- Sites are numbered roughly from North to South
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Site #	Site Name	Rank	Township(s)	USGS quad map(s)	Page(s)
1	LAKE OF THE MEADOWS	5	Apolacon, Bradford Co.	Little Meadows	87
2	Carmault Lake	LS	Apolacon	Friendsville	87
3	SGL #140 WETLAND	4	Apolacon	Friendsville	87
4	Choconut Lake	LS	Choconut	Friendsville	115
5	St. Joseph Ravine	LS	Choconut, Silver Lake	Laurel Lake	115
6	Silver Lake	LS	Silver Lake	Laurel Lake	197
7	LITTLE RHINEY CREEK	5	Silver Lake, Liberty	Laurel Lake	181, 197
8	Cranberry Lake	LS	Silver Lake	Laurel Lake	197
9	SALT SPRINGS	3	Franklin, Silver Lake	Franklin Forks, Laurel Lake	131
10	SUSQUEHANNA RIVER	3	Great Bend, Harmony, Oakland	Franklin Forks, Great Bend, Susquehanna	139, 148
11	ISLAND PLAIN WETLAND	5	Great Bend	Great Bend	139
12	MITCHELL CREEK HEADWATERS	5	Great Bend	Great Bend	139
13	DEACON CREEK WETLANDS	5	Great Bend	Gteat Bend	139
14	BRUSHVILLE LAKE	5	Jackson, Oakland	Great Bend	163, 191
15	EAST LAKE WETLANDS	5	New Milford, Jackson	Great Bend	187, 163
16	GILLESPIES POND	5	New Milford	Harford	187
17	STEINBACHS CORNERS WETLAND	5	New Milford	Harford	187
18	Little Butler Lake	LS	Jackson	Harford, Thompson	163
19	Butler Lake	LS	Jackson	Thompson	163
20	ROUND HILL WETLANDS	5	Harmony	Susquehanna	148
21	LITTLE ROARING BROOK WETLANDS	5	Harmony	Susquehanna	148
22	BRANT SLOPES	5	Harmony	Susquehanna	148
23	ROARING RUN HEADWATERS	5	Harmony	Susquehanna	148
24	NORTH BRANCH HEMLOCK CREEK SLOPES	4	Harmony	Starrucca	148
25	HEMLOCK CREEK WETLAND	4	Harmony	Starrucca	148
26	CHURCHILL LAKE	3	Harmony, Thompson	Susquehanna	148, 207
27	WEIRS POND/SHELLY PRESERVE	4	Thompson	Susquehanna	207
28	ORSON MUD POND	2	Ararat, Wayne Co.	Orson	91
29	DUNN LAKE	2	Ararat	Orson	91
30	PINE SWAMP	4	Ararat	Orson, Thompson	91
31	ROUTE 171 WETLANDS	5	Ararat, Thompson	Thompson	91, 207
32	BALL LAKE	1	Ararat	Thompson	91

Site #	Site Name	Rank	Township(s)	USGS quad map(s)	Page(s)
33	ROMOBE LAKE	1	Ararat	Thompson	91
34	TINGLEPAUGH SWAMP	5	Ararat	Thompson	91
35	HATHAWAY LAKE	5	Ararat	Thompson	91
36	BURNWOOD POND	4	Ararat, Herrick	Thomspon	91, 157
37	WEST BRANCH LACKAWANNA RIVER HEADWATERS	5	Herrick	Orson, Thompson	157
38	FIDDLE CREEK WETLANDS	3	Herrick	Thompson	157
39	SGL #236 WETLANDS	3	Herrick	Thompson	157
40	LOWE LAKE	4	Herrick	Clifford, Thompson	157
41	LEWIS LAKE	4	Herrick	Clifford, Forest City	157
42	FOREST CITY OUTCROPS	2	Clifford	Forest City	119
43	DUNDAFF CREEK HEADWATERS	5	Clifford	Clifford	119
44	POTTER LAKE	5	Gibson	Thompson	135
45	PAYNE POND	4	Gibson	Harford	135
46	Mud Pond	LS	Clifford	Clifford, Lenoxville	119
47	TEA POND	5	Lenox	Lenoxville	175
48	ROBINSON LAKE	1	Lenox	Lenoxville	175
49	HARTLEY POND	5	Lenox	Lenoxville	175
50	TUNKHANNOCK CREEK WOODLAND	5	Lenox	Lenoxville	175
51	Tyler Lake Headwaters	LS	Harford	Harford	145
52	MONTROSE HIGH SCHOOL WETLANDS	5	Bridgewater	Montrose East	105
53	BUMPS CORNERS WETLAND	4	Forest Lake	Montrose West	127
54	Tuscarora Lake	LS	Auburn, Rush	Auburn Center	103, 195
55	ELK LAKE WETLANDS	5	Dimock, Jessup	Montrose West	123, 167
56	DOC LUTZ WOODS	5	Jessup	Montrose West	167
57	WOODBOURNE PRESERVE	3	Dimock	Montrose West	123
58	NORTH POND	2	Bridgewater, Brooklyn	Montrose East	105, 111
59	LINDAVILLE MARSH	4	Brooklyn	Hop Bottom	111
60	HILLSDALE BOG	1	Lathrop	Hop Bottom	171
61	Union Church Bog	LS	Lathrop	Hop Bottom	171
62	SCHOOLEY POND	4	Springville	Hop Bottom	203
63	MONROE CREEK WETLANDS	5	Springville, Bradford Co	Hop Bottom	203

Index to Susquehanna County Sites—Listed Alphabetically by Site Name

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PREFACE

The Susquehanna County Natural Areas Inventory is a document compiled and written by the Pennsylvania Science Office of The Nature Conservancy. It contains information on the locations of rare, threatened, and endangered species and of the highest quality natural areas in the county; it is not an inventory of all open space. It is intended as a conservation tool and should in no way be treated or used as a field guide. Accompanying each site description are general management recommendations that would help to ensure the protection and continued existence of these rare plants, animals and natural communities. The recommendations are based on the biological needs of these elements (species and communities). The recommendations are strictly those of The Nature Conservancy and do not necessarily reflect the policies of the state or the policies of the county or townships for which the report was prepared.

Managed areas such as federal, state, county and township lands are also provided on the maps where that information was available to us. This information is useful in determining where gaps occur in the protection of land with rare species, natural communities and locally significant habitats. The mapped boundaries are approximate and our list of managed areas may be incomplete, as new sites are always being added.

Implementation of the recommendations is up to the discretion of the landowners. However, cooperative efforts to protect the highest quality natural features through the development of site-specific management plans are greatly encouraged. Landowners working on management or site plans for specific areas described in this document are encouraged to contact the Pennsylvania Science Office of The Nature Conservancy for further information.

Although an attempt was made through advertising, public meetings, research, and informal communications to locate the sites most important to the conservation of biodiversity within the county, it is likely that many things were missed. Anyone with information on sites that may have been overlooked should contact the Susquehanna County Planning Commission (see address on following page).

ACKNOWLEDGEMENTS

This project was funded in part by a state grant from the DCNR Wild Resource Conservation Program. Additional support was provided by the Department of Community & Economic Development. Additional funding was provided by the U.S. Fish and Wildlife Service through State Wildlife Grants program grant T-2, administered through the Pennsylvania Game Commission and the Pennsylvania Fish and Boat Commission. Thanks to everyone who provided financial and administrative support for the inventory. Without your help, this study would not have been possible.

The species information utilized in the inventory came from many sources as well as our own field surveys. We wish to acknowledge all of those who carried out botanical and zoological survey work over the years. Without their contributions, this survey would have been far less complete.

The report benefited from the help of local naturalists and conservationists who gave generously of their time. Thanks to all the help and support given by:

Susquehanna County Planning Commission
Susquehanna County Conservation District
E.L. Rose Conservancy
R.E.S.C.U.E.
North Branch Land Trust
Dave & Carol Clemens
Dr. Jerry Skinner
Carolyn Doolittle
Dr. Carol Loeffler - Pilot
Nick Donnelly - Odonate Consultation
Attny. Katherine Shelly
Nate Libal – Biological Survey Volunteer
Steve and Joyce Libal
Dr.Tim Block & Dr.Ann Rhoads – Botanical Consultation
Rick Koval - Naturalist/Photographer
David Werier – Botanical Surveys

Thanks to the many other private citizens who contacted our office with information on natural areas.

Many thanks to everyone who participated in the Technical Advisory Committee by reviewing the draft Natural Area Inventory Report. Finally, we especially wish to thank the many landowners that granted us permission to conduct inventories on their lands. The task of inventorying the natural heritage of Susquehanna County would have been far more difficult without this tremendous pool of information gathered by many people over many years.

Copies of this document may be obtained from:

Susquehanna County Planning Commission
31 Public Avenue
Montrose, PA 18801

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Characteristic of highly acidic and nutrient poor wetlands, the insectivorous pitcher plant is well suited to many of Susquehanna County's peat-accumulating wetlands
Photo: PA Natural Heritage Program

INTRODUCTION

The population of Susquehanna County has maintained a nearly even level of growth in the past 100 years. In 1900 the population was approximately 40,043 and dropped to a low of 31,970 in 1950, to rise to roughly 42,047 in 2004 (U.S. Census Bureau). Though there has been little recent increase in population in the county, future increases should be anticipated. A substantial increase in population may lead to increased development pressure on some of the sensitive natural areas of the county. Economically unsustainable farms may be sold for residential and commercial uses. Farms represent several generations of cultural heritage, and many farms contain a natural component or are adjacent to a natural area. The natural areas that comprise the natural heritage of Susquehanna County can be easily lost without careful planning of growth and development. Ironically the scenic and remote nature of these areas may make them prime targets for residential developments. Protecting the integrity of these natural systems provides benefits to humans as well as providing for the survival of all flora and fauna, rare and otherwise. Planning for long-term sustainability can maintain open space, including natural environments and the plants and animals associated with them. Using a Natural Areas Inventory as a conservation tool can steer development away from environmentally sensitive areas, creating a needed balance between growth and the conservation of scenic and natural resources.

It is important that county and municipal government, the public, developers and planners know the location of such environmentally sensitive areas in order to maintain a balance and protection of these areas. Knowing where these areas are located can help prevent potential land-use conflicts, and help focus conservation efforts and limited funds to the most vulnerable areas. The Pennsylvania Science Office of The Nature Conservancy, under contract with the Susquehanna County Planning Commission, has undertaken this project to provide a document and maps that will aid in the identification of these important areas.

The Natural Areas Inventory (NAI) report presents the known outstanding natural features, floral, faunal and geologic in Susquehanna County. The Inventory provides maps of the best natural communities (habitats) and the locations of animal and plant species of special concern (endangered, threatened, or rare) in Susquehanna County. Due to budget and time constraints, some high-quality areas in the county are likely to have been overlooked. The maps do not pinpoint the site of the species of concern but rather represent a zone of potential impacts within the site's watershed. A written description and a summary table of the sites, including quality, degree of rarity, and last-observed date, accompany each map.

Particular species names, common and scientific, are provided in coordination with the appropriate jurisdictional agency. Plants and terrestrial invertebrates are under the jurisdiction of the PA Department of Conservation and Natural Resources (DCNR). Mammals and birds are under the jurisdiction of the PA Game Commission (PGC). **Aquatic animals, reptiles and amphibians are under the jurisdiction of the PA Fish and Boat Commission (PFBC) and are often subject to unauthorized collection. They are therefore not identified in the text of this report, at the request of the agency, in order to provide some measure of protection for the species.**

Potential threats and some suggestions for protection of the rare plants or animals at the site are included in many of the individual site descriptions. Selected geologic features of statewide significance are also noted. In addition, the inventory describes locations of areas that are significant on a county-wide scale, but have not been deemed exemplary natural communities because no species of concern were documented at these sites. These **"locally significant"** sites represent good examples of habitats that are relatively rare in the county, support an uncommon diversity of plant species, and/or provide valuable wildlife habitat on a local level. Locally significant sites are referenced in **lower case lettering** throughout this report.

The information and maps presented in this report provide a useful guide for planning commercial and residential developments, recreational parks, for conserving natural areas, and for setting priorities for the preservation of the most vulnerable natural areas. An overall summary identifies the highest quality sites in the county. All

of the sites in this report were evaluated for their importance in protecting biological diversity on a state and local level, but many also have scenic value, provide water quality protection, and are potential sites for low-impact passive recreation, nature observation and/or environmental education.

The Natural Areas Inventory will be provided to each municipality through the Susquehanna County Planning Commission. The Inventory is a conservation tool that will aid in the creation of municipal, county and comprehensive plans, and the emphasis on biological diversity should inform county and regional open space plans already underway. Susquehanna County, its municipalities, land trusts, and other organizations can also use the Natural Areas Inventory to identify potential protection projects that may be eligible for funding through state or community grant programs such as the Growing Greener Fund. Landowners will also find this inventory useful in managing and planning for the use of their land; it gives them the opportunity to explore alternatives that will provide for their needs and still protect the species and habitats that occur on their land. For example, the Forest Stewardship program, coordinated by PA Department of Conservation and Natural Resources, Bureau of Forestry, assists landowners in creating management plans. This plan is developed based on landowner objectives (e.g., wildlife or timber management). Other programs include the USDA's Forest Legacy Program and the PA Department of Agriculture's Agricultural Land Preservation Program. Land managers may wish to consult with this report and the Pennsylvania Natural Diversity Inventory (PNDI) in an effort to avoid potential conflicts in areas with species of special concern and/or identify ways of enhancing or protecting this resource. Users of this document are encouraged to contact the Pennsylvania Science Office (717-948-3962) of The Nature Conservancy for additional information.

Questions regarding potential conflicts between proposed projects and species of concern mentioned in this report should be directed to the Environmental Review Specialist at the PNHP Office in Harrisburg (717) 772-0258.

NATURAL HISTORY OVERVIEW OF THE COUNTY

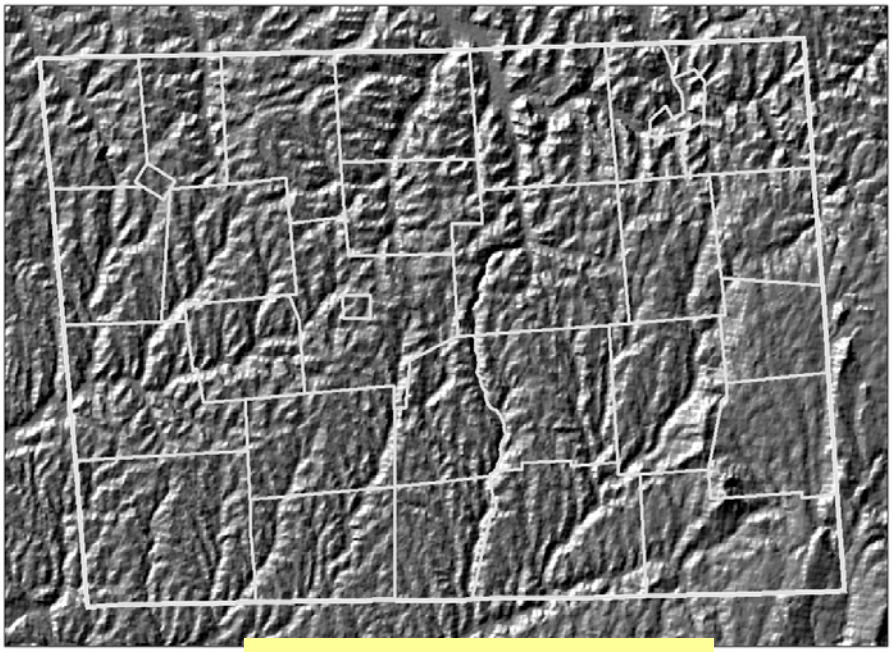
The climate, topography, geology, and soils have been particularly important in development of ecosystems (forests, fields, wetlands) and physical features (streams, rivers, mountains) that occur in Susquehanna County. Many disturbances, both natural and human, have been influential in forming and altering many of Susquehanna County's ecosystems, causing extirpation of some species and the introduction of others. These combined factors provide the framework for locating and identifying exemplary natural communities and species of special concern in the county. The following sections provide a brief overview of the physiography, geology, soils, surface water, and vegetation of Susquehanna County.

Physiography and Geology

The characteristic landscapes and distinctive geological formations classify Physiographic Provinces. Physiography relates in part to a region's topography and climate. These two factors, along with bedrock type, significantly influence soil development, hydrology, and land use patterns of an area. Additionally, both physiography and geology are important to the patterns of plant and animal community distribution. Because of the differences in climate, soils, and moisture regime, certain plant communities would be expected to occur within some provinces and not in others. Physiographic and geologic information was obtained from many sources including Ground Water in Northeastern Pennsylvania (Lohman 1957), The Geology of Pennsylvania (PA Geological Survey and Pittsburgh Geological Survey 1999), Soil Survey of Susquehanna County, Pennsylvania (USDA 1986), and Physiographic Provinces of Pennsylvania (Sevan 2000).

Susquehanna County's bedrock, composed largely of reddish shales and sandstone, was formed during the Devonian Era (360-408 million years ago) and is common to the eastern portions of the Allegheny Plateau (Cuff et al. 1989). Despite the lack of large tectonic activities, the county has a diverse topography that has largely formed as a result of glacial activity.

As the most recent ice age came to an end, the retreat of the ice pack northward carved the landscape and deposited glacial material, creating many of the forms seen today. Glacial deposits dammed some of the county's creeks and rivers creating lakes and bogs. Additionally, large masses of ice, buried beneath glacial outwash, melted and created deep glacial lakes known as kettleholes (Crum 1988). Other waterways in the county swelled as a result of the large amounts of melt water, further deepening the valleys and accentuating the hills and mountains (Cuff et al. 1989).



Topography of Susquehanna County

Soils

The glaciers that covered the northern counties of Pennsylvania were relatively thin and therefore deposited more material than was scoured away. As a result, Susquehanna County has soils of varying depth, which are relatively immature and largely composed of glacial till (Cuff et al. 1989).

A soil association is a group of soils with a distinctive, proportional pattern of occurrence in the landscape. This description of the soils of Susquehanna County comes from *The Soil Survey of Susquehanna County* (USDA, 1986).

Soil Association	Description	Percentage of Area in County	Land Use
Volusia-Mardin	Nearly level to sloping, somewhat poorly drained and moderately well drained soils on a dissected plateau	20	Primarily woodlands
Morris-Wellsboro-Volusia	Gently sloping to moderately steep, somewhat poorly drained to moderately well drained soils on a dissected plateau	35	Farming to a large degree but also forested portions
Mardin-Volusia-Oquaga	Sloping to steep, somewhat poorly drained to well drained soils on the sides and tops of hills next to major stream valleys	35	Forested valley bottoms with many flagstone quarries
Morris-Wellsboro	Level to sloping, somewhat poorly drained to moderately well drained soils on a high, undissected plateau	7	Many glacial wetlands surrounded by much forest
Chenango-Barbour-Volusia	Level to sloping, well drained soils on flood plains and terraces, and somewhat poorly drained soils on lower valley slopes	3	Used for farming and forested stream buffers

Vegetation

Upland Forest Communities

The current plant communities of Susquehanna County are largely a result of the soils present from glacial activities. The majority of the forests in the county are northern hardwood forests, which favor moderately well drained soils. Dominant species of this community type include the sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), eastern hemlock (*Tsuga canadensis*), yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*), sweet birch (*Betula lenta*), paper birch (*Betula papyrifera*), white ash (*Fraxinus americana*), northern red oak (*Quercus rubra*), and black cherry (*Prunus serotina*). Additionally, white pine (*Pinus strobus*) and eastern hemlock (*Tsuga canadensis*) can be found scattered but generally make up less than 25% of the canopy (Cuff et al. 1989, Fike 1999). Common shrubs in the understory of this forest type include witch-hazel (*Hamamelis virginiana*), striped maple (*Acer pensylvanicum*), witch-hobble (*Viburnum lantanoides*), serviceberry (*Amelanchier* spp.) and hornbeam (*Carpinus caroliniana*) (Fike 1999). The unique topography and soils, as well as the addition of some typically southern species to the forest community, give the county a diverse mix of species, not present northward in the Hemlock-White Pine-Northern Hardwoods region (Braun 1950).

Wetlands

In addition to influencing the forest community structure in the county, glacial activity heavily shaped the composition of the county's wetlands. These systems, left unaltered, provide highly unique habitats that can support many distinctive plants and animals.

Wetlands are the key to the survival of many species of plants and animals considered rare in the state. Even though wetlands account for only two percent total of Pennsylvania's area, they are home to a diverse array of rare plants and animals and are an extremely productive part of the landscape as a whole (Cuff et al 1989). The Glaciated Plateau sections of the Appalachian Plateau Province make up 24% of the state's area, while they contain 62% of the state's wetlands (Tiner 1987). Susquehanna County, like the other glaciated counties of Pennsylvania, accounts for a disproportionate share of the state's wetlands. Wetlands differ in size, structure and species diversity. Wetlands also differ according to their placement on the landscape – at stream headwaters, dips in valleys, or on slopes where ground water discharges; and whether the water contained is flowing or stagnant. These different scenarios result in bogs and fens, marshes, swamps, floodplain forests, forested wetlands, wet meadows, and seeps. Wetlands differ also in vegetative species cover. Tree species such as red maple (*Acer rubrum*), yellow birch (*Betula allegheniensis*), eastern hemlock (*Tsuga canadensis*) and ash species (*Fraxinus* spp.) usually dominate forested swamps. The understory typically consists of shrub species such as highbush blueberry (*Vaccinium corymbosum*), azaleas (*Rhododendron* spp.), winterberry holly (*Ilex verticillata*), alders (*Alnus* spp.), swamp rose (*Rosa palustris*) and many others.

- **Graminoid marshes** are wetlands dominated by grass-like plants such as cattails, sedges, rushes and grasses. This type of wetland may be found in association with slow streams or in areas with ground water seepages. Graminoid marshes in the county are usually formed as successional communities following beaver dams or other impoundments.

Graminoid Marsh

- **Shrub swamps** are wetlands occurring on mineral soils usually with a thick accumulation of sphagnum and other organic matter with water near

or above the surface most of the year (Cuff et al 1989). Shrubs under 20 feet tall dominate the wetland. Shrub swamps in the county frequently include highbush blueberry (*Vaccinium corymbosum*), chokeberry (*Aronia* spp.), mountain holly (*Nemopanthus mucronatus*), alder (*Alnus* spp.), leatherleaf (*Chamaedaphne calyculata*), swamp rose (*Rosa palustris*), meadowsweet and steeplebush (*Spiraea* spp.), and sedges (*Carex* spp.).

Shrub Swamp

- **Ephemeral or vernal pools** are wetlands that fill with water on an intermittent basis due to annual precipitation, rising groundwater, or surface water runoff (Kenney and Burne 2000). These pools become almost completely dry in most years, losing water through transpiration and evaporation. These pools, due to being ephemeral and virtually free of fish, attract many species of breeding salamanders, frogs and toads. Some species, like the Jefferson Salamander (*Ambystoma jeffersonianum*) are obligate vernal pool species. This species and other *Ambystoma* species lay eggs only in vernal pools. Plants typically associated with vernal ponds include woolgrass (*Scirpus* spp.), three-way sedge (*Dulichium arundinacea*), pin oak (*Quercus palustris*), highbush blueberry (*Vaccinium corymbosum*), and red maple (*Acer rubrum*).

- **Peat forming wetlands**: Many of the county's wetlands are contained within the Acidic Glacial Peatland Complex. These wetlands are oligotrophic, meaning they are low in nutrient levels, and are often of glacial kettlehole origins dominated by evergreen and semi-evergreen shrubs. The nutrient poor and fairly acidic conditions provide unique growing conditions that are suitable for interesting vegetation, including large amounts of peat mosses (*Sphagnum* spp.). Common shrubs found in these systems in Susquehanna County include leatherleaf (*Chamaedaphne calyculata*), bog rosemary (*Andromeda polifolia*), bog laurel (*Kalmia polifolia*), highbush blueberry (*Vaccinium corymbosum*), and cranberry (*Vaccinium macrocarpon*). The herbaceous species known from these systems include cottongrasses (*Eriophorum vaginatum* and *E. virginicum*) as well as several insectivorous plants including pitcher plants (*Sarracenia purpurea*), sundews (*Drosera intermedia* and *D. rotundifolia*), and bladderworts (*Utricularia* spp.) (Fike 1999).

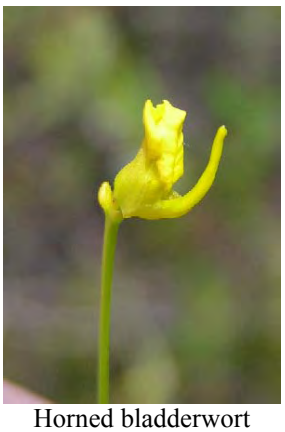
Kettlehole Bog

Due to the rarity of undisturbed examples of quality wetlands in Susquehanna County and Pennsylvania, all good examples of these habitats should be preserved whenever possible. Wetlands provide valuable habitat for breeding and migrating birds, mammals, reptiles, amphibians and insects. Wetlands also provide a refuge for many species of wetland dependent rare plants.

A few of the plants associated with peat-forming wetlands in Susquehanna County

Bog rosemary
(*Andromeda polifolia*)

Pitcher plant (*Sarracenia purpurea*)



Horned bladderwort
(*Utricularia cornuta*)

Grass-pink
(*Calopogon bulbosa*)

Rose pogonia
(*Pogonia ophioglossoides*)

Few-flowered sedge
(*Carex pauciflora*)

Many-fruited sedge
(*Carex lasiocarpa*)

Rough cotton-grass
(*Eriophorum tenellum*)

Cranberry
(*Vaccinium macrocarpon*)

Photos: PNHP

Disturbance

Disturbances, whether natural or man-made, have played a key role in shaping many of the natural communities and the associated species. The frequency and scale of these disturbances have played a key role in the appearance of natural communities today.

- **Fire & Flood:** Natural disturbances such as fire and flooding can actually benefit certain natural communities and species. Periodic fires are needed to maintain pitch pine and scrub oak barren areas in order to sprout new growth of these species and keep out other successional species. Floodplain forests benefit from the periodic scouring and deposition of sediments as streams overtop their banks. At the same time, streamside wetland communities hold excess water, thus reducing the scale of flooding downstream.

- **Deer:** Another natural disturbance, over-browsing by deer, can have detrimental effects on natural communities and species (Rhoads and Klein, 1993). Excessive deer browse can decrease the understory of some forests, and halt regeneration of new growth of the canopy and understory. Deer feeding preferences can also have a direct effect on rare plants. Private landowners can be encouraged to control deer populations by allowing hunting on their lands.

- **Beaver:** Disturbances caused by beaver (*Castor canadensis*) can be either beneficial or detrimental to wetland habitats within the county. On one hand, thinning the canopy and flooding by beavers can eventually create open wetland meadows upon which many unique species rely. On the other hand, damming by beavers can alter habitats to a degree that renders the sites no longer suitable for some of the rare species of the county. For example, floating bog mats support an array of rare plants and animals, but flooding by beaver can degrade these communities until they no longer support the unique bog adapted species. Similarly, many of the county's forested wetlands have recently been flooded due to beaver activity, resulting in dead trees standing in open water ponds. These types of wetlands can be beneficial to some species, but the diverse forested wetland habitat will likely take a century or more to recover. Beaver activity in the long term is critical to the cyclic pattern of wetland disturbance, but in the short term, beaver activity can threaten the integrity of wetland habitats and jeopardize many of the unique species that inhabit these natural communities. This creates difficulty in assessing how beavers should be managed. The long-term benefit of habitat creation must be weighed against the potential short-term threat to the existing plants and animals. In certain situations, beaver removal is preferred and implementation of management practices with regard to beaver must be considered on a case-by-case basis.

- **Wetland Conversion**: While beaver activity has resulted in cyclic flooding and draining of many of the region's wetlands, human alterations of wetlands typically have much longer lasting impacts on the local ecology. Past attitudes perceived marshy wetlands as idle and unproductive, to be improved by draining or filling. Many bogs, marshes and forested wetlands have been converted to open water ponds by dam construction, eliminating the wetland habitat in favor of recreational lakes. Many of the region's glacial lakes have already been ringed with cottages, eliminating much of the natural vegetation and altering the chemical and biological composition of the water. Past actions, though well intentioned, have resulted in a marked decrease in some of the state's rarest habitats. These wetlands, once seen as idle waste lands, are now know to be important reservoirs of biodiversity.

An illustration from an old USGS Soil Survey publication gave well intentioned, but sadly inappropriate advice.

Human and natural disturbances create different habitats in different scenarios, but it's human disturbances that often leave the most lasting effect

on the environment. Many human disturbances can be beneficial, especially to species that require an early successional habitat. However, what may be beneficial to a few species is often detrimental to other species. Many rare species have become rare because they just can't adapt to disturbance of their particular habitat, which is often a specialized niche. Consequently, many species have declined due to human alteration of the landscape. Human disturbances are semi-permanent parts of landscape, but decisions about the type, timing, location and extent of future disturbances are important to the natural ecological diversity that remains.

- **Mining:** From a historical perspective, human disturbance to the natural communities of the county have been occurring for hundreds of years. Susquehanna County was formed in October of 1812 from Luzurne County, but human disturbance was occurring well before the county was founded. Bluestone mining has played a large role in Susquehanna County and has been quarried quite heavily since the mid 1800's. The building of the Starrucca Viaduct, constructed by the Norfolk-Southern Railroad in 1848, required massive amounts of stone, and quarries were set up to provide for the construction of the structure. Along with the quarries, villages and rail lines were erected. Since the start of the bluestone mining industry, Susquehanna County has remained a major center for the stone, which is still widely used today in construction and landscaping. The disturbance created by bluestone quarries may affect the natural habitats of Susquehanna County and much care and appropriate planning is needed to maintain a sustainable quarrying industry and balance the vulnerable plant and animal species of the county. In particular, runoff from mining activities can impact downstream waterways, loading streams, rivers and ponds with sediment. Sediment can directly affect stream ecology by reducing or eliminating many types of aquatic insects. The reduction of aquatic insects can result in a reduction of fish, birds and mammals that rely on them as a food source. The establishment of suitable buffers to protect watersheds from mine sediment should be a priority of watershed restoration efforts.

Blue stone mining occurs on many hilltops in the county. Their impact on downstream waterways should be carefully monitored to prevent sediment loading of local streams.

- **Logging, Farming & Urbanization:** Forestry has been a component of the early land use in the county and small rail lines and villages were built to supply the industry. By the end of the 19th century, most of Pennsylvania had been clear cut of trees to provide timber and fuel to industry and communities. Small farms supplied foodstuffs for early inhabitants of the county and a good portion of the county still has active farms. More recently, smaller farming operations are being replaced with larger, more mechanized farm facilities. Most of these farms raise dairy cattle though a small number of chicken and beef cattle farms exist (USDA 1986).

In many cases, human disturbances have directly affected natural communities and animal and plant species. In Susquehanna County, farming and urbanization have created biological "islands" where small natural areas are surrounded by agriculture or development. This isolates gene pools of wildlife and/or plant species, inhibiting the gene flow between populations. In addition, logging and mining can affect forest age and natural community structure. For example, the amount of old-growth forest has virtually disappeared despite the fact that some scattered old trees remain. Additionally, many wetlands have been intentionally flooded or drained resulting in loss of biodiversity at a given site. As farming remains an important industry in Susquehanna County, some farm practices and abandoned farmland make conditions favorable for some grassland birds. Birds such as Short-eared Owl, Eastern Meadowlark, Bobolink, Henslow's Sparrow and Vesper Sparrow have benefited from

human managed and created early successional habitats, including reclaimed strip mines.

Mining, industry, agriculture, residences, road building and other activities have contributed to the degradation of water quality in many areas of the county. Protecting the quality and purity of surface and groundwater resources from degradation contributes to the future well being of all plants and animals, including human communities. The PA State-wide Surface Waters Assessment Program can provide information on specific potential sources of water impairment within Susquehanna County. Much information on the water and geological resources of the county can be found on the PA DEP eMap web page: (http://www.dep.state.pa.us/external_gis/gis_home.htm).

- **Invasive Species:** Perhaps the most detrimental indirect effect that human disturbance has had on natural communities and associated species is the spread of non-native (i.e. exotic) invasive species in natural areas. Many of these invasive species, including the chestnut blight that changed the composition of eastern forests, have caused such widespread problems that they are now out-competing native species and decreasing overall quality of natural areas. Non-native plants such as Japanese barberry, multiflora rose, Japanese honeysuckle, tree-of-heaven, garlic mustard and autumn olive have become commonplace in disturbed woodlands, often to the point of excluding some of the native plants. In wetlands and along streams, common reed, European buckthorn, autumn olive, purple loosestrife, multiflora rose, Japanese honeysuckle, Japanese knotweed and tree-of-heaven are aggressive, weedy species that follow in the wake of disturbance and crowd out native species. Some invasive tree and shrub species have been widely planted and have since shown to be unwelcome invaders. These include, but are not limited to multiflora rose, autumn olive, Norway maple, callery or Bradford pear, butterfly bush (*Buddleia sp.*), English ivy and winged euonymus (*Euonymus alatus*). These species should not be planted in the landscape, and existing specimens should be phased out.

Some of these non-native invasive plants have become serious threats to ecosystems in Susquehanna and in all counties in Pennsylvania. Control of these invasive plants is needed, especially in or adjacent to areas that have been categorized as high quality natural areas to help control further encroachment. Some nurseries in Pennsylvania now carry a selection of tree, shrub and herbaceous species that are native to Pennsylvania, and these are recommended where plantings are necessary in, or adjacent to, natural areas. In addition to native species, trees, shrubs and plants of local seed sources are preferred. This helps maintain the local genetic variability of the species. *The Vascular Flora of Pennsylvania* (Rhoads and Klein 1993) is a helpful reference for determining whether a plant species is native to the state or not. Additional references include two PA Department of Conservation and Natural Resources publications*: Invasive Plants in Pennsylvania* and *Landscaping with Native Plants in Pennsylvania*

Invasive Plant Species

Among the most aggressive introduced plant species in Pennsylvania include the following top offenders of natural areas. These species are not kept in check by natural predators, and out-compete native species. Once established, they can be very difficult and time consuming to remove. Natural Areas should be monitored regularly for pioneer populations of these species. Small populations, once encountered, should be eradicated to help ensure the continued viability of natural areas.
Photos: PA Department of Agriculture & PNHP

Garlic mustard (*Alliaria petiolata*)

Multiflora rose (*Rosa multiflora*)

Tree of Heaven (*Ailanthus altissima*)

Japanese Knotweed (*Polygonum cuspidatum*)

Below: Edge habitat that has been invaded by aggressive species of plants including tree-of-heaven, Japanese honeysuckle, multiflora rose and Asiatic bittersweet becomes a snarled, poor-quality forest.

Purple loosestrife (*Lythrum salicaria*)

Japanese honeysuckle (*Lonicera japonica*)

A Review of Susquehanna County's Animals

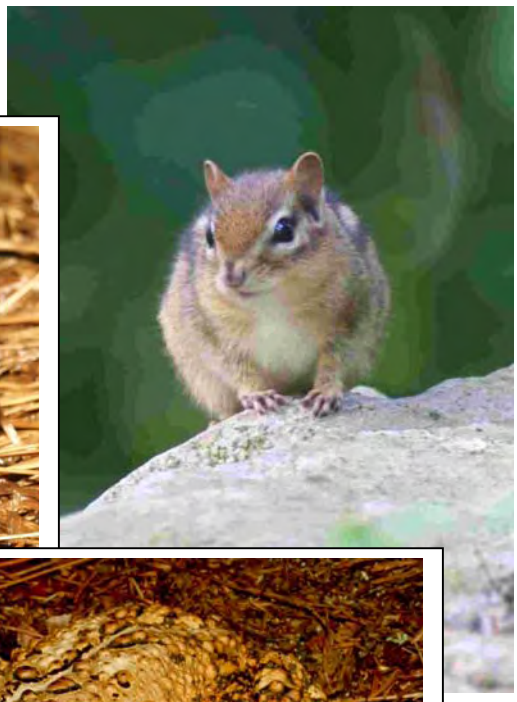


Photo Sources: PNHP, Charlie Eichelberger, Rick Koval

Mammals and Mammalian Habitats in Susquehanna County

Susquehanna County mammal habitat can best be described as wetlands and floodplains in a glacial landscape. With over 99% of the county contained within the glaciated low-plateaus section of the Appalachian Plateaus Province, the landscape is very different from the more heavily forested counties to the west and south where forest cover is deep and substantial.

As with most other northern-tier counties, hunting is very important to the economy of the region. Although deer are plentiful, in many instances they are concentrated in the disjointed woodlands and forests occurring at upper elevations, often moving down into the less forested areas to feed as well as during the winter months when food becomes scarce in the higher forests.

One of the more important game species in Susquehanna County is the **black bear (*Ursus Americana*).** Susquehanna consistently ranks in the upper 25% of the state's counties in terms of number of bears harvested. 2005 ranked as one of the best years on record for Susquehanna with 114 bears taken during the 3-day hunting period. With 4 State Gamelands situated in the northern portion of county, there is plenty of habitat to support a healthy population of black bears. Other important mammal species that occur in the county and are important to local economies during the various hunting seasons including the grey and fox squirrel and fur-bearer species such as the mink and other weasels. What is less well known is the fact that these same habitats and many others throughout the county support a diverse and important non-game mammal fauna as well.

Black bear (*Ursus Americana*) Photo: Hal Korber

White-footed mouse (*Peromyscus leucopus*) Photo: Dick Cooper

Many of the species occurring throughout the county are quite unremarkable in that they possess abilities that ensure their survival in a wide range of habitat types and are well represented throughout Pennsylvania. These species are termed "generalists" and include the northern short-tailed shrew (*Blarina brevicauda*) and several other shrew and mole species, **white-footed mouse (*Peromyscus leucopus*)** and several other rodent species, as well as skunks, red fox, coyote and the ubiquitous chipmunk. All of these species occur throughout the diverse forests and widespread marshes and other wetland habitats within Susquehanna County and are in no jeopardy of disappearing from the landscape.

Other species have fairly restricted habitat needs and are termed "habitat specialists". They may be restricted to grassland- and meadow-type habitats, the forest interior, upper elevation ridgelines, wetlands and streams or, during part of their life cycle, to specific habitats such as caves and mines. Examples of these species include the meadow vole (grasslands and meadows), the fisher (forest interiors), muskrats and beaver (wetlands and streams) and most, if not all, of the bat species (caves and mines).

Several species that occur within the county are of special concern due to either population declines in parts of the state or throughout their natural range or the species occurs at the limit of their distribution in the United States. The list includes species such as the northern flying squirrel (*Glaucomys sabrinus*) and the **rock vole (*Microtus chrotorrhinus*).** These species are very dependant on the large, undisturbed forest habitats in the northern portion of the county as well as specific habitat types. One species that remains unreported from Susquehanna County but may occur during the summer months in upper elevation forests is the federally endangered Indiana bat (*Myotis sodalis*), a species that requires large blocks of mature forest.

Rock vole (*Microtus chrotorrhinus*)
Photo: Cal Butchkoski

Wetlands and streams play a major role in providing habitat for mammals as well as serving as corridors for dispersal throughout the county. Whenever biologists research mammals, one of the first environs investigated are marshes, bogs and streams as they are often sites where the number of species of mammals, or diversity, is highest. It is not uncommon to find 6 species of shrews, 9-10 species of rodents including the beaver (*Castor Canadensis*), 4-5 species of weasels including the mink (*Mustela vison*), 6-7 species of bats as well as sign of various medium-sized carnivores, squirrels, bear and deer along these habitats. One species that can be found around small streams within Susquehanna County is the northern **water shrew (*Sorex palustris albibarbis*)**, a species rarely observed in Pennsylvania. This species was once thought to be extremely rare but recent evidence seems to indicate that it is much more widespread in the northern tier counties of Pennsylvania than previously thought. One of the larger shrew species, the northern water shrew swims and dives in pools along the smaller tributaries that empty into medium to larger sized streams. Since its diet consists primarily of macro-invertebrates such as caddisflies, stonefly, mayfly and other aquatic insect species, it most likely depends on clean, un-degraded streams and wetlands and may serve in the future as an "indicator species", a species that may alert us to arising environmental problems such as acid mine drainage or acid rain.

Northern water shrew (*Sorex palustris albibarbis*)
Photo: Charlie Eichelberger

Openland in the form of wet meadows and reverting grasslands are habitat types that are fairly common in Susquehanna County. Normally a product of former and present agricultural practices, these habitats are also found in areas that are somewhat flood-controlled. The most well known mammal occurring in these openlands is the meadow vole (*Microtus pennsylvanicus*). The runways formed by this medium-sized rodent can be spotted under dense vegetation during the summer months and under the icy crust forming on snow during the winter months. Meadow voles are so successful at dispersing throughout the county that they are sometimes found in grassy forest clearings within large tracts of forest, having made their way there along the forest roads,

Ground hog (*Marmota monax*)
Photo: Dennis W. Donohue

pipelines and power right-of-ways. Several other species of mammal are known to occur within openlands including the eastern cottontail rabbit (*Sylvilagus floridanus*), **ground hog or whistle pig (*Marmota monax*)** and red fox (*Vulpes vulpes*).

Snowshoe hare (*Lepus americanus*)
Photo: Harry Walker

While openlands as mentioned above are familiar to many, one type that is more often than not overlooked is scrub-shrub openlands. Although commonly made up of scrub oak, blueberry and other low-growing plants, they do not have the large expanses of canopy high overhead as found in forests. The understory in these types of habitats is fairly open in that there are few very low-growing plants except in areas that may have suffered from recent burns, common along these dry sites. These habitats are extremely important to several species as either foraging areas or nesting sites and include the black bear (*Ursus americanus*), Appalachian cottontail (*Sylvilagus obscurus*) and varying or **snowshoe hare (*Lepus americanus*)**. Openlands such as these can most often be found along upper elevation forests in areas where soils are thin and the climate fairly dry.

Bats are a common component of the wetlands, streams and forests of Susquehanna County, most often encountered during the summer months along the streams and open bodies of water that occur throughout the county. During the summer, floodplain forest along the Susquehanna River and its many tributaries may provide roost sites for many bat species as they raise their young. One rarely encountered bat species, the **silver-haired bat (*Lasionycteris noctivagans*)** may occur within Susquehanna County during the early spring or late fall months as it migrates through the state on its way to and from its summer habitat in the northern portion of the United States and in Canada. During the winter months, however, bats most likely disappear from the majority of the county as the caves and mines that are important to them during the winter are lacking. Hibernating bat species such as the little brown bat (*Myotis lucifugus*) and big brown bat (*Eptesicus fuscus*) probably migrate either to large mines in New York or south to caves occurring in the central portion of Pennsylvania. Several species such as the hoary bat (*Lasiurus cinereus*) and red bat (*Lasiurus borealis*) don't over-winter in the state at all and migrate further south to states like the Carolinas and Florida and are thought to spend their winter months in hibernation under deep patches of leaf and forest floor litter.

silver-haired bat (*Lasionycteris noctivagans*)
Photo: Merlin Tuttle


Big brown bat (*Eptesicus fuscus*)
Photo: James A. Hart

Historically, several species have either disappeared from Susquehanna County or their populations had become so low that they were thought to be gone from the county.

Two of these species, the fisher (*Martes pennanti*) and the river otter (*Lontra Canadensis*) have been re-introduced by the Pennsylvania Game Commission in portions of their range in Pennsylvania where habitat necessary to their existence still occurs. These populations have expanded into other portions of the state and now occur in the northern portions of Susquehanna County. It is likely that they will be spotted in the future by hunters and fishermen along the Susquehanna River and other watercourses throughout the county as well as interior portions of the existing forests.

As outlined here, Susquehanna County is very diverse in terms of the habitats available to the mammal fauna of Pennsylvania. In many portions of the state, many habitats are fragmented and the ecosystems necessary for the survival of many species have become small, occupied blocks within a matrix of inhospitable habitat. Development of land, splitting of habitats by un-crossable barriers such as major highways, drainage of wetland areas and environmental degradation have all served to confine many mammal species to very localized populations that become limited in their ability to survive any major change in food resources, availability of nesting habitat or increased predation. These populations may be doomed to what is termed as "localized extinction". If enough of these populations disappear from the landscape, these species existence in Pennsylvania may be in jeopardy.

Fisher (*Martes pennanti*)
Photo: www.mass.gov/dfwele/ dfw/dfw_fisher.htm

Susquehanna County has become a popular destination for residents of Pennsylvania during the various hunting seasons and has a brisk tourist trade. As the area continues to attract people for its present scenic beauty, it may in the future suffer from expansion of developments and accompanying infrastructure. The large blocks of forested wetlands and vegetated stream corridors that serve as avenues of dispersal to the diverse list of mammals noted to occur in the county may, in the future, be seriously impacted. Continued vigilance as well as enlightened management will ensure that this list of mammals will not be shortened and may grow in the future providing opportunities to all Pennsylvanians for viewing the state's mammalian wildlife. This, in turn, will enhance the county's wealth as the ecotourist industry beginning to flourish in Pennsylvania gains strength.

Birds of Susquehanna County

Pennsylvania Important Bird Areas

Susquehanna County has much undeveloped land, forest interior, and a myriad of wetland communities that provide some of the finest bird habitats in Pennsylvania. The forests of the county provide outstanding habitat for bird species that rely on large unfragmented forested tracts, including the Northern Goshawk, Barred Owl and Scarlet Tanager. Pennsylvania's bird diversity is a critical component to the integrity and character of Penn's Woods and Susquehanna County accounts for a high proportion of the state's forests. Birds provide numerous benefits to human including insect and pest control, plant seed dispersal, tremendous aesthetic value, and in some cases hunting opportunities. Pennsylvania birders spend hundreds of millions of dollars in bird watching activities and equipment purchases every year!

Since European colonization, our diversity of bird life has been dramatically altered. Gone from the state are the Carolina Parakeet, the Heath Hen, and the Passenger Pigeon, a species which once stood as North America's most common bird. With the intense forestry practices of the 1800's, birds that relied on large forested tracts declined precipitously. During the past century, much of Pennsylvania's cleared forests have regenerated, restoring much of the lost habitat for forest birds that had been eliminated in years prior. Marsh birds have also been in decline across the U.S. from the draining and modification of natural marshlands.

In an effort to conserve the Commonwealth's avifauna, the Pennsylvania chapter of the National Audubon Society, along with the Pennsylvania Ornithological Technical Committee of the Pennsylvania Biological Survey, has identified 81 areas within the state, which they consider to be a part of a global network of places recognized for their outstanding value to bird conservation. Though no Important Bird Areas are currently identified in Susquehanna County, the county hosts a very good diversity of birds and quality bird habitats. More information about the Important Bird Area Program can be found at Audubon PA's website (http://pa.audubon.org/).

Currently identified Important Bird Areas of Pennsylvania
From Audubon PA's website (http://pa.audubon.org/).

Forest Interior Birds: Various Warblers, Vireos, Thrushes, Tanagers, Flycatchers, etc.

Neo-tropical migrant landbirds are birds that breed in temperate North America and spend the non-breeding season mainly in South and Central America, the Caribbean Islands, and extreme southern United States. There has been concern over long-term declines of neo-tropical migratory birds since the 1960's. Determining the main causes of the decline is difficult due to the fact that these birds occupy critical habitats over the entire western hemisphere. Loss of suitable breeding habitat, wintering habitat and stopover habitat, and pesticides are the most frequently known causes of the declines. Neo-tropical migrant landbirds will breed in a variety of different habitats, from early successional old-field settings to forested wetlands to open wetlands to large forest interior. The purpose of this fact sheet is to understand more about forest interior bird species and why conserving large amounts of land is crucial for their continued success.

Acadian Flycatcher - Photo Source: Ron Austing

Scarlet Tanager – Photo Source: Ron Austing

Louisiana Waterthrush - Photo Source: Ron Austing

Hooded Warbler – Photo Source: Ron Austing

Forest Interior

Forest interior is defined as unbroken forest at least 200-300 feet from habitat edges and usually is related to size of a patch of forests (large patch size, more forest interior). Forest interior migrant landbirds usually avoid forest edges during nesting and are adapted to forested interior conditions. Consequently, these birds will usually avoid nesting in smaller fragmented landscapes. Studies in the Midwestern United States have documented that forest interior species may not successfully breed in small patches of otherwise suitable habitat. As the threat of suburban development continues to decrease the size of woodlots, forest interior species may have trouble finding enough suitable habitats.

Forest Interior Bird Species in Pennsylvania

Many forest interior bird species occur in Pennsylvania, where large contiguous and diverse forests and wetlands still occur. These species have different types of habitat requirements but all prefer large, contiguous forests with little fragmentation. Several species of commonly occurring forest birds in Pennsylvania are high priorities in the multi-agency Partners in Flight (PIF) program launched to identify declining populations if migratory birds and address the conservation and management needs of species before they become threatened or endangered. Forest-interior bird species on the PIF list occurring in Pennsylvania include Kentucky Warbler (*Oporornis formosus*), Worm-eating Warbler (*Helmitherus vermivorus*), Wood Thrush (*Hylocichla mustelina*), Canada Warbler (*Wilsonia canadensis*), Cerulean Warbler (*Dendroica caerulea*), and Prothonotary Warbler (*Protonotaria*

citrea). Other forest interior songbirds occurring relatively commonly in Pennsylvania include Scarlet Tanager (*Piranga olivacea*), Blue-headed Vireo (*Vireo solitarius*), Ovenbird (*Seiurus aurocapilla*), Acadian Flycatcher (*Empidonax virescens*), Hooded Warbler (*Wilsonia citrina*), Black-throated Blue Warbler (*Dendroica caerulescens*), Black-throated Green Warbler (*Dendroica virens*), and Louisiana Waterthrush (*Seiurus motacilla*). Several species, such as Louisiana Waterthrush, Cerulean Warbler, Worm-eating Warbler, Canada Warbler, and Black-throated Blue Warbler, are priority species in PIF conservation plans for the Allegheny Plateau and/or Northern Ridge and Valley physiographic areas. Rare birds that are state-listed/candidates that rely on forest interior include Prothonotary Warbler, Yellow-bellied Flycatcher (*Empidonax flavescens*), Northern Goshawk (*Accipiter gentilis*), and perhaps Swainson's Thrush (*Catharus ustulatus*), who may also use forest edge and second growth conifer woodland.

<u>*Management Recommendations for Forest Birds*</u>
Many different species of birds will require different stages of forest succession. It is important to know the forested area that management is to be conducted. For instance, it is vital to know what type of wetlands, uplands, forest cover types, and streams/rivers are on a particular piece of property. It is also important to know the size of the forested area, and if it is contiguous with other forested areas. The larger the forest involved, and the more types of habitats within the forested areas, the more management can be conducted. Forest interior birds require large amounts of forested areas, and typically avoid edges of forests. Many forest interior birds, however, require different microhabitat conditions. A mosaic of structural diversity throughout the forest is ideal along with creating openings that do not create edge effects. Edges are often associated with higher amounts of nest predation and brood parasitism, fewer food resources for some species, warmer air and soil temperatures, drier conditions, and more wind than interior forest. Some birds forage or nest only in small saplings or shrubs, whereas other birds spend most of their time high in the forest canopy. It is possible to create more foraging and nesting opportunities for birds by retaining trees, saplings and shrubs in a variety of class sizes that result in providing more vertical layers of forest. Specifically, the following recommendations can increase chances of attracting forest interior birds to a particular forested area.

1) ***Enhance vertical structure within the forest stand***
2) ***Keep forest buffers along streams***
3) ***Do not harvest all trees***
4) ***Retain decaying and standing dead trees (snags)***
5) ***Create irregular edges when harvesting stands***
6) ***Leave large patches of forest close to other forest patches***
7) ***Maximize the forest interior area of unharvested stands***
8) ***Keep house cats inside***
9) ***Allow hunting to reduce White-tailed Deer population***

<u>*Keeping Common Birds Common*</u>
Projects such as Partners in Flight (Rosenberg et al. 1999) "A Land Manager's Guide to Improving Habitat for Scarlet Tanagers and other forest interior Birds" focus efforts on reversing the population decline of Neo-tropical migrant landbirds. Many of these species mentioned above are still relatively common throughout their breeding range. However, if declines continue throughout the species breeding range, these birds could become rare in the future. The goal of these programs is to keep common bird species common by identifying concentrations, population goals, and active management of vulnerable target species of conservation concern. In addition to critical breeding habitat, PIF is identifying critical migratory habitat in the ridges and valleys of Pennsylvania. Forest interior bird species are, as a whole, a good indicator of habitat quality and forest health. A healthy forest will contain good populations of forest songbirds, healthy insect populations, and a good forest structure.

Grassland-dependent Bird Species

Many bird species depend on early-successional habitats such as hayfields, open grasslands and prairies, abandoned strip-mines, and air fields. These species are habitat specialists, and the specificity of their habitat choices has deemed them a species group of management concern. Many of these species cannot tolerate land use changes from open grassland/pasture to row crop agriculture such as cornfields and soybean fields. In Pennsylvania, many of these species are quite unpredictable in their range and site fidelity. Species, such as Dickcissel, for example, occur unpredictably on the fringe of their range. Other species, such as Henslow's Sparrow, may have increased in Pennsylvania due to the reclaiming of abandoned strip mines into grassland habitats. The historic extent of the distribution of grassland-bird dependent species in Pennsylvania is relatively unknown, but indications are that prior to European settlement, grassland bird species were fairly rare in Pennsylvania. However, as forests were cleared in the 1800's, and by 1840, almost half of Pennsylvania was farmland. This cleared the way for grassland bird species to increase in numbers, and become somewhat common up until the mid 1900's. However, by 1980, only 26 percent of the land remained in agricultural production. Many grassland bird species are now decreasing in Pennsylvania and throughout their range. There is hope in programs such as CREP (Conservation Reserve Enhancement Programs), and reclaiming of strip mines into grassland, which have assisted in restoring habitat for these grassland-dependent species.

Species specific habitat requirements

***Upland Sandpiper** (*Bartramia longicauda*) -areas with low to moderate forb cover, low woody cover, moderate grass cover, moderate to high litter cover, and little bare ground (fence posts and display perches may be important components of suitable habitat)- they use native and tame grasslands, wet meadows, hayland, pastures, planted cover, highway and railroad rights-of-way, and grassy areas of airports. The Upland Sandpiper is a Partners in Flight (PIF) priority species in the regional conservation plans for physiographic regions Allegheny Plateau and Northern Ridge and Valley.

Henslow's Sparrow (*Ammodramus henslowii*) - fallow weedy fields, often with broomsedge (*Andropogan* spp.) grasses, reclaimed strip mines, use grasslands that have well-developed litter, relatively high cover of standing dead residual vegetation, tall dense vegetation, and generally low woody stem densities. They may use idle hayfields, CREP lands, or wet meadows. The Henslow's Sparrow is listed on the Partners in Flight (PIF) watch list as a highest concern species and is a priority target species in the regional conservation plans for physiographic regions Allegheny Plateau and Northern Ridge and Valley.

***Dickcissel** (*Spiza americana*) - prefers habitat with dense, moderate to tall vegetation and moderately deep litter. Suitable habitats are found in oldfields, hayfields (especially alfalfa), fencerows, hedgerows, road rights-of-way, planted cover, CREP fields and dense nesting cover, and moderately grazed and idle prairie. The Dickcissel is listed on the Partners in Flight (PIF) watch list as threatened and declining.

Grasshopper Sparrow (*Ammodramus savannarum*) - generally prefers moderately open grasslands and prairies with patchy bare ground, selects different components of vegetation, depending on grassland ecosystem. This species generally avoids grasslands with extensive shrub cover but regularly occurs in hayfields, dry pastures, and reclaimed strip mines.

Savannah Sparrow (*Passerculus sandwichensis*) - occupies similar habitats to Grasshopper Sparrow such as hayfields and pastures, but also may occur in wet meadows. In Pennsylvania, the species occurs in meadows, cultivated fields, grasslands, hayfields, and reclaimed strip mines.

Vesper Sparrow (*Pooecetes gramineus*) - prefer extensive meadowlands or even croplands, cornfields, alfalfa fields, hayfields, reclaimed strip mines. They require elevated perches from which to sing from such as isolated trees, power lines, or tall grass.

Eastern Meadowlark (*Sturnella magna*) - grazed and ungrazed pastures, hayfields, winter wheatfields, idle or fallow areas, reclaimed strip mines. Males prefer areas with an elevated perch, such as a tree or utility perch.

Bobolink (*Dolichonyx oryzivorus*) - prefers open fields, moist meadows with heavy stands of hay, clover, alfalfa, or weeds, and reclaimed strip mines. The Bobolink is a PIF priority species in the regional conservation plans for physiographic region Northern Ridge and Valley.

***Short-eared Owl** (*Asio flammeus*) - reclaimed strip mines, field stubble and grasslands, and originally, and possibly still, open marshlands. Within such areas, these owls require cover, dense thickets, grassy tussocks, clumps of rushes or reeds, and even dense evergreen, and an abundance of mammalian prey. The Short-eared Owl is listed on the Partners in Flight (PIF) watch list as threatened and declining.

*Denotes species of concern in Pennsylvania

Eastern meadowlark – Photo Source: Ron Austing

Conservation/Management Recommendations for Grassland Birds

Many of the above species depend heavily on some type of agricultural practice for maintenance of their preferred breeding habitats. The loss of pasture and hayfields to suburban development and succession of abandoned pasture and hayfields to old-field and woodland habitat are two of the biggest threats to these species in Pennsylvania. Many of the above species nest in active hayfields and pasture, and early mowing and harvesting of these fields in the summer will destroy many nests. It is recommended, if possible and feasible, that farmers delay mowing and harvesting hayfields until late July to give these species juveniles time to fledge. Selling of farms to developers is a process that is occurring most frequently in southern Pennsylvania, where development pressure is high. Reclaimed strip mines may be a harbor for some of these grassland species, especially ones that have been applied proper management. However, there are far too few of these reclaimed strip mines to support healthy populations of these species. Conservation Reserve Enhancement Programs (CREP) have also been proving beneficial to restoring some breeding areas for many of these species, and one of the goals of this program is to provide financial and technical assistance for Pennsylvania farmers to voluntarily restore wetlands, riparian areas and grasslands by enrolling up to 200,000 acres of farmland in CREP. For more information on CREP or to find out how to enroll in CREP, visit http://www.fsa.usda.gov/pas/publications/facts/html/creppa03.htm. This program will hopefully give farmers incentives to plant native grasses and help the populations of grassland birds reach a healthy level.

Partners in Flight Goals for Grassland Birds

Partners in Flight has identified the Northern Ridge and Valley and Allegheny Plateau physiographic provinces as high priorities for conserving grassland bird species. In Northern Ridge and Valley, one objective of Partners in Flight is to identify, and either acquire, manage, or restore grasslands greater than 50 hectares with potential to support Henslow's Sparrow or Upland Sandpiper. Patners in Flight also hopes to preserve 13,000 hectares of pastureland in an effort to support 12,000 pairs of Bobolinks and other grassland species, and at least 1,000 hectares of that area should be conserved where patches are large enough to support 50+ pairs of Upland Sandpipers and potentially Henslow's Sparrow.

Marsh Bird Species

Many bird species depend on herbaceous-dominated marsh wetlands such as cattail-dominated wetlands, sedge-dominated wetlands, and open herbaceous marshes and ponds. These species are habitat specialists, and the specificity of their habitat choices has deemed them a species group of management concern. Marshes are a type of wetland, generally being less acidic than sphagnum moss dominated wetlands, and support a variety of plant life, most notably cattail (*Typha* spp.) and sedges (*Carex* spp.).

Marsh-dependent birds are uncommon to very rare in Pennsylvania. In general, they are also very secretive birds that require abundant time and effort in surveying for them. Many rail species do not fly when flushed from their habitat, as their narrow bodies are supremely adapted to stalking through vegetation when disturbed. Many of these species are area sensitive as well, and will not breed in very small marshes/wetlands. In Pennsylvania, all marsh-related birds are birds of special concern and are either candidates for state listing or are already state-listed.

Marshes provide critical habitat for all species named above and for a variety of other wildlife and plant life. Many marshes/emergent wetlands have been lost to development. From 1956 to 1979, Pennsylvania lost six percent of its vegetated wetlands, a loss of 1,200 acres a year. Wetland loss continues throughout the state, and despite regulations, some estimates have suggested that about half of Pennsylvania's wetlands are now gone. The conversion of marshes/wetlands to lakes ponds and reservoirs, conversion to farmland, urban development, and channelization drainage projects are the largest threats to all wetland habitats.

Least Bittern – Photo Source: Ron Austing

Species specific habitat requirements:

Sora – Photo Source: Ron Austing

***Sora** (*Porzana carolina*) - This species nests in a variety of freshwater marshes, bogs, and wet meadows, but prefer cattails and sedges with mud and standing water. It eats primarily seeds, but also some insects as well. According to the first breeding bird atlas, Sora numbers have decreased sharply in PA in the last 25 years, but Sora remains the most common breeding rail in Pennsylvania.

Virginia Rail – Photo Source: Mark Chappell

***Virginia Rail** (*Rallus limicola*) - This species inhabits Freshwater and occasionally brackish marshes, mostly in cattails, reeds, and deep grasses, also in or close to other emergent vegetation. It prefers to inhabit shallow freshwater emergent wetlands of every size and type, from roadside ditches and borders of lakes and streams to large

cattail marshes. This species can occur even in small marshes.

***King Rail** (*Rallus elegans*) - King Rails prefer to nest in large brackish or freshwater marshes, although a diversity of habitats have been used across its entire range. The King Rail is one of the rarest breeding birds in Pennsylvania, and it has been designated as an endangered species. Much of the habits of the King Rail are still unknown, due to its secretive nature.

***Common Moorhen** (*Gallinula chloropus*) - This species inhabits lakes, ponds, and river edges if sufficient vegetation exists. However, for nesting, this species prefers to nest in cattail marshes, which could be large or small in extent. This species tends to inhabit the open areas of the marsh, as opposed to rails, that prefer to be hidden in the thick herbaceous vegetation. It has been noted that this species prefers thick vegetation, preferably cattails, and deep water with scattered open places were important to the nesting success of this species. They may nest in patches of sweetflag, arrow-arum, and in tussocks of sedges and rushes.

***American Coot** (*Fulica americana*) - A rare breeder in Pennsylvania, this species prefers to nest nearer to open water than other marsh species, setting up breeding territories along the edge of an open pool in a cattail marsh, or less commonly, in a large bed of spatterdock. Coots occur most frequently in the northwest part of Pennsylvania, where optimum habitat conditions exist. Scattered other areas occur throughout the state, and anywhere where there is enough open water with herbaceous vegetation, this species could be present.

American Coot – Photo Source: Mark Chappell

***American Bittern** (*Botaurus lentiginosus*) - This species prefers to breed in extensive freshwater marshes, especially those characterized by dense stands of cattail, and thick growths of spatterdock, bulrushes, grasses, and sedges, interspersed with areas of open water. Rarely does this species nest in smaller marshy areas along rivers or sluggish streams and in bogs, ponds, wet meadows, and possibly dry grassy areas. The American Bittern is a rare and declining species in Pennsylvania, and occurs more commonly in the northwest part of the state.

***Least Bittern** (*Ixobrychus exilis*) - Least Bitterns prefer to nest in freshwater or brackish marshes, swamps, and bogs. In Pennsylvania, this species prefers large, deep-water cattail marshes that have scattered shrubs and small trees growing in and around them. This species is very rare in Pennsylvania, and has been designated as a threatened species.

Marsh Wren – Photo Source: Mark Chappell

***Marsh Wren** (*Cistothorus palustris*) - This species almost exclusively nests in large cattail marshes, both brackish and freshwater marshes, in marshy lake or pond edges, and along the banks of tidal rivers and sluggish streams. The first Breeding Bird Atlas determined that Marsh Wrens may be in trouble in Pennsylvania. Precipitous declines have occurred, and former strongholds for this species are no longer. This species is a species of concern in Pennsylvania, and is a candidate for listing in the state.

***Sedge Wren** (*Cistothorus platensis*) - This species prefers moist upland sedge meadows with little or no standing water, and usually does not occupy

deep cattail marshes like its close relative the Marsh Wren frequents. Less commonly, Sedge Wrens may nest in a low pasture among clumps of sweetflag and grasses, or may even nest in orchard grass in an upland hayfield along with the Savannah Sparrow and Bobolink (Brauning 1992). This species is very rare in Pennsylvania, and has been listed as threatened in the state.

Conservation/Management Recommendations for Marsh Birds

Throughout the range of marsh-dependent bird species, breeding habitat continues to be destroyed, with only modest amounts marsh habitat restored and created. As a result, the populations of these species have responded to these changes in habitat availability accordingly. Marsh birds have declined in many locations where large extensive marshes have been drained, filled or developed. For example, King Rails have declined precipitously in the last fifty years and the species has undergone extreme range contraction with virtual disappearance from the northeast, upper Midwest, and southeast Canada. This species continues to decrease even in strongholds in the southeast, where large populations still occur.

Other possible reasons for decline of marsh birds include pesticides and other contaminants/toxics, ingestion of lead and plastic, collisions with stationary/moving structures or objects, degradation of wintering habitat, disturbance at nest, roost, or feeding habitat, and human/research impacts. It is not known to what effect these factors have on marsh bird populations, but research should be conducted to determine reasons for decline. One large discrepancy is the lack of information on the populations of all marsh birds, due to the very secretive nature of these species. The most important conservation need is the immediate preservation of emergent wetlands that provide breeding, migration, and wintering habitats. Many wintering habitats, including coastal marshes in California, Florida, Louisiana, New Jersey, and Texas provide critical habitat for Soras and other marsh bird species, yet these areas are extremely vulnerable to habitat degradation. Marsh birds will benefit from policies and management that eliminate or minimize effects of wetland draining and filling, siltation, competition from resident Canada Geese and exotic Mute Swans, toxic bioaccumulation, eutrophication, and other forms of pollution, and invasion of exotic plant species.

North American Waterbird Conservation Plan

The North American Waterbird Conservation Plan is a management plan that deals with conservation of all waterbirds, including wetland dependent birds in North America. This plan provides a continental scale framework for the conservation and management of over 210 species of waterbirds. Each species is evaluated and the species with the most conservation concerns are highlighted. In the Southeast regional plan, three rail species are identified for immediate conservation management (Yellow Rail, Black Rail and King Rail). In addition, according to the plan, management action is needed for Least Bitterns, American Bitterns, and American Coots. Long-term management and planning was identified as a priority for Virginia Rails, Soras and Common Moorhens. In the Middle-Atlantic and New England region, a marshbird monitoring program is being implemented due to the conservation concerns for these species. The goal is to develop a targeted monitoring program following standardized regional (or national) approach, and using remote acoustical techniques to monitor marshbirds.

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Reptiles And Amphibians In Susquehanna County

The herpetofaunal makeup of Pennsylvania is rather unique. The Commonwealth is home to some of the northern species common in the glaciated regions of the Canadian Shield as well as many of the southern species from the lower regions of the Appalachians. The ranges of most Pennsylvania reptiles and amphibians are restricted to certain regions of the state, a testament to the varied topography and physiographic providences within the region. Pennsylvania's mixed landscapes create a great diversity of habitats for a wide range of reptile and amphibian species.

Susquehanna County is home to many common, generalist species, such as the eastern garter snake (*Thamnophis sirtalis*), the red-spotted newt (*Notophthalmus viridescens*), and the **snapping turtle** (*Chelydra serpentina*). These species occur in many different habitats and exist throughout the entire state. Along with these common species, Susquehanna County possesses several rarer species of reptiles and amphibians. Many of these less common species are considered specialists, meaning their life histories have more specific habitat requirements.


Snapping turtle (photo: Charlie Eichelberger)

Much of Pennsylvania has succumbed to a large amount of habitat degradation, destruction, and fragmentation from land development. Susquehanna County has retained many forested tracts, albeit small and rather fragmented. These forested areas and many wetlands in the county provide a tremendous amount of habitat for the often overlooked reptiles and amphibians of the state. The array of habitats within the remaining forested areas serves both the generalist and specialist species.

The terrestrial woodland salamanders depend on canopied forests with adequate amounts of leaf litter. These salamanders are voracious predators of the forest floor. Their roll in limiting the numbers of leaf decomposing invertebrates has been shown to be significant in maintaining a rich layer of organic matter on the forest floor. The red-backed and slimy salamanders (*Plethodon cinereus*, *P. glutinosis*) are the most common woodland species throughout Susquehanna County's forests.


Long-tailed salamander
(photo: Charlie Eichelberger)

The numerous waterways and small streams of Susquehanna County provide habitat for the streamside salamanders, including the northern and mountain dusky salamanders (*Desmognathus fuscus, D. ochrophaeus*), the two-lined and **long-tailed salamanders** (*Eurycea bislineata, E. longicauda*) and the northern spring salamander (*Gyrinophilus porphyriticus*). In the cold-water seepy drainages of the county, the brilliant northern red salamander (*Pseudotriton ruber*) can be found under the litter and rocks in spring heads. All of the streamside salamanders require high water quality, and forested stream edges. The Eastern hellbender (*Cryptobranchus alleganiensis*) has been recorded from Susquehanna County and inhabits cool, shallow waterways with an abundance of rock slabs. These enormous salamanders, which have been recorded at over 20 inches in length, are one of the largest salamanders in the world and have a bizarre appearance with compressed bodies covered with wrinkled folds of skin. Hellbenders have severely declined over that past few decades and are now considered of special concern in the state. Amphibians as a whole are particularly sensitive to toxins. Consequently, acid mine drainage is detrimental to the salamanders that inhabit affected waterways.


Wood frog (photo: Charlie Eichelberger)

Jefferson salamander
(photo: Charlie Eichelberger)

Portions of the county support complexes of ephemeral wetlands. These small pockets of water are not typical of the vernal pools found in other regions of the state, but they do support amphibians that rely on the wet/dry annual cycle. The **wood frog** (*Rana sylvatica*), and the **Jefferson and spotted salamanders** (*Ambystoma jeffersonianum, A. maculatum*), all of which utilize ephemeral wetlands, are known from Susquehanna County. These species cannot reproduce without the presence of fish-free, fluctuating wetlands. Many other frogs and toads can also be found using temporary wetland habitats. The American toad (*Bufo amercianus*), spring peeper (*Pseudacris crucifer*), and grey tree frog (*Hyla versicolor*) are regular visitors to temporary wetlands and may use these sites to breed. These species are typically more generalist in nature, and may breed in permanent bodies of water as well.

Spotted salamander
(photo: Charlie Eichelberger)

The four-toed salamander (*Hemidactylum scutatum*) is often found in association with hummocks of peat moss (*Sphagnum spp.*), which are common throughout Susquehanna County. An uncommon trait among reptiles and amphibians, the four-toed salamander tends its clutch until the young hatch. As the larvae hatch, they wriggle down the hummocks and into the water below where they spend about 6 weeks in the aquatic larval stage before metamorphosing to their terrestrial adult stage.

The bull frog (*Rana catesbeiana*) and **green frog** (*Rana clamitans*) are found in a wide range of aquatic habitats, from temporary puddles to huge ponds and lakes. These species epitomize the term "generalist" and are found throughout much of the east. The pickerel frog (*Rana palustris*) and northern leopard frog (*Rana pipiens*) are more specialized and they require heavily vegetated streams and creeks. Once one of North America's most common species of frog, the northern leopard frog has rapidly disappeared from much of its range for mysterious reasons. Many are now concerned with the future of this species.

The range of the Fowler's toad just enters the very southern portion of the county and can be found in areas with sandy soil. These toads are difficult to distinguish from the more common American toad but have a characteristic nasal whine that differs greatly from the drawn-out trill of the similar American Toad. The Eastern hognose snake (*Heterodon platyrhinos*) also prefers sandy soils and is a species of special concern in the state. Hognose snakes feed almost exclusively on the frogs and toads buried in sandy soils. Their spade-like head aids in extracting meals of toads from loose soils. This species of snake is well camouflaged and is very difficult to locate.

Green frog (photo: Charlie Eichelberger)

The eastern box turtle was likely gone from Susquehanna County by the time of European settlement. Box turtle remains are a common find in archeological digs from western New York State and it is thought that box turtles were found across New York State and northern Pennsylvania but were wiped out of these regions by over-collecting by Native Americans.

The painted turtle (*Chrysemys picta*) is a common occurrence in Susquehanna County. This species relies on permanent water habitats including ponds and rivers. Common map turtles are know from the Susquehanna River and could possibly be found in the large tributaries in Susquehanna County. The wood turtle (*Glyptemys insculpta*) relies on wooded creeks and rivers, and can be locally common in areas. There is now concern for this species because many populations are void of juvenile turtles, indicating that there is little successful reproduction occurring. The nests of the wood turtle are laid in suitable substrates along waterways. These sites are usually used by many nesting females and are easily targeted by overpopulations of raccoons, skunks, and opossums.

Acid mine drainage is detrimental to the riverine turtles because the pollution causes the collapse of the food webs.

The northern black racer (*Coluber constrictor*) and the black rat snake (*Elaphe allegheniensis*), two fairly common species is the state, can be found in many different habitats across the county. These two species prey upon small mammals including mice and squirrels. The brilliantly patterned milk snake (*Lampropeltis triagulatum*) can be found in a variety of habitats and though it is common, this species is rather secretive and is rarely seen. A more frequently observed snake, northern water snake (*Nerodia sipedon*) is a widespread resident of Susquehanna County. This species hunts by both ambush and pursuit along open waterways, searching for amphibians and small fish.

The smooth green snake (*Liochlorophis vernalis*) is likely common in sedgy and grassy areas but is difficult to locate because their camouflage allows them to virtually disappear into vegetation. Three small and secretive snakes in the county are the red-bellied, northern brown, and northern ringneck snakes (*Storeria occipitomaculatum*, *S. dekayi* & *Diadophis punctatus*). These species are common residents and can be found beneath decaying wood. The **eastern ribbon snake** (*Thamnophis sauritis*) depends on the sedge and grass covered edges of wetlands. This species is thought to be declining due to wetland destruction.

Ribbon snake (photo: Charlie Eichelberger)

The **timber rattlesnake** (*Crotalus horridus*) has long been persecuted in northeast. Although the snake may deliver a serious bite if threatened, the danger they pose has been drastically over exaggerated. In fact, there has never been a human fatality in Pennsylvania from a rattlesnake bite. There are only a few records of this species in Susquehanna County and the county is not considered a stronghold for this species. Rattlesnakes are able to use a wide range of habitats and could be encountered throughout the forested regions of the county. They primarily occur on rocky slopes where they can find refuge in spaces between the boulders as well as thermoregulate in the sunny openings. Timber rattlesnakes forage in a variety of habitats, but favor forested areas with healthy small mammal populations. Hibernacula, or dens, often are found under canopy cover but are usually located within several hundred meters of an open basking site. Persistence of these sites relies on forestry practices that maintain a diversity of open areas adjacent to forested foraging habitat.

(photo: Charlie Eichelberger)

Timber rattlesnake
(photo: Charlie Eichelberger)

The other venomous pit viper known from Susquehanna County is the northern copperhead (*Agkistrodon contortrix*). This species can inhabit many of the same areas where rattlesnakes are found but can also be found in lower, wetter regions that rattlesnakes typically avoid.

Susquehanna County is a significant spot in the state for the Commonwealth's reptiles and amphibians. The forested tracts with numerous waterways provide critical habitat for the reptiles and amphibians of the county. Of utmost importance to the conservation of the county's herpetofauna is the protection of the regions wetlands, including the communities of ephemeral wetlands. The rich and diverse herpetofauna of Susquehanna County is unique to Pennsylvania and should be considered in the long term plan of the region.

INTRODUCTION

Damselflies and dragonflies are grouped together in the scientific order called Odonata (or informally, the odonates). Odonata comes from the Greek word 'odon' which means 'tooth'. Both adult and larval (immature) odonates possess mouthparts armed with serrated, tooth-like edges and grasping hooks that help them catch and eat their prey.

Damselflies and dragonflies are closely related insects, and they share many features. As adults they have very small antennae, prominent compound eyes, a long abdomen composed of ten segments, and four large wings of approximately equal length, laced with a network of veins. They have similar life histories and utilize a similar suite of habitats.

Damselflies and dragonflies also differ in several notable ways. All damselflies have eyes that are widely separated, while many dragonflies have eyes that touch or are less widely separated. Damselflies tend to be shorter and more slender in body than dragonflies. Damselflies tend to fly slowly, close to the surface of the water, or stay sheltered in patches of vegetation. Dragonflies tend to be more visible and have a more powerful and aggressive flight. Damselflies usually perch with their wings folded together over their back or cocked open at a 45 degree angle, while dragonflies perch with their wings spread all the way open.

Damselfy

SPECIES DIVERSITY IN PENNSYLVANIA

In North America, there are an estimated 350 species of dragonflies (Needham et. al. 2000) and 161 species of damselflies (Westfall and May 1996). In Pennsylvnia, there currently are 121 known species of dragonflies and 55 species of damselflies (PNHP 2006).

Families of Damselflies (Order Odonata, Suborder Zygoptera) in Pennsylvania:
Calopterygidae – Broad-winged Damselflies
Coenagrionidae – Pond Damsels
Lestidae - Spreadwings

Families of Dragonflies (Order Odonata, Suborder Anisoptera) in Pennsylvania:
Aeshnidae - Darners
Cordulegastridae - Spiketails
Corduliidae - Emeralds
Gomphidae - Clubtails
Libellulidae - Skimmers
Macromiidae - Cruisers
Petaluridae - Petaltails

Dragonfly

Life History and Habitats

Eggs

Adult odonates lay their eggs (oviposit) in or near water. There are two common methods of oviposition. Some species lay their eggs inside the stems or leaves of living or dead plant material. This is called endophytic oviposition. Other species lay their eggs in the water, singly or in a mass. This is called exophytic

oviposition. Many odonate species have very unique and specific criteria for oviposition sites and females can be observed testing multiple sites before finding the right conditions (Westfall and May 1996). Odonate eggs develop at different rates depending on the species, but in general development quickens as temperature increases (Brooks 2003). The eggs of certain tropical species may hatch in as few as five days, but in temperate regions like Pennsylvania, it is more common for eggs to develop over a period of several weeks to several months. Once the eggs hatch, the larvae seek out their preferred niche in the aquatic habitat.

Larvae

There are many different hunting techniques and habitat preferences among odonate larvae. These preferences are reflected even in the appearance of the larvae. For example, some larvae in the family Gomphidae are found on the silty bottoms of still or slow-moving waters. They have long legs and a wide, flat body that distributes their weight over the soft bottom. This keeps them from sinking deep into the muck. They have small eyes because little light penetrates to the bottom and they rely on touch rather than sight to find food. They are patient hunters, lying in wait rather than actively pursuing their prey. Their long, sensitive legs and antennae help them to detect the movements of nearby prey. They also tend to be covered in long hairs that trap little particles of debris. Their coat of duff camouflages them from both hungry predators and wary prey.

In contrast, some odonate larvae, including many members of the Aeshnidae family, prefer to climb about in submerged aquatic vegetation, hunting their prey actively rather than lying in wait for prey to wander past. These species have large, well-developed eyes which they use to watch for the movements of prey or predators. They have short antennae, because they rely on sight rather than touch to find food. Their bodies are long and streamlined. They also lack the hairy coat of their muck-dwelling relatives, but their smooth skin is camouflaged by colored patterns that match their environment.

As larvae, odonates are found in a wide variety of aquatic habitats, such as seeps, seasonal pools, streams, rivers, ponds, lakes, and a variety of wetlands. Within each habitat, larvae seek out favorable microhabitats with the right combination of water flow, vegetation, substrate texture, etc. They feed on the other insect larvae that share their aquatic habitat such as mosquitoes, midges, gnats, and other flies. Odonates and many other groups of aquatic insects spend their immature stages feeding and growing in the water. During larval development, odonates undergo 5-15 molts (Westfall and May 1996) over a period of a few months for some species up to several years for others. The number of molts depends upon the species and also on environmental conditions.

When a larva is fully developed, it undergoes metamorphosis inside its larval skin. Then it crawls out of the water for its final molt. This movement of the larva out of the aquatic habitat to shed its larval skin is called emergence. The site selected for emergence varies by species. Many Gomphidae prefer to crouch on the ground or a low rock. Other species, including many Libellulidae, climb up onto emergent vegetation. Once properly positioned, the larval skin is shed one last time and a winged adult emerges.

Adult newly emerged from nymphal exoskeleton.
Photo: PA Natural Heritage Program

Adults

Many insect larvae escape the cavernous appetites of predators such as fish and odonates when they leave the water to become adults, but they are jumping from the frying pan into the fire. Odonates emerge from the water too, transforming from camouflaged stalkers into jeweled fighter planes. Adult odonates continue to feed on the community of insects with whom they shared an underwater life. They also add to their diet

additional insects they encounter for the first time as adults such as butterflies.

Adult odonates are closely associated with the larval habitat during mating and subsequent oviposition when the eggs are laid in suitable habitat. However, it is important to recognize the additional habitat requirements of the adults. For example, some species have specific perching preferences, and will not use a habitat that lacks proper perches, even when suitable larval habitat is present (Westfall and May 1996). Feeding areas are also very important for odonates. After the process of metamorphosis and emergence, a fresh adult has very little energy in reserve and must begin feeding as soon as possible. Young adult females in particular avoid breeding areas for a period of time while they build up mass, mostly in growth of their ovaries. Males and females can frequently be found feeding far away from breeding habitat, along roadsides, in wooded glades, in open meadows, and other upland and aquatic habitats. Some males and females disperse long distances from their natal aquatic habitat to find new breeding areas, an important process that strengthens populations by diversifying the gene pool.

CONSERVATION

There are a few important pieces of information needed when developing conservation and management plans for odonates:

1) **Research and define the specific habitat requirements of each life stage of the species of concern.**

Most research on the habitats of odonates has focused on the larval habitat. This makes sense because of the more sedentary nature of the larvae compared to the adults and the subsequently tighter association of larvae to habitat. The adults are also associated with the larval habitat during mating and oviposition when the eggs must be placed in suitable habitat. However, it is important however not to lose sight of the additional habitat requirements of the adults such as perching and upland feeding areas.

2) **Acknowledge and maintain the balance that is necessary between predators and their prey.**

Larval and adult odonates feed on the other insects that share their environment, such as mosquitoes, midges, gnats, and other flies. Odonates help control insect species that are considered pests. However, when homes encroach upon wetland habitats, municipalities and homeowners often take pest control into their own hands. The pesticides used to control mosquitoes and other nuisance insects have many negative effects on non-target species. Direct mortality of all insect species occurs when broad-based killing agents are used. More specific killing agents are available that only harm black flies or mosquitoes, but indirectly this still affects predators such as fish and insects who experience a decrease in food availability when their formerly abundant prey items are eliminated.

3) **Protect the species and habitats within a healthy, functioning ecosystem.**

Landscape scale conservation of wetland habitats and the supporting upland habitat is needed for long term survival of healthy odonate populations. This is addressed in more detail in the 'Threats' and 'Recommendations' sections.

THREATS

The specific habitat requirements of many odonates are not well known. Alteration or destruction of habitat is the greatest threat to populations of odonates (Westfall and May 1996). Many activities take place that destroy or alter odonate habitats so that they are no longer suitable for odonates, or can only support a few tolerant species. These activities are discussed below.

Connectivity (Habitat fragmentation)

Development of extensive agricultural, urban and suburban areas creates biological "islands" of isolated natural areas. It can be difficult for animals to move long distances across unsuitable habitat and to navigate large obstacles such as highways and fences. Some strong-flying odonates are able to disperse over these obstacles. Other odonate species are not strong flyers or are disinclined to fly any great distance from their preferred type of habitat. For those species that can travel large distances, there is increased risk they will not be able to find suitable habitat at the end of their journey in a fragmented landscape with diminished habitat.

Just as habitat fragmentation isolates a group of animals on an island of habitat, it also isolates the gene pool collectively held by that group of animals. When animals cannot make contact with other populations, inbreeding within one population takes place. This means there is no gene flow between populations and a loss of genetic diversity results. As genetic diversity is lost, the ability of that population to adapt to changes in the environment is reduced. This increases the chances that the population will not be able to survive over the long-term.

Hydrology

Alteration of hydrology can also cause odonate mortality. Poor storm water management can cause unusually large fluctuations in water flow. Heavy water demand can lead to decreased water tables and decreased water flow. If natural water flow patterns are altered in an aquatic habitat, this changes many qualities of the habitat such as inundated area and depth, length of inundation, temperature, dissolved oxygen levels, and types and amounts of vegetation in and around the aquatic habitat. All of these factors are important in proper development of odonate eggs and larvae.

Substrate

The term substrate is used here to refer to the environment at the bottom of a stream, lake, or wetland. Substrate requirements can be quite specific for odonates. The amount and composition of materials such as cobble, gravel, sand, silt, woody debris, living plant material, and even the rate of water flow over the bottom are important factors. The substrate can be removed or altered by activities such as dredging, dam installation, or bridge installation. Gradual non-point effects from run-off can also change substrate. For example, fine sediments eroding from agricultural fields wash down slope into a gravel and cobble-bottomed stream. The silt settles onto the bottom of the stream in places, filling in the spaces between the gravel and cobble. This deposition of silt in the substrate has effectively eliminated the gravel and cobble habitat needed by certain odonate species.

Vegetation

Removal of wetland or riparian vegetation or a significant change in the composition of the vegetation is a threat. For species that utilize lay their eggs in plant material, a change in the type or amount of vegetation in or around aquatic habitats will eliminate egg-laying sites. For species that lay their eggs in the water, removal of vegetation from around or within aquatic habitat will reduce shade. This causes water temperatures to reach higher temperatures and evaporation rates to increase. This can be particularly noticeable in small wetlands like seasonal pools. One cause of mortality of odonate eggs is prolonged high temperatures or periods of drought (Brooks 2003).

Water Quality

Many human activities have degraded water quality in aquatic habitats. The adverse effects on aquatic life are well documented. Some of the most significant pollution problems are caused by acid mine drainage, discharge from sewage treatment plants, and run-off from urban, suburban, industrial, and agricultural areas.

Agricultural runoff is a major source of pollutants in Pennsylvania where there are abundant farmlands. Agricultural runoff is generated as rain falls and flows through fields that have been treated with artificial and natural fertilizers, herbicides, and insecticides, and through livestock pastures and feedlots, washing the waste into local aquatic systems.

Suburban and urban runoff comes from rainwater that flows off rooftops, streets and parking lots, through industrial zones and garbage disposal sites, and through lawns and golf courses treated with various chemicals. This runoff may contain sediments, garbage, road salt, oil, pesticides, herbicides, and a whole mixed bag of other household and industrial chemicals.

Testing for a variety of synthetic chemicals and heavy metals that can be toxic to wildlife is an important part of water quality monitoring. There are other important variables used to monitor water quality including temperature, pH, dissolved oxygen, sediment load, nutrient levels such as nitrates and phosphates, and bacterial and algal levels. The types of plants and animals found living at a site can be used to evaluate water quality. Certain species are very tolerant of poor water quality, while others will only be found in clean habitats. The types of plants and animals living at a site can be monitored for change over time. If species intolerant of pollution such as certain mayflies disappear from a site, and species tolerant of pollution such as blood worms increase, this is an indication that there is a problem with water quality.

Climate Change

All aspects of the life of an odonate, from egg and larval development to adult feeding, thermoregulation, and reproductive success, depend on certain environmental cues and conditions. While predictions of climate change do not agree on the details, evidence shows that changes in average yearly temperatures, minimum and maximum temperatures, rainfall amounts, and other environmental changes are occurring. These changes will have an effect on wildlife that cannot control their environment as humans do. There is already evidence that the geographic ranges of plant and animals have been shifting in response to changes in climate. Climate change may be of increasing concern for species of special concern, especially in regard to species that are geographically restricted (Westfall and May 2000).

RECOMMENDATIONS

Protecting habitats where odonates of special concern currently occur is a first step towards ensuring their long-term survival. Tioga and Susquehanna Counties are notable in Pennsylvania for the extent of varied

wetland habitats they support. This is reflected in the number and diversity of odonates that were found in these counties during these surveys, including many species of special concern. Protection of large tracts of wetland habitats from alteration and fragmentation is an attainable goal for these counties, and will have a positive impact on odonate species conservation for the state as a whole. Restoration efforts should strive to return aquatic habitats and the surrounding uplands to relatively natural conditions in terms of connectivity, hydrology, substrate, vegetation, and water quality.

Pond and Lake Habitats*:* Several of the state's most rare odonata are species that live in pond and lake habitats (list species). They require ponds and lakes with good water quality and natural vegetation in and around the lake or pond.

- Encourage healthy abundance of aquatic plants and algae by reducing agricultural or urban runoff using a multi-approach, comprehensive storm water management plan
- Maintain / restore natural vegetation in the pond or lake
- Maintain / restore natural vegetation along the shoreline (avoid mowing up to the shoreline)
- Maintain / restore natural vegetation in the surrounding upland (200+ ft) of the pond or lake
- Maintain / restore adjacent wetland habitats
- Avoid spraying herbicides or insecticides around the water. Especially avoid broad-spectrum chemicals that eliminate all insect or plant species, not just the target pest insect or plant.
- Avoid introducing fish where fish do not naturally occur.

Wetland Habitats: Several of the state's most rare odonata are species that live in wetland habitats. Conversion of wetlands to lakes and ponds is a common activity but this can make the habitat unsuitable for many odonate species of special concern that require vegetated wetlands. Wetlands themselves can be an effective tool in cleaning up agricultural and urban runoff. However, attempts to manage agricultural and urban runoff using multi-approach, comprehensive storm water management plans should always be made, especially around wetlands of high quality or with species of special concern.

- Carefully screen and minimize activities that destroy or alter wetlands such as draining, filling, flooding, and dredging
- Carefully screen and minimize conversion of wetlands to ponds or lakes. A lake or pond supports less species diversity than a mosaic of wetland types including shrub, graminoid, and forested wetlands (for descriptions of each, please refer to the Vegetation >> Wetlands portion of the Natural History Overview of the County.
- Preserve large areas of good quality wetlands, a variety of wetland types, and wetlands that may serve as stepping stones between good quality wetland habitats.
- Maintain / restore natural vegetation in the wetland
- Maintain / restore natural vegetation in the surrounding upland (200+ ft) of the wetland
- Maintain / restore adjacent wetland habitats
- Reduce agricultural or urban runoff using a multi-approach, comprehensive storm water management plan

Rivers and Streams: Several of the state's most rare odonata are species found in streams and rivers (list species). They require good water quality and healthy in-stream and surrounding upland habitats. It is hard to find large rivers in good, unaltered condition due to the concentration of agricultural, urban, and industrial developments next to large rivers. Because of this, large rivers receive effluents from industry, sewage treatment plants, urban storm water and agricultural runoff. Dams, found frequently on the Susquehanna and other large rivers in the state, fundamentally alter the river habitat and change natural flow patterns.

- Minimize and carefully plan major channel alteration
- Carefully site new bridge placement and design
- Carefully site and conduct bridge maintenance
- Minimize and carefully plan dam placement
- Restore riparian zones and upland buffers
- Reduce agricultural or urban runoff using a multi-approach, comprehensive storm water management plan
- Monitor and upgrade sewage treatment facilities
- Exclude livestock from streams

Aquatic Community Classification

A statewide project of the PNHP, the Pennsylvania Aquatic Classification Project, collected aquatic datasets from state and federal agencies, interstate basin commissions, and universities, analyzed information with standard statistical methods, and identified community types and habitat associations in flowing water habitats, such as rivers and streams. A community represents a group of organisms that occur together in a particular habitat. The organisms require similar habitat features, may be dependent on each other for food or other resources, and/or may be dependent on similar processes in their environment.

The aquatic communities resulting from the classification project are categorized by three types of organisms:

- **fish**
- **macroinvertebrates**
- **mussels**

Aquatic communities for each type of organism can be used to describe the aquatic resources, habitat types, and stream quality.

All three types of organisms hold unique places in Pennsylvania's streams and rivers.

Fish prey upon macroinvertebrates and other stream organisms. Food resources and spawning habitats can be specific for fish. They, too, are influenced by the stream quality and entire environment of the watershed. For example, sediment from erosion at mismanaged construction site near a stream may cover gravel and cobble habitats where brook trout lay the eggs. Developing fish will be smothered by layers of fine particles.

Macroinvertebrates include aquatic insects, worms and crustaceans (like crayfish and scuds), which occupy the lower levels of food webs in aquatic systems. The presence of certain macroinvertebrates reflects food availability, water quality, and habitats, and gives an overall picture of stream health. The most common community type per watershed was chosen to represent typical watershed organisms and habitats. Although other community types may exist in a particular watershed, the major community type is described.

Freshwater mussels are filter-feeders that siphon water to extract particles of food. They also require relatively clean water to thrive. They are particularly sensitive to industrial discharge, acid mine drainage, and urban runoff pollution. Mussels require habitats where they can burrow into the stream bottom and typically occur in larger streams and in rivers that contain sufficient food particles

Many factors influence the occurrence of aquatic communities, including natural variations in stream habitats. Fast-flowing, cold streams flowing from ridges provide a different environment than slower and warmer rivers meandering through valleys and aquatic communities reflect their environment. Geology also varies across Pennsylvania and flowing waters may have a unique chemical composition based on the rock that it contacts. Over any natural habitat variations are human alterations to aquatic environments. Many changes within a watershed can be detected within its streams and rivers. If implemented improperly, timber harvest, agriculture, urban development and roads are among some alterations that may cause changes in water quality and stream habitats from non-point source pollution. A number of pollutants enter aquatic systems from point sources to flowing waters, such as discharges from sewage treatment plants, mines, and industrial sources.

Based on the Aquatic Classification Project, Susquehanna County is host to six distinct fish communities, 2 freshwater mussel communities, and 2 macroinvertebrate communities.

Communities are named by the commonly occurring animals in the community type. Other organisms that may be found in the community are also listed. While not every organism described in a community will occur in every community location, species listed by community types give a general account of what organisms to expect in a community habitat. Stocking of trout species (brown trout, rainbow trout, and brook trout) is very pervasive in Pennsylvania. Steps were taken to describe communities of wild-reproducing trout without the influence of stocking. In communities where stocked trout may be temporary residents, they are not listed common community members.

The characteristics of each community type lead to recommendations for conserving or restoring the watershed. None of the communities identified in the county are considered rare within the Commonwealth, though many are of conservation priority based on their quality or vulnerability to degradation.

Aquatic Communities in Susquehanna County

Table 1. Watersheds in Susquehanna County and fish, mussel, and macroinvertebrate community types. (Many watersheds lack specific information on community members. *Surveys by the Pennsylvania Fish and Boat Commission found one or more fish (brown trout, brook trout, and rainbow trout) present of hatchery origin. This suggests that this watershed or a nearby watershed is stocked.)

Watershed name	Fish community	Mussel community	Macroinvertebrate community	*Stocked Trout Present? (y = yes)
Apalachin Creek	warm water community 1		rolledwinged stonefly / small minnow mayfly community	
Butler Creek	cool water community 1			
Choconut Creek			rolledwinged stonefly / small minnow mayfly community	
E Branch Lackawanna River	cool water community 2			
E. Branch Tunkhannock Creek-Dundaff Creek	cold water community			y
East Branch Tunkhannock Creek	warm water community 1			y
East Branch Wyalusing Creek	warm water community 1			y
Gaylord Creek	warm water community 2			y
Hop Bottom Creek				
Horton Creek	warm water community 1			y
Lackawanna River-Lees Creek	cool water community 2		brushlegged mayfly community / fingernet caddisfly community	y
Lake Stream				
Little Snake Creek			rolledwinged stonefly / small minnow mayfly community	
Martins Creek	warm water community 1			y
Meshoppen Creek	warm water community 1		brushlegged mayfly community / fingernet caddisfly community	y
Meshoppen Creek-W. Branch Meshoppen Creek	warm water community 1		rolledwinged stonefly / small minnow mayfly community	y
Middle Branch Wyalusing Creek	warm water community 1			y
Nine Partners Creek	warm water community 1			
North Branch Wyalusing Creek	warm water community 1			y
Riley Creek			rolledwinged stonefly / small minnow mayfly community	y
Salt Lick Creek	warm water community 1			y
Silver Creek	cool water community 1			y
Snake Creek	warm water community 1		brushlegged mayfly community / fingernet caddisfly community	y
Starrucca Creek	warm water community 1			y
Susquehanna River	river and impoundment community			
Susquehanna River-Chenango River		eastern elliptio community		
Susquehanna River-Denton Creek	river and impoundment community		rolledwinged stonefly / small minnow mayfly community	y
Susquehanna River-Towbridge Creek	warm water community 1		rolledwinged stonefly / small minnow mayfly community	

Trowbridge Creek				
Tunhannock Creek-Nine Partners Creek	warm water community 1			y
Tunkhannock Creek	warm water community 1			
Tunkhannock Creek	warm water community 1	yellow lampmussel community	rolledwinged stonefly / small minnow mayfly community	
Tuscarora Creek	warm water community 1			y
W Branch Lackawanna River	cool water community 2		brushlegged mayfly community / fingernet caddisfly community	
W. Branch Meshoppen Creek	river and impoundment community		rolledwinged stonefly / small minnow mayfly community	
Wappasening Creek	warm water community 1		rolledwinged stonefly / small minnow mayfly community	
Wyalusing Creek-Bennet Creek	warm water community 1			

I. Fish Communities

Community type: <u>Warm Water Community 1</u> - Central stoneroller *(Campostoma anomalum)/* Northern hogsucker *(Hypentelium nigricans)*

Other community members: river chub (*Nocomis micropogon*), longnose dace (*Rhinichthys cataractae*), cutlips minnow (*Exoglossum maxilingua*), mottled sculpin (*Cottus bairdii*), margined madtom (*Noturus insignis*), creek chub (*Semotilus atromaculatus*), rosyface shiner (*Notropis rubellus*), fantail darter (*Etheostoma fabellare*), greenside darter (*Etheostoma blenniodes*)

Species of concern: none

Habitat
The warm water community 1 usually occurs in small to medium size watersheds (mean 128 sq mi) at moderate to relatively high elevation and in streams with less than 1% gradient.

Streams have intermediate alkalinity (average 50 mg/l) and conductivity (average 175 uS/cm) relative to other groups and neutral pH values (average 7.2). Warm water temperatures are also characteristic of this community group. Thermal tolerances of fish in the community group are higher than other communities. Habitat preferences of indicator taxa suggest this community occurs in warm water streams with moderate to high gradients and currents and little silt.

Stream quality rating - Medium

Community rarity- No

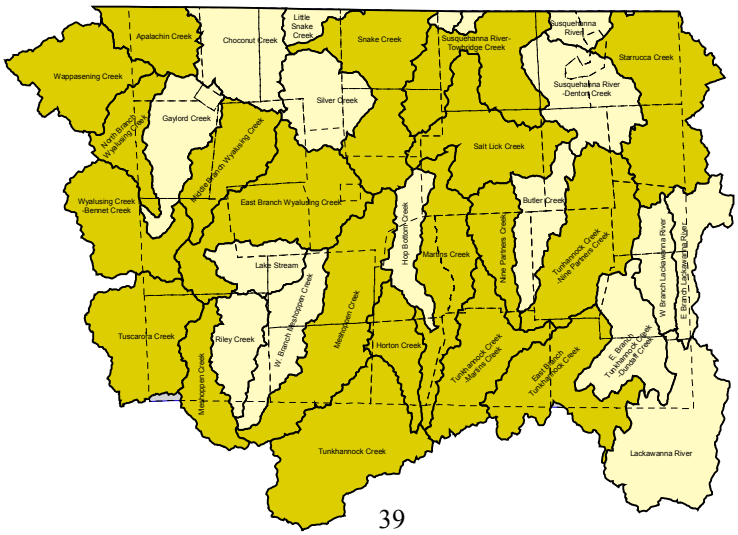
Threats – Water quality and habitat may be influenced by non-point source pollution. Poorly managed agriculture can be a threat to this community. In most cases, where this community occurs, about 1/3rd of the watershed is agriculture. In Susquehanna County, large portions of watersheds are agricultural. Potential nutrient enrichment and excess sedimentation of streams from mismanaged agricultural practices could degrade conditions for this community type.

Conservation recommendations –
The warm water community 1 is the most common community type in the county. It is found in many watersheds including: Apalachin Creek, Snake Creek, Starrucca Creek, Salt Lick Creek, North Branch Wyalusing Creek, Middle Branch Wyalusing Creek, East Branch Wyalusing Creek, Wyalusing Creek-Bennet Creek, Tunkhannock Creek-Nine Partners Creek, Martins Creek, Meshoppen Creek-W Branch Meshoppen Creek, Tunkhannock Creek, East Branch Tunkhannock Creek Tuscarora Creek, Horton Creek, Susquehanna River-Towbridge Creek

This community is a high conservation priority. Warm water streams in good condition are not common. The fish associates of this community type are not especially rare individually; however, the community group occupies habitats that need protection in Pennsylvania.

Since warm water streams mainly occur in valleys downstream of human influences, they are often subject to pollution from non-point sources, such as agriculture and urban runoff. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution.

Distribution in Susquehanna County



Community Members

Central stoneroller

Photo source: www.ohiodnr.com/dnap/ rivfish/

Northern hogsucker

Photo source: www.ohiodnr.com/dnap/ rivfish/

Habitat:

Photo source: PHNP

Photo source: PHNP

Medium-sized streams without many groundwater inputs are typical of warm water streams. Stream sequences of pools (slow-moving habitats), riffles (swift current habitats), and runs (intermediate current habitats) provide a variety of habitats and support warm water fish communities.

Fish Communities (continued…)

Community type: **Warm Water community 2** - Redbreast sunfish *(Lepomis auritus)* and rock bass *(Ambloplites rupestris)*

Other community members: spotfin shiner (*Cyprinella spiloptera*), fallfish (*Semotilus corporalis*), smallmouth bass (*Micropterus dolomieu*), spottail shiner (*Notropis hudsonius*), common shiner (*Luxilus cornutus*), tessellated darter (*Etheostoma olmstedi*), pumpkinseed (*Lepomis gibbosus*), bluntnose minnow (*Pimephales notatus*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), satinfin shiner (*Cyprinella analostana*), swallowtail shiner (*Notropis procne*), yellow bullhead (*Ameiurus natalis*), shield darter (*Percina peltata*), American eel (*Anguilla rostrata*), largemouth bass (*Micropterus salmoides*), common carp (*Cyprinus carpio*)

Less common community members: comely shiner (*Notropis amoenus*), chain pickerel (*Esox niger*), banded darter (*Etheostoma zonale*), brown bullhead (*Ameiurus nebulosus*), redfin pickerel (*Esox americanus*), creek chubsucker (*Erimyzon oblongus*), sea lamprey (*Petromyzon marinus*), rosyside dace (*Clinostomus funduloides*)

Habitat: The warm water community 2 is found in larger streams than the warm water community 1. The typical habitat is in medium-size streams and rivers with mean watershed area of 626 sq mi in areas with moderate elevation and low gradient.

Many community fish are habitat generalists. They tend to prefer pools in warm streams or ponds. Some indicator fish are fairly tolerant of water quality

Typical water chemistry values are moderate alkalinity (average 47mg/l) and conductivity (average 237 uS/cm). pH is neutral and water temperatures are also warm.

Stream quality rating: Medium

Community rarity: No

Threats:
Similar to the other warm water community, non-point source pollution is a threat. About 39% agricultural land cover typically occurs in watersheds where the warm water community 2 occurs.

Many fish in the community were not originally present in the Susquehanna River basin that includes all of Susquehanna County. For instance, rock bass and smallmouth bass have been transplanted into the Susquehanna River basin.

Conservation recommendations:
This community type mainly occurs in North Branch of Creek. It represents the fish community of a small river. This community is downstream of many human settlements and has been altered to some degree from its natural condition. Agricultural fields border the stream in this watershed. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution.

Distribution in Susquehanna County

Community members:

Redbreast sunfish

Photo source: www.ohiodnr.com/

Rock bass

Photo source: www.nj.gov/dep/

Habitat:

Photo source: PHNP

In large streams and rivers with warm waters, this community occurs because the variety of habitats supports a diverse fish community.

Fish Communities (continued…)

Community type: Cool Water Community 1 - slimy sculpin *(Cottus cognatus)*

Other community members: stocked brown trout (*Salmo trutta*), fathead minnow (*Pimephales promelas*), pearl dace (*Margariscus margarita*)

Species of concern: none

Habitat: Small streams with an average watershed area of 54 sq mi are the most common habitats for this community type. Streams often occur in areas of relatively high elevation and gradient.

Water chemistry is similar to the warm water community types with relatively high alkalinity (average 54 mg/l) and conductivity (average 225 uS/cm); pH (average 7.0) values are moderate. Water temperatures are cooler than warm water streams.

Community fish prefer cool, rocky streams that may occur in transitional areas between coldwater streams and warm water ones. This community type may represent streams with put-and-take trout fisheries or cool streams with seasonally warm temperatures.

Stream quality rating - Low

Community rarity - No

Threats: This community occurs downstream of headwaters and are not usually protected from human influences. Stream temperature may be warmer than natural temperatures because protective vegetation on stream banks was removed. Stream habitats may also have been altered where this community is found.

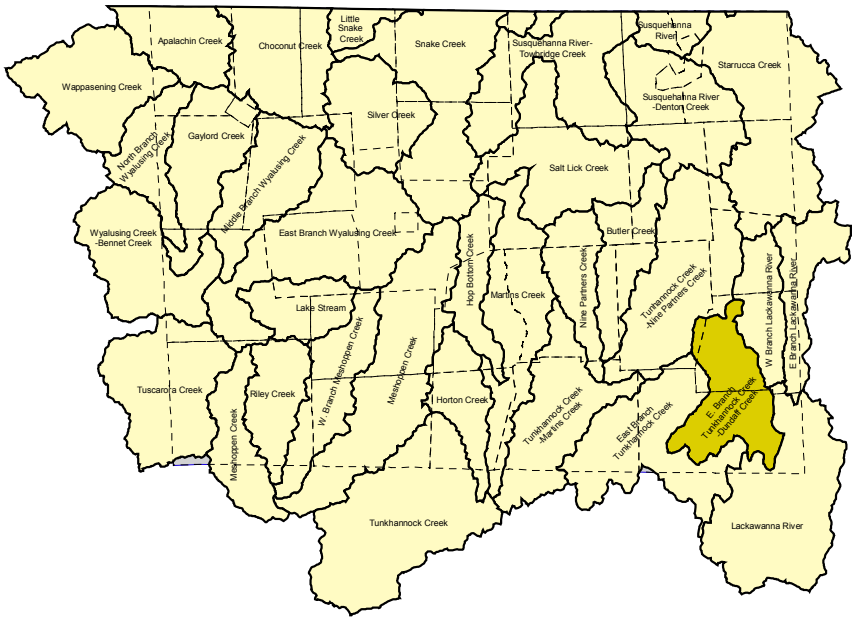
Similar to other valley stream systems, non-point source pollution is the biggest threat. Runoff from agriculture and roads alters water quality.

Conservation recommendations:
This community type occurs in the Silver Creek and Butler Creek watersheds.

Restoration of stream temperature, habitat, and water quality to natural conditions is recommended. Management of storm water runoff and riparian vegetation restoration are critical to improvement of community conditions.

Where stocking of non-native fish is occurring, native fish are displaced. Restoration of native fish is recommended. The habitat for the cool water community 1 represents an important transition between cold headwater streams and warm, larger streams; the habitat is distinct among other habitat types and should be protected and restored.

Distribution in Susquehanna County



Community members:

Slimy sculpin

Photo source: www.nj.gov/dep/

Fathead minnow

Photo source: http://www.cnr.vt.edu/efish/

Habitat:

Photo source: PNHP

Medium-sized streams with moderate to high gradient and rocky substrate are the typical habitats of cool water 1 community.

Fish Communities (continued…)

Community type: <u>Cool stream community 2</u> - blacknose dace *(Rhinichthys atratulus)* and white sucker *(Catostomus commersoni)*

Other common fish: golden shiner (*Notemigonus crysoleucas*)

Habitat: This community type is similar to cool water community 1 since it occurs in small to medium size streams (average watershed area of 46 sq mi) at moderate to relatively high elevation. Streams are faster than warm water streams and are intermediate in temperature between warm and cold streams.

Stream chemistry indicates that alkalinity (average 55.6 mg/l) and conductivity (average 213 uS/cm) are relatively high compared to other community groups. pH is nearly neutral (average 7.2).

Community fish are habitat generalists and generally pollution tolerant. There are few fish species present in the cool water community 2. This community type may represent small cool water communities that are more degraded than cool water 1 communities. Brown trout and brook trout may also be present in some areas.

Stream quality rating-Low

Community rarity- No

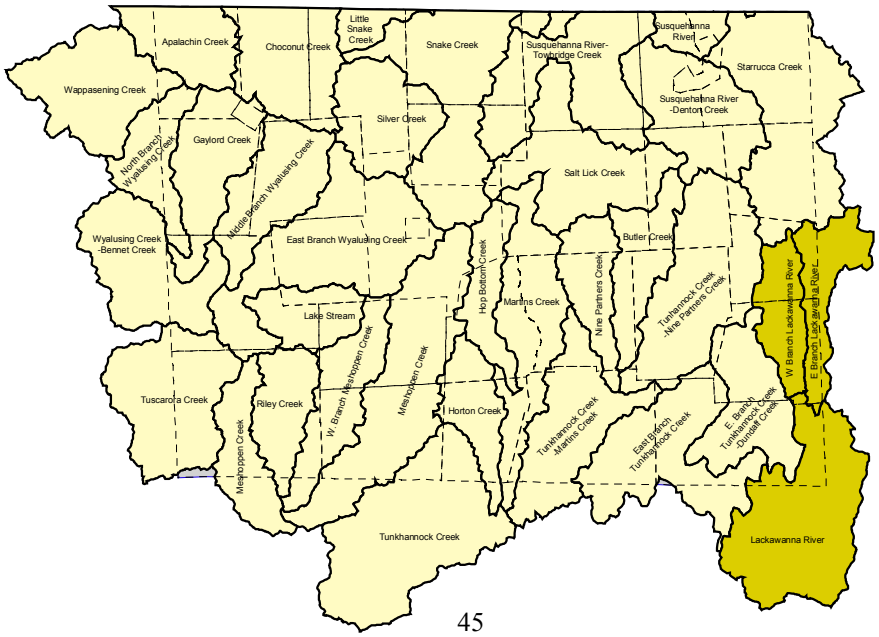
Threats:
Threats to cool water 2 communities are similar to threats to cool water 1 communities, but may be worse in cool water 2 communities. Restoration of stream temperature, habitat, and water quality to natural conditions is recommended. Management of storm water runoff and riparian vegetation restoration are critical to improvement of community conditions.

Dams in the Lackawanna River watersheds fundamentally alter stream habitats and natural flow patterns. Runoff from agricultural fields in the West Branch Lackawanna River and East Branch Lackawanna River is detrimental to water quality and stream habitats. Urban developments in Forest City Borough most likely contribute storm water runoff to local streams.

Conservation recommendations:
This community type occurs only in the West Branch Lackawanna River, East Branch Lackawanna River, Lackawanna River watersheds in the Susquehanna County.

The low community diversity and high pollution tolerance of community members indicates that pollution and habitat alteration have diminished stream quality. Mitigating runoff from agriculture and urban runoff will improve stream conditions. Some coal mining in the Lackawanna River watershed may also be negatively influencing water quality.

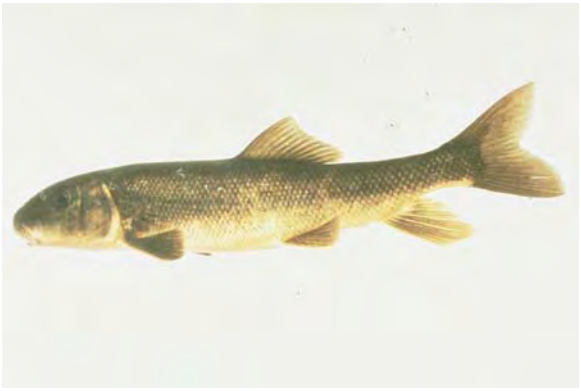
Distribution in Susquehanna County



Community members:

Blacknose dace

Photo source:
http://www.ohiodnr.com/dnap/rivfish/bndace.html



White sucker

Photo source:
www.nj.gov/dep/wmm/ bfbm/fishlist2002.html

Habitat:

Photo source: PNHP

Cool water 2 communities tolerate a variety of habitats in medium-sized streams and small rivers. Habitat-generalist fish tolerate slow and silty streams.

Fish Communities (continued…)

Community type: <u>Coldwater Community</u> - brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*)

Other community members: rainbow trout (*Oncorhynchus mykiss*)

Species of concern: none

Habitat: This headwater stream community occurs in small watersheds (average watershed area of 18 sq mi). Swift streams running off ridges at relatively high elevation at fairly high gradient typify the habitat for this community type. Water temperatures are the coldest among the fish communities.

Streams have low alkalinity (average 27mg/l) and conductivity (average 140 uS/cm); water temperatures are cold. pH is lower than for other community types (average 6.7).

The coldwater community represents headwater streams with brook trout and slightly larger streams with brook trout and brown trout or brown trout only.

Stream quality rating- High

Community rarity- No

Threats- Few threats are present

Conservation recommendations:
East Branch of Tunkhannock Creek- Dundaff Creek watershed has wild brown and brook trout and are characterized as the cold-water fish community.

Local land managers may value this fishery resource. Because cold, headwater streams often occur in terrain unsuitable for human developments, they are not usually subject to the same types of water pollution issues as valley streams.

Trout streams in Pennsylvania have been greatly altered since European settlement and the transplantation of European brown trout and rainbow trout from western North America. Habitats for native brook trout have been restricted by competition with other trout species. Restoration of native trout habitats would help return cold water streams to their natural state.

Distribution in Susquehanna County

Community members:

Brook trout

Photo source:
http://www.cnr.vt.edu/efish/

Brown trout

Photo source:
http://www.cnr.vt.edu/efish/

Habitat:

Photo source: PHNP

Small, high gradient streams with forested watersheds are typical of the cold water community habitat.

Fish Communities (continued…)

Community Type: River and Impoundment Community - walleye *(Stizostedion vitreus)* and yellow perch *(Perca flavescens)*

Other community members: black crappie (*Pomoxis nigromaculatus*) and goldfish (*Carassius auratus*)

Species of concern: None

Habitat:
The river and impoundment community habitat is large streams and rivers (average watershed area of 325 sq mi) that are sometimes impounded by dams. This environment occurs at moderate elevation in streams with low gradients.

Streams are characterized by warm waters (mean temp18.6C) with relatively high conductivity (256 uS/cm) and alkalinity (60 mg/l), compared to other community groups, and slightly alkaline pH (7.4).

Stream quality rating: Medium

Community rarity: No

Threats:
Large streams and rivers, downstream of many human settlements, are subject to many types of pollution. Large rivers receive effluents from industrial, sewage treatment plants, and storm water overflow sources. Non-point source pollution from agricultural and urban runoff also occurs. Dams, such as the Oakland Dam, on the Susquehanna River also fundamentally alter the river habitat and change natural flow patterns.

This community is primarily composed of fish that are not native to the Susquehanna watershed. Walleye, black crappie, and goldfish are all introduced to Susquehanna County. Many game fish, like walleye and yellow perch, are stocked around Pennsylvania.

Conservation recommendations:
In Susquehanna County, the largest river system in the area, the Susquehanna River, is habitat for the river and impoundment community. Second, White Creek a tributary to the Susquehanna River in the southern part of the county is also characterized by this community. The stream is most likely influenced by the nearby Susquehanna River in its fish community.

Mitigating the non-point source pollution from agricultural and urban runoff, effluents from sewage treatment plants, and industrial point sources will improve water quality. Minimizing habitat disturbance from bridge maintenance and other river altering activities will prevent further damage to large rivers.

Distribution in Susquehanna County

Community members:

Walleye

Photo source:
http://www.cnr.vt.edu/efish/

Yellow perch

Photo source:
www.nj.gov/dep/wmm/ bfbm/fishlist2002.html

Habitat:

Photo source: PNHP

Rivers, like the Susquehanna River, and impoundments are the common habitats of this community type.

II. Macroinvertebrate Communities:

Community type: Brushlegged mayfly *(Isonychiidae)* / fingernet caddisfly *(Philopotamidae)*

Other community members: dobsonfly (Corydalidae), Saddlecase maker (Glossosomatidae), watersnipe fly (Athericidae), common burrowers (Ephemeridae), snailcase maker (Helicopsychidae)

Species of concern: none

Habitat:
This community is found in streams with lower elevation and lower gradient than other macroinvertebrate communities. Sandy stream bottoms mixed with larger cobble and boulders are typical. High quality habitats usually occur with this community type; stream organisms are not influenced by stream sedimentation, or channel alteration.

Chemistry components of this habitat are usually typified by moderate alkalinity (average 76 mg/l), high conductivity (average 203 uS/cm), and neutral pH

Stream quality rating- High

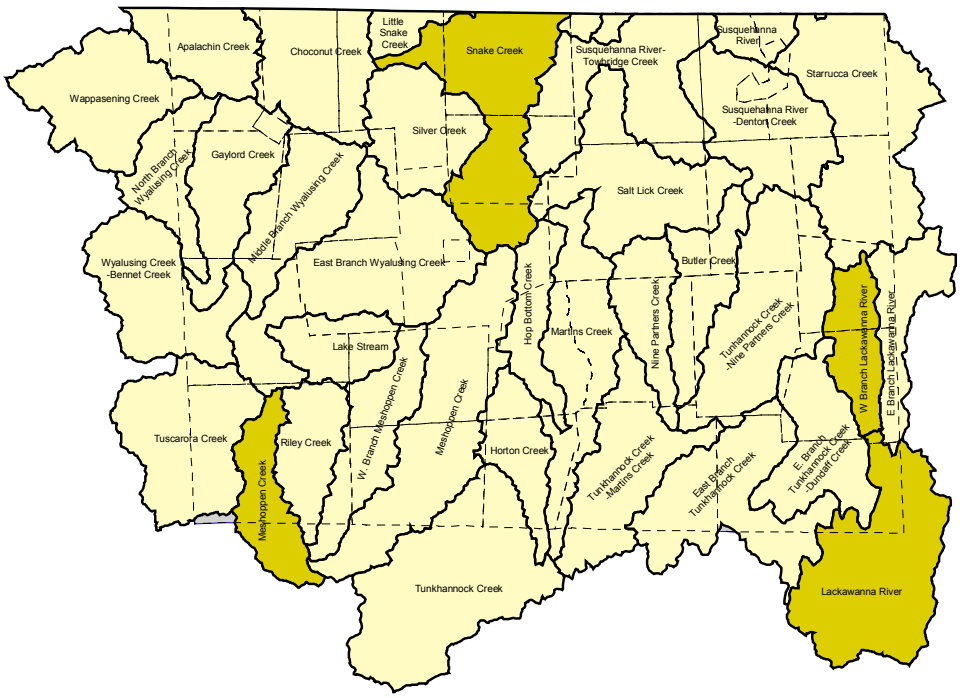
Community rarity- No

Threats
Organisms in this community type are sensitive to organic pollution and habitat degradation. Non-point source pollution from agriculture and urban sources could alter this community.

Conservation recommendations
The brush-legged mayfly and fingernet caddisfly community was identified in Snake Creek, Meshoppen Creek, Lackawanna River and West Branch Lackawanna River watersheds in Susquehanna County.

Because this community type represents a river system where water quality and habitat are relatively intact and because a diverse suite of organisms typically occurs with this community group, watershed with this community type should be a conservation priority within the county. Improperly managed agricultural near the streams and resultant non-point source pollution can affect stream quality. Storm water management, restoration of riparian buffer zones, and exclusion of livestock from streams are some mitigation techniques for non-point source pollution.

Distribution in Susquehanna County



Community members:

Brushlegged mayfly

Photo source:
www.dec.state.ny.us

Fingernet caddisfly

Photo source:
www.dec.state.ny.us

Habitat:

Photo source: PNHP

Typical community habitats are medium-sized streams with diverse stream-bottom habitats and high water quality.

Macroinvertebrate Communities (continued…)

Community type: Rolledwinged stonefly *(Leuctridae)* / Small minnow mayfly *(Baetidae)*

Other community members: crayfish (Cambaridae), trumpetnet caddisfly (Polycentropodidae), darners (Aeshnidae)

Species of concern: None

Habitat:
Occurring in small high gradient streams in high quality habitat, this community represents moderate to high quality streams in the commonwealth. Organisms are sensitive to pollution.

Water chemistry is usually moderate alkalinity (average 51 mg/l), conductivity (average 223 uS/cm) and pH values

Stream quality rating: Medium/high

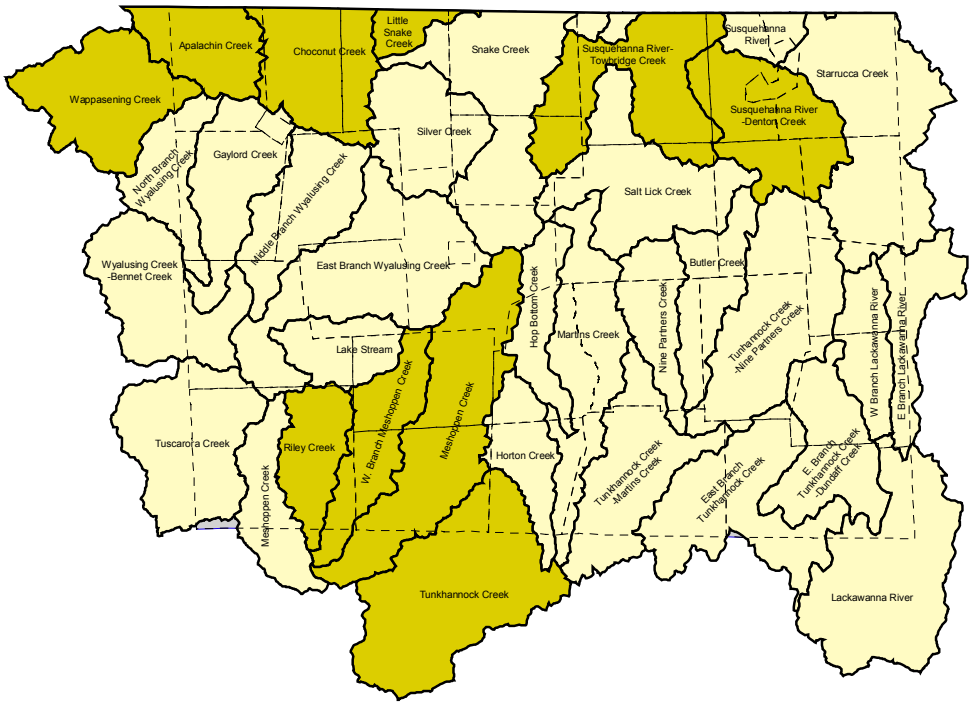
Community rarity: No

Threats:
Excess sediment and nutrients from agricultural runoff can impair stream quality. Runoff from roadways, parking lots and other urban developments is also detrimental to water quality and habitat.

Conservation recommendations:
Several watersheds in Susquehanna County have this community type: Apalachin Creek, Choconut Creek, Little Snake Creek, Susquehanna River-Towbridge Creek (near NY border), Susquehanna River-Denton Creek, Meshoppen Creek - West Branch Meshoppen Creek, Tunkhannock Creek, and Riley Creek.

Managing runoff from agricultural and urban sources, particularly road runoff, would be most beneficial for improving stream quality. Community watersheds appear to have large sections of agriculture along the stream corridor, where non-point source pollution can enter the stream. Storm water management, restoration of riparian buffer zones, and exclusion of livestock from streams are some mitigation techniques for non-point source pollution.

Distribution in Susquehanna County



Community members:

Rolledwinged stonefly

Photo source:
www.dfg.ca.gov

Small minnow mayfly

Photo source:
www.guillaume.doucet.free.fr

Habitat:

Photo source: PHNP

Small, fast-moving streams with rocky habitats are typical of this community type.

III. Mussel Communities

Community type: Yellow lampmussel *(Lampsilis cariosa)*

Other community members: eastern floater (*Pyganodon cataracta*), green floater (*Lasmigona subviridis*), eastern lampmussel (*Lampsilis radiata*), triangle floater (*Alasmidonta undulata*)

Species of concern: Yellow lampmussel (G3G4, S3S4). eastern floater (G3, S2), eastern lampmussel (G5, S1), triangle floater (G4, S3S4)

Habitat:
Large, low elevation rivers in areas that slow-moving and low gradient is the common habitat for this community type. This community type tends to occur in large rivers, like the Susquehanna River and the Lower Tunkhannock Creek watershed.

Stream quality rating: Medium

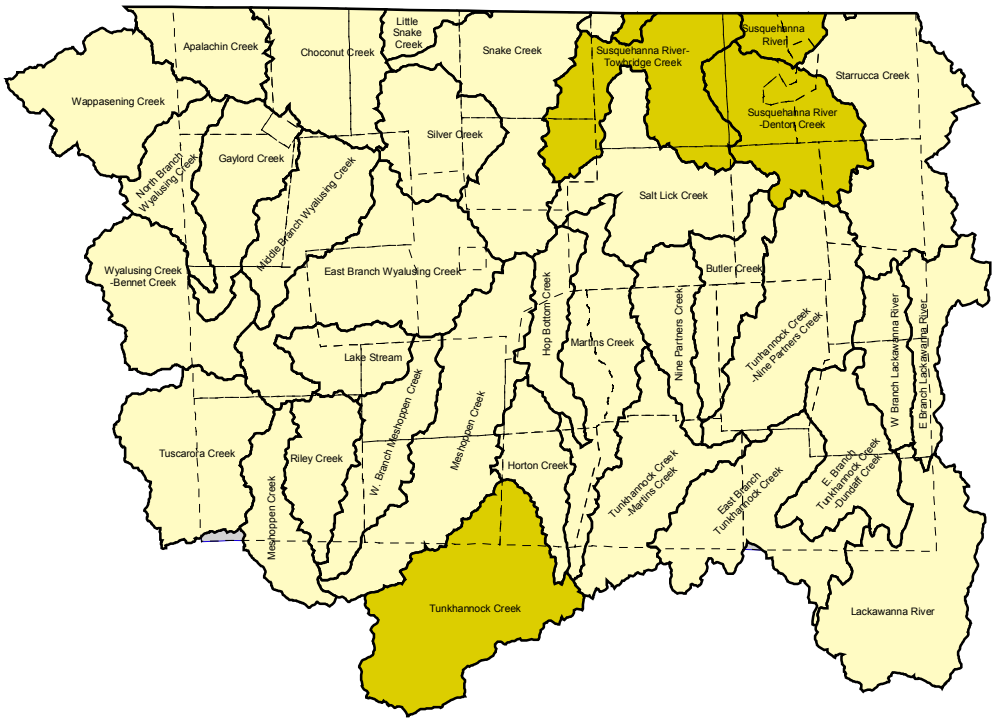
Community rarity: Yes

Threats:
Since this community occurs in large streams and rivers, it often occurs downstream of many potential pollution sources. Non-point source and point source pollutants can threaten this community type. Dams and habitat alteration can also be detrimental to mussel communities.

Conservation recommendations:
Most of the species occurring in the community are species of concern, including the primary species, yellow lampmussel. Mussels, in general, are declining in North America. In the past 100 years, more than 10% of our continent's mussels have become extinct. For mussel species in the United States, nearly 25% have a Federal endangered or threatened status and 75% are listed as endangered, threatened or special concern by individual states (Nedeau et al. 2005).

Mussel communities are generally indicative of habitat types that are rare in the Commonwealth and becoming increasingly rare. Mussel habitat requirements are not well known. Protecting habitats where mussels are currently occurring is a first step to ensuring the long-term mussel resource. Major channel alteration, bridge building, and dams could potentially destroy habitat.

Distribution in Susquehanna County



Community members:

Yellow lampmussel
Photo source: Rich Ring

Habitat:

Photo source: PNHP

Usually found in larger rivers, this community type occurs in a variety of substrate types including sand, silt, cobble, and gravel.

Mussel Communities (continued…)

Community type: Eastern Elliptio *(Elliptio complanata)*

Other community members: rainbow mussel (*Villosa. iris*), brook floater (*Alasmidonta varicosa*), yellow lamp mussel (*Lampsilis cariosa*), and eastern lampmussel (*Lampsilis. radiata*) are not consistent community members, but are often associated with this community.

Species of concern:
rainbow mussel (*Villosa. iris*) (S1 G5), brook floater (*Alasmidonta varicosa*) (S2 G3), yellow lamp mussel (*Lampsilis cariosa*) (S3S4 G3G4), and eastern lampmussel (S1 G5).

Habitat:
The eastern elliptio community is usually found in large streams with moderate elevation. Stream bottom habitats can be variable, but this community requires some sand and silt mixed with larger cobble and gravel.

This community occurred mainly in the Susquehanna River near the New York state border in the Susquehanna River-Chenango River watershed. Water quality in the habitats of this community is typified by moderate alkalinity, and low conductivity.

This community is common throughout Pennsylvania.

Threats:
This community is threatened by non-point source pollution from agriculture and urban development. Alteration of in-stream habitat would also be very detrimental to the eastern elliptio community.

Conservation recommendations:
Although the eastern elliptio is not a rare species in Pennsylvania, some of the associated species that may occur with this community are species of concern. Mussels, in general, are declining in North America. In the past 100 years, more than 10% of our continent's mussels have become extinct. For mussel species in the United States, nearly 25% have a Federal endangered or threatened status and 75% are listed as endangered, threatened or special concern by individual states (Nedeau et al. 2005).

Mussel communities are generally indicative of habitat types that are rare in the commonwealth and becoming increasingly rare. Large streams and rivers in good quality without major habitat alterations are few.

Protection from upstream non-point source pollution from agriculture and urban developments is important for this mussel resource. Management of urban runoff from Great Bend Borough and Route 11 is critical for maintaining water quality in the Susquehanna River.

Mussel habitat requirements are not well known. Protecting habitats where mussels are currently occurring is a first step to ensuring the long-term mussel resource. Protection from major channel alteration, bridge building, and dams are important for maintaining habitat.

Distribution in Susquehanna County

Community members:

Eastern Elliptio Photo source: PNHP

Habitat:

Photo source: PNHP

The Eastern Elliptio Community can occupy diverse habitats from small, slow-moving rivers to larger rivers, like the Susquehanna River.

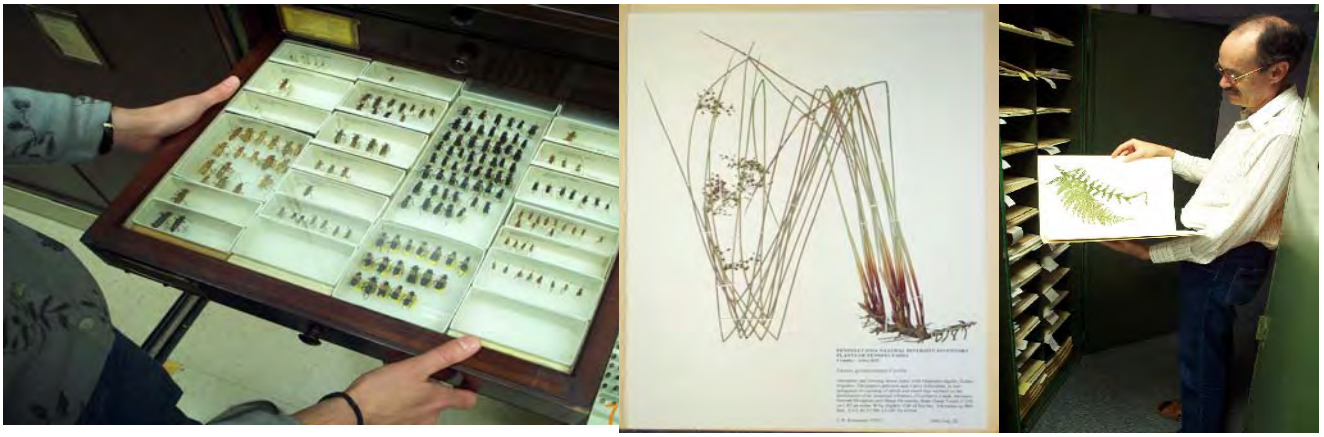
Pennsylvania Natural Heritage Program Data System

In order to conduct an inventory of significant flora, fauna, and natural communities in the county, scientists from Pennsylvania Science Office of The Nature Conservancy first consulted the Pennsylvania Natural Diversity Inventory (PNDI) database. PNDI was established in 1982 as a joint venture between the PA Department of Conservation and Natural Resources (DCNR), The Nature Conservancy (TNC), and the Western Pennsylvania Conservancy (WPC). In its 20 years of operation, the PNDI database has become Pennsylvania's chief storehouse of information on outstanding natural habitat types (natural communities), uncommon plants and animals (species of special concern). Several other noteworthy natural features are also mapped including DEP designated Exceptional Value Streams (Shertzer 1992) and outstanding geologic features (based on recommendations from Geyer and Bolles (1979 and 1987).

PNDI has collected existing data on occurrences of species and communities (elements) of special concern, drawing from publications, herbarium and museum specimens, and the knowledge of expert botanists, zoologists, ecologists, and naturalists. From this foundation, PNDI has focused its efforts on, and conducts systematic inventories for, the best occurrences of the priority species and natural communities.

PNDI has recorded over 15,000-detailed occurrences of species and communities of special concern, largely the result of field surveys. These are stored in computer and manual files and denoted on topographic maps. Additional data are stored in extensive manual and digital files set up for over 200 natural community types, 1400 animals, and 3500 plants. These files are organized by each of Pennsylvania's 881 7½ USGS topographic quadrangle maps using a geographic information system (GIS).

The PA Science Office has used this systematic inventory approach to identify the areas of highest natural integrity in Susquehanna County. The natural community and sensitive species data are the basis for judging the biological values of sites within the County. Protecting the sites with the best occurrences of the County's natural communities, and good populations of sensitive plant and animal species can help to insure that a full range of biological diversity in Susquehanna County is preserved for the future.



The Pennsylvania Natural Diversity Inventory database has collected existing data on occurrences of species and communities (elements) of special concern, drawing from publications, herbarium and museum specimens, and the knowledge of expert botanists, zoologists, ecologists, and naturalists.

Natural Areas Inventory Methods

Methods used in the Susquehanna County Natural Areas Inventory followed Pennsylvania Natural Heritage Program (PNHP) procedures, and those developed in Illinois (White 1978) and Indiana. The inventory proceeds in three stages: 1) information is gathered from the PNDI database files, local experts, and map and air photo interpretation; 2) ground surveys are preceded by one low-altitude flight over the county; and 3) data are analyzed and mapped.

Information Gathering

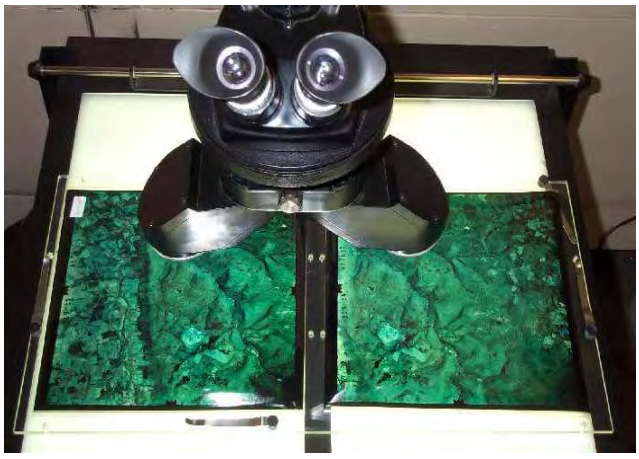
A list of natural features found in the county was prepared from the PNDI database and supplemented with information volunteered by local individuals and organizations familiar with Susquehanna County. In April of 2002 a public meeting was held and recommended Natural Area Survey Forms (Appendix I) were distributed to facilitate public input. PNHP staff solicited information about potential natural communities, plant species of special concern and important wildlife breeding areas from knowledgeable individuals and local conservation groups. A number of potential natural areas were identified by audience members and scheduled for field surveys.

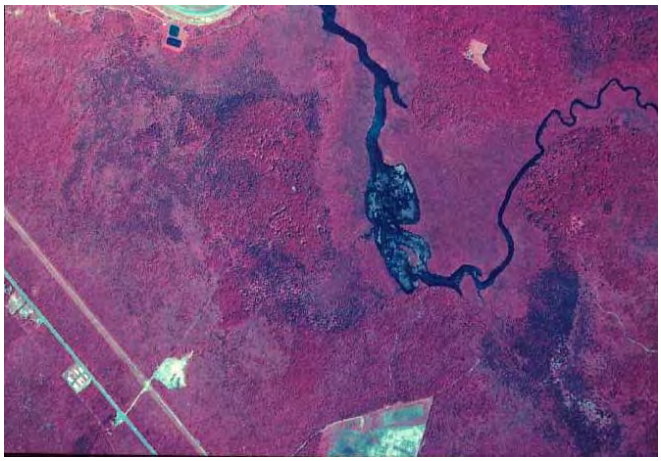
Map and Air Photo Interpretation

PSO ecologists familiarized themselves with the air photo characteristics of high quality natural communities already documented (Appendix II). Additional data from vegetation maps, soil survey maps, field survey records and other sources were consulted to gain familiarity with Susquehanna County's natural systems. This information, along with references on physiography, geology, and soils, was used to interpret photos and designate probable vegetation types and potential locations for exemplary communities and rare species. In many instances, vegetation was classified at an ecosystem level, and it was therefore critical that an ecologist or person with similar training interprets the maps and aerial photos.

Work progressed systematically within the area encompassed by each USGS topographic map. The natural area potential of all parcels of land was assessed using aerial photographs. Areas continuing into adjacent counties were examined in their entirety. Topographic maps used during field surveys were marked to indicate locations and types of potential natural areas based on characteristics observed on the photos. For example, an uneven canopy with tall canopy trees could indicate an older forest; a forest opening, combined with information from geology and soils maps, could indicate a seepage swamp community with potential for several rare plant species. Baseline information on sites appearing to have good quality communities or potential for rare species was compiled to help prioritize fieldwork.

After an initial round of photo interpretation, field surveys were conducted to evaluate the potential natural areas. Locations with minimally disturbed natural communities or with species of special concern were outlined on topographic quadrangle maps. The photo signatures (characteristic patterns, texture, tone of vegetation, and other features on the photos) of these sites were





then used as a guide for continued photo interpretation and future field surveys. Photo signatures with poor quality sites led to the elimination of further fieldwork on other sites with similar signatures.

Field Work

Experienced PSO biologists and contractors conducted numerous field surveys throughout Susquehanna County during 2004 and 2005. Biologists evaluated the degree of naturalness of habitats (including assessment of percent of native vs. non-native plant species, degree of human disturbance, age of trees, etc.) and searched for plant and animal species of special concern. Workers also categorized the vegetation of each potential natural area visited. An evaluation of quality was made for each potential natural community element, care being taken to give reasons for the quality rank. Boundaries of the community types were redrawn, if needed, based on new field information. Community information recorded included the dominant, common, and other species, as well as disturbances to the community. Field forms were completed for all occurrences of plant and animal species of special concern, and natural communities (see sample Field Survey Form, Appendix III), the quality of each population or community was assessed, and locations were marked on USGS topographic quadrangle maps.

In April of 2005, one low altitude reconnaissance flight was flown over the county to provide a more accurate overview of the current condition and extent of known natural areas and to assess the potential of any additional areas.

Data Analysis

To organize the natural features data and set conservation priorities, each natural community or species (element) is ranked using factors of rarity and threat on a state-wide (state element ranking) and range-wide (global element ranking) basis (see Appendix IV). Each location of a species (an element occurrence) is ranked according to naturalness, its potential for future survival or recovery, its extent or population size, and any threats to it. An explanation of the five element occurrence quality ranks is given in Appendix V. The element-ranking and element occurrence-ranking systems help PSO personnel to simultaneously gauge the singular importance of each occurrence of, for example, a Hemlock Palustrine Forest Natural Community or bog rosemary occurrence in Susquehanna County, as well as the statewide or world-wide importance of these natural features. Obviously, sites with a greater number of highly ranked elements merit more immediate attention than sites with a smaller number of lower ranked elements.

Field data for natural communities of C-rank or better, and for all plant and animal species of concern found were combined with existing data and summarized on PNHP Element Occurrence Records for mapping and computerization. Mapped locations of natural features, including approximate watershed or subwatershed boundaries, were then created and added electronically to PNHP's Geographical Information System (GIS) layer.

Information on the needs of the rare species in this report has come from a variety of sources, including field guides and research publications. For reptiles and amphibians, the major sources are Hulse et al. (2001) and DeGraaf and Rudis (1981); for birds, Brauning (1992); for moths, Covell (1984); for butterflies, Opler and Krizek (1984) and Opler and Malikul (1992); Schweitzer (1981) provided much of the information on rare moth and butterfly species in Pennsylvania. A list of Plant and Animals of Special Concern in Susquehanna County is provided in Appendix VI.

Landscape Analysis

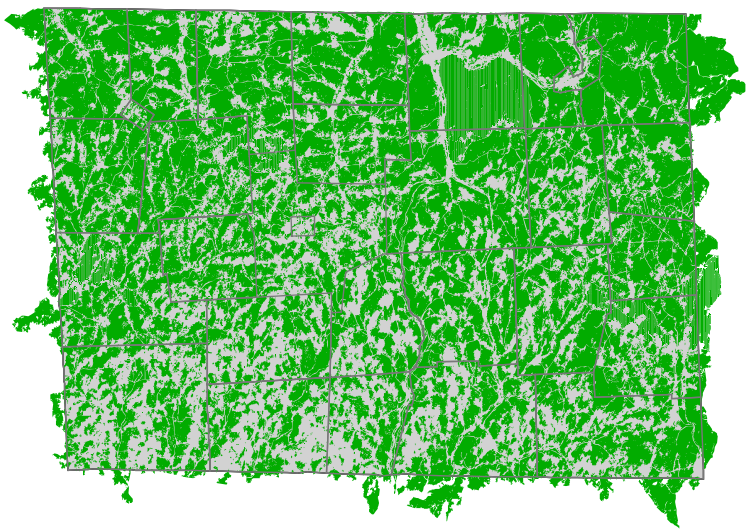
Background: Fragmentation of the landscape by roads, utility lines, and other human disturbances can impact the surrounding landscape significantly. A road or utility line cut through a forested block cleaves the large block into two smaller blocks and significantly increases the amount of edge habitat within the forest. When a forest with a closed canopy is disturbed by road building activities, the newly disturbed soil and open canopy can be beneficial for many species, but tend to favor the establishment of invasive species of plants and animals. Many of these will out-compete and displace native species in this disturbed habitat. These smaller forest fragments will have significantly more edge habitat and less forest interior than the original forest block. Furthermore, fragmentation of large forest blocks decreases the ability of many species to migrate across manmade barriers such as roads. Migration corridors, once severed, isolate populations of species one from another, limit the gene flow between populations and create islands of suitable habitat surrounded by human activity. Much of the native biological diversity of an area can be preserved by avoiding further fragmentation of these large forested areas.

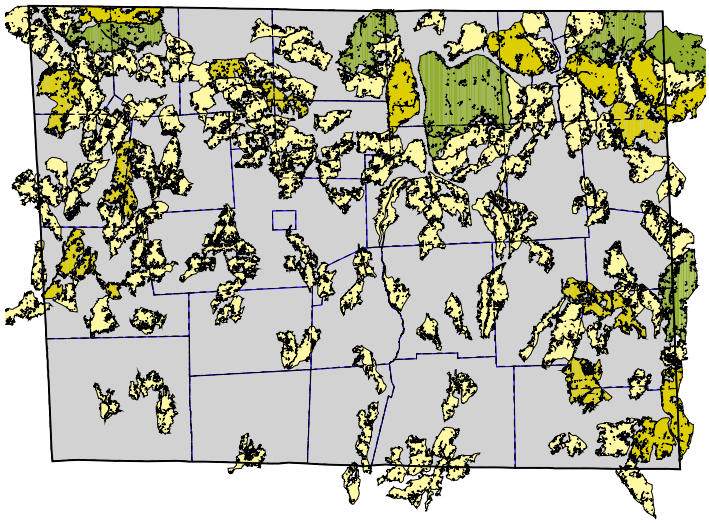
The larger forested blocks in the County (those of at least one mile in area ~ 640 acres) have been highlighted in an effort to draw attention to the significance of large forested blocks within the County. Besides being habitat suitable for many native species, large unfragmented forest blocks in close proximity to each other become natural corridors for species movement within and through the county. In many cases, by highlighting the larger forested blocks, the most natural landscape corridors become evident.

GIS Methodology: Creating NAI Forest Block Layer

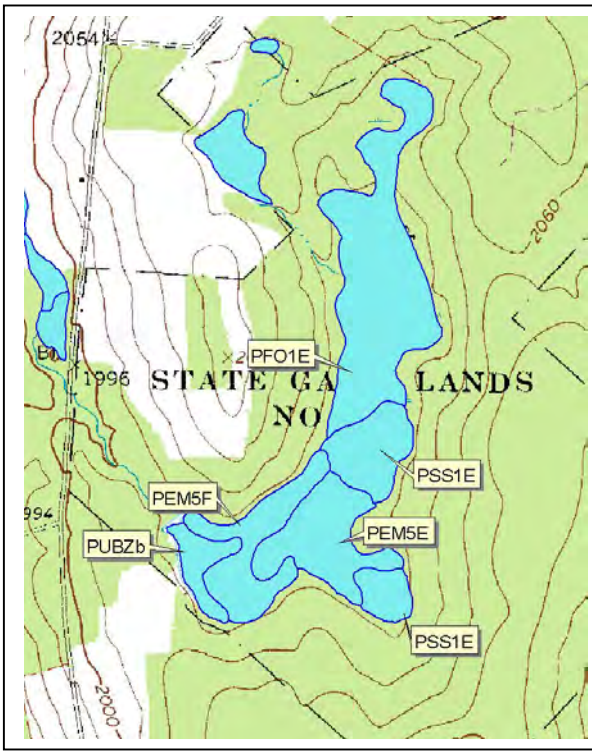
The Pennsylvania portion of the National Land Cover Dataset (NLCD) was created as part of land cover mapping activities for Federal Region III that includes the states of Maryland, Delaware, Pennsylvania, Virginia, West Virginia, and the District of Columbia. The NLCD classification contains 21 different land cover categories with a spatial resolution of 30 meters. The NLCD was produced as a cooperative effort between the U.S. Geological Survey (USGS) and the U.S. Environmental Protection Agency (US EPA) to produce a consistent, land cover data layer for the conterminous U.S. using early 1990s Landsat thematic mapper (TM) data. The analysis and interpretation of the satellite imagery was conducted using very large, sometimes multi-state image mosaics (i.e. up to 18 Landsat scenes). Using a relatively small number of aerial photographs for 'ground truth', the thematic interpretations were necessarily conducted from a spatially-broad perspective. **This evaluation must be made remembering that the NLCD represents conditions in the early 1990s** (The Nature Conservancy 1999).

Deciduous, evergreen and mixed forest land cover types were grouped to provide a single "forested" cover type. This forest block layer was overlain by the Penn DOT road layer to identify forest blocks fragmented by roads. The Penn DOT right-of-way (ROW) distance was applied as a buffer to roads: Interstates have a 500-foot ROW, PA and US designated roads have a 150-foot ROW, local roads have a 100-foot ROW. Forest blocks with an area of greater than one square mile were selected from the forest land cover type. This process highlights interior forest blocks greater than one square mile in area as presented below.





At first glance, most of Susquehanna County appears forested (left). Unfortunately much of the county's forested areas are in small fragmented blocks with a high edge to interior ratio. When forest blocks of at least one square mile are selected from the county's forested areas, the most important forest blocks become more apparent (right). These large forested blocks are critical habitat for plants and animals that are dependent of forest interior conditions such as many migrating bird species, fishers, bobcats, Northern Goshawks and Barred Owls. These forest blocks and their adjacent streams should be considered the backbone of wildlife habitat in the county. Conservation efforts in the county should concentrate on maintaining these large forest blocks by avoiding further fragmentation with additional roads, development and utility rights-of-way.



Wetlands are frequently a combination of several types of natural communities. National Wetland Inventory (NWI) maps provide distinctions among these types. The lines that occur within wetlands on the township maps in this report represent these distinctions. Tinglepaugh Swamp, in State Game Lands #236 is represented in the aerial photo and the topographic map above. Distinct zones of open water and types of vegetation are clearly visible in the aerial photo and roughly correspond to the lines on the topographic map. This helps illustrate the complex diversity of habitats found in many wetlands. For a definition of wetland codes visit the National Wetland Inventory web site at: http://wetlandsfws.er.usgs.gov/tips.html

Riparian Buffer Recommendations:

Riparian areas are lands directly adjacent to streams, creeks and rivers. Land adjacent to waterways and wetlands has an immediate influence on the quality of the water and the habitat it supports. An undisturbed (no-cut) riparian buffer of 100 meters is recommended adjacent to all streams. The riparian buffers recommended in this report also include wetlands over one acre in size, while artificially created farm ponds have been excluded from this riparian buffer.

The literature varies with regard to buffer distances. From a strictly water quality standpoint, wetland buffers of 35-100 feet are thought to be sufficient for water quality maintenance. However, many of these buffer recommendations do not take wildlife habitat into account. Unfortunately, many states still refer to older literature with regard to wetland buffers and many of these studies are now considered to be rather obsolete. Newer scientific techniques have allowed researchers to conduct better studies with regard to habitat buffers. For example, wetland buffers of 15-30 meters were once thought to be sufficient to protect vernal pool amphibians. A series of papers from Conservation Biology (Semlitsch and Brodie 2003 - Buffer Zones for Wetlands and Riparian Habitats) conclude that buffers of this size are inadequate to protect terrestrial habitats for amphibians and reptiles. Some bird species require forested buffers to be closer to 500 meters!

PNHP recommends minimum buffers of 100 meters to maintain the water quality of the wetland as well as to support many of the species of wildlife found in these sites. These buffers were not created for any one particular species but are thought to overlap the habitats used by both common and rare species found at these sites. Certainly, expanding these buffers will still provide water quality protection while increasing habitat for species that require larger blocks of contiguous forest, such as the fisher and Northern Goshawk. It is our scientific judgment that a minimum buffer of 100 meters should be implemented around the wetland and riparian areas identified in the report to continue to support the species, both common and rare found at these locations.

The Township maps graphically symbolize these recommended riparian buffers in a green shade. Where these buffers coincide with large forested blocks (yellow, orange or brown) the riparian buffer is a priority for conservation. Where the buffers are outside of large forested blocks (gray areas) these are riparian buffers that should be considered priorities for restoration.

Riparian buffers through large forest blocks should be considered a priority for conservation (left)

Riparian buffer through non-forested areas should be considered a priority for restoration (below).

CONSERVATION RECOMMENDATIONS

Susquehanna County has a number of groups pursuing the protection of natural areas within the county. The following are general recommendations for protection of natural areas within a county. Approaches to protecting a natural area are wide-ranging and factors such as land ownership, time constraints, and tools/resources available should be considered when prioritizing protection of these sites. Prioritization works best within a planning situation, however, opportunities may arise that do not conform to a plan and the decision on how to manage or protect a natural heritage area may be made on a site-by-site basis. Keep in mind that personnel in the PNHP program or staff from state natural resource agencies are available to discuss more specific options as needed.

1. Consider conservation initiatives for natural areas on private land.

- *Conservation easements* protect land while leaving it in private ownership. A conservation easement is a legal agreement between a landowner and a conservation or government agency that permanently limits a property's use in order to protect its conservation values. It can be tailored to the needs of both landowner and conservation organization. Tax incentives apply to conservation easements.
- *Leases, management agreements, and mutual covenants* also allow the landowner to retain ownership and ensure permanent protection of land, though in a much more limited way. There are no tax deductions for these conservation methods. A lease to a land trust or government agency can protect land temporarily and ensure that its conservation values will be maintained. This can be a first step to help a landowner decide if they want to pursue more permanent protection methods. Management agreements require landowner and land trust to work together to develop a plan for managing resources such as plant or animal habitat, or protecting a watershed. Mutual covenants can be appropriate where land protection is important to several landowners but not of sufficient benefit to the general public to warrant a conservation easement.
- *Land acquisition* can be at fair market value, as a last resort by conservation organization, or as a bargain sale in which a sale is negotiated for a purchase price below fair market value with tax benefits that reduce or eliminate the disparity. The NAI will help to pinpoint areas that may be excellent locations for new county or township parks. Sites that can serve more than one purpose such as wildlife habitat, flood and sediment control, water supply, recreation, and environmental education would be particularly ideal. Private lands adjacent to public should be examined for acquisition when a priority site is present on either property and there is a need of additional land to complete protection of the associated natural features.
- *Fee simple acquisition* gives landowner maximum control over the use and management of the property and its resources. This conservation initiative is appropriate when the property's resources are highly sensitive and protection cannot be guaranteed using other conservation approaches.
- *Local zoning ordinances* are one of the best-known regulatory tools available to municipalities. Examples of zoning ordinances a municipality can adopt include: overlay districts where the boundary is tied to a specific resource or interest such as riverfront protection and floodplains, and zoning to protect stream corridors and other drainage areas using buffer zones.

2. Prepare management plans that address species of special concern and natural communities.

Many of the already-protected natural areas are in need of additional management recommendations to ensure the continued existence of the associated natural elements. We hope that managers will incorporate specific recommendations into existing plans or prepare new plans. These may include: removal of exotic plant species; leaving the area alone to mature and recover from previous disturbance; creating natural areas within existing parks; limiting land-use practices such as mineral extraction, residential or industrial development, agriculture and certain forestry practices.

Existing parks and conservation lands provide important habitat for plants and animals at both the county level and on a regional scale. For example, these lands may serve as nesting or wintering areas for birds or as stopover areas during migration. Management plans for these areas should emphasize a reduction in activities that fragment habitat. Adjoining landowners should be educated about the importance of their land as it relates to species of special concern and their habitat needs and agreements should be worked out to minimize encroachments that may threaten native flora and fauna.

3. Protect bodies of water.

Protection of reservoirs, wetlands, rivers, and creeks is vital; especially those that protect biodiversity, supply drinking water, and are attractive recreational resources. Many sites that include rare species, unique natural communities or locally significant habitats are associated with water. Protection of high quality watersheds is the only way to ensure the viability of natural habitats and water quality. Land managers and township officials should scrutinize development proposals for their impact on entire watersheds not just the immediate project area. Cooperative efforts in land use planning among municipal, county, state, and federal agencies, developers, and residents can lessen the impact of development on watersheds.

4. Provide for buffers around natural areas.

Development plans should provide for natural buffers between disturbances and natural areas, be it a barrens community, wetland, water body, or forest. Disturbances may include construction of new roads and utility corridors, non-conservation timber harvesting, and disruption of large pieces of land. County and township officials can encourage landowners to maintain vegetated buffer zones within riparian zones. Vegetated buffers (preferably of PA-native plant species) help reduce erosion and sedimentation and shade/cool the water. This benefits aquatic animal life, provides habitat for other wildlife species, and creates a diversity of habitats along the creek or stream.

Watersheds or subwatersheds where natural communities and species of special concern occur (outlined on the Township maps in this report) should be viewed as areas of sensitivity, although all portions of the watershed may not be zones of potential impact. As an example, conserving natural areas around municipal water supply watersheds provides an additional protective buffer around the water supply, habitat for wildlife, and may also provide low-impact recreation opportunities.

5. Reduce fragmentation of surrounding landscape.

Residents and township officials should encourage development in sites that have already seen past disturbances. Care should be taken to ensure that protected natural areas do not become "islands" surrounded by development. In these situations, the site is effectively isolated and its value for wildlife is reduced. Careful planning can maintain natural environments and the plants and animals associated with them. A balance between growth and the conservation of natural and scenic resources can be achieved by guiding development away from the most environmentally sensitive areas.

The reclamation of previously disturbed areas, or brownfields development, for commercial and industrial projects presents one way to encourage economic growth while allowing ecologically sensitive areas to remain undisturbed. Cluster development could be used to allow the same amount of development on much less land and leave much of the remaining land intact for wildlife and native plants. By compressing development into already disturbed areas with existing infrastructure (villages, roads, existing ROW's), large pieces of the landscape can be maintained intact. If possible, networks or corridors of woodlands or greenspace should be preserved linking sensitive natural areas to each other.

6. Encourage the formation of grassroots organizations.

County and municipal governments can do much of the work necessary to plan for the protection and management of natural areas identified in this report. However, grassroots organizations are needed to assist with obtaining funding, identifying landowners who wish to protect their land, providing information about easements, land acquisition, and management and stewardship of protected sites. Increasingly, local watershed organizations and land trusts are taking proactive steps to accomplish conservation at the local level. When activities threaten to impact ecological features, the responsible agency should be contacted. If no agency exists, private groups such as conservancies, land trusts and watershed associations should be sought for ecological consultation and specific protection recommendations.

7. Manage for invasive species.

Invasive species threaten native diversity by dominating habitat used by native species and disrupting the integrity of the ecosystems they occupy. Management for invasives depends upon the extent of establishment of the species. Small infestations may be easily controlled or eliminated but more well established populations might present difficult management challenges.

Each year biologists representing various taxonomic groups of the Pennsylvania Biological Survey meet to discuss and rank the most important species for the protection of biodiversity in Pennsylvania. The various Biological Technical Committees include the Vascular Plant Technical Committee, the Herpetological Technical Committee and the Ornithological Technical Committee. These meetings consist of a review and ranking of species of concern within the state, in terms of the rarity and quality of the species or habitats of concern, potential threats, and protection needs. The results of these meetings provide a baseline for evaluating the statewide significance of the species recognized in the Natural Areas Inventory. The list of sites for Susquehanna County was then evaluated by the Pennsylvania Science Office of The Nature Conservancy and ranked in order of importance for conservation of biodiversity at a statewide level based on the relative importance of the species found there. Rankings are also based on the ecological integrity of the site.

Site Ranking

The Pennsylvania Natural Heritage Program considers several criteria when ranking NAI sites to ensure that all sites, regardless of ecological differences, are evaluated systematically. Each criterion is considered independently and then all are examined collectively to ensure that no one criterion receives more emphasis than another. First, the commonness/rareness of the species at a site, defined by the global and state ranks (G & S ranks Appendix IV), is considered in the site ranking process. Those sites which include rarer species with lower ranks (i.e. G3 or S1) are given precedence over sites with more common, higher ranked species (i.e. G5 or S3). Next, the number of different species occurring at a site is also considered in the ranking process. Sites with multiple tracked species are considered to be higher conservation priorities than sites with fewer tracked species. The ecological characteristics of the species at each site are also considered in the ranking process. For example, species that have highly specialized habitat requirements and are not known to readily disperse during periods of disturbance are under greater ecological pressure than species that have more general habitat requirements and have a greater capacity for dispersion. Finally, the site ranking process examines the landscape context of each site. For example, a site that is entirely isolated due to fragmentation, with little chance of restoration of connectedness, is a lower conservation priority than a site which remains connected to other suitable patches of habitat. Site connectedness is critical because the potential for connected populations to remain viable is far greater than small isolated populations. By considering these criteria, the conservation priorities within Tioga County are highlighted to promote appropriate use of conservation dollars and efforts.

Priorities for Protection

The Natural Areas Inventory recognizes sites at two primary levels of significance for the protection of biological diversity: 1) sites of statewide importance and 2) sites of local significance.

Table 2, presented in the Results section, prioritizes sites with natural communities and species of concern documented in Susquehanna County. These sites are displayed in **UPPER CASE LETTERS** throughout the report. This table ranks sites from the most important and threatened to the least, with 1 representing the highest priority sites and 5 representing the lowest priority sites for the conservation of biodiversity in the county. Ranks are based on rarity, quality, and threats or management needs of the elements at the site. Sites in this category that are ranked 1 or 2 may contain some of the best natural areas in the state. Table 2 lists the site name, local jurisdiction, and pertinent information about the site. A more detailed description for each site is included in the text for each Township in which it occurs.

"Locally Significant" sites are indicated in **Title Case Letters** throughout the document, and are briefly discussed in the text accompanying each map. These are sites at which species of special concern or high-quality natural communities could not be documented during the survey period. These areas may not be exemplary at the state level, but may be important at the county level. Examples would include relatively intact forested areas, large wetlands, and other areas significant for maintaining local biodiversity. These secondary sites are arranged in Table 3 in the Results section. They have been given qualitative ranks (high, medium, or low) according to size, level of disturbance, proximity to other open-space lands, and potential for sustaining a diversity of plant and animal life. These secondary-site ranks must be viewed as very approximate.

RESULTS

Each of the primary sites identified in this report has associated with it areas described as **Core Habitat** and **Supporting Landscape**. Core Habitat areas are intended to identify the essential habitat of the species of concern or natural community that can absorb very little activity or disturbance without substantial impact to the natural features. The Supporting Landscape identifies areas surrounding or adjacent to core habitat that are not considered the primary habitat of the species of concern or natural community, but may serve as secondary habitat. These areas also provide support by maintaining vital ecological processes as well as isolation from potential environmental degradation. Supporting Landscape areas may be able to accommodate some types of activities without detriment to natural resources of concern. Each should be considered on a site by site and species by species basis.

Exceptional Natural Feature

Different regions of the state have characteristic landforms that contain the regions' most biologically interesting habitats. Southeastern PA has tidal estuaries and serpentine barrens, central PA has extensive cave systems and vernal pools, and north-central PA has old growth forests. The glaciated portions of northwest and northeastern PA are somewhat similar in that they both have extensive wetland complexes formed as the result of glacial activity. These wetlands include glacial lakes and the loosely termed "Acidic Glacial Peatland Complex". The peatland complex includes kettlehole bogs and other peat-forming wetlands, which contain many characteristic plant species adapted to the highly acidic conditions found in these habitats. Though often much more abundant in more northern climates, many of these species are very near the southern limit of their range in Susquehanna County. The most significant natural feature of Susquehanna County is the numerous peat-forming wetlands and glacial lakes found throughout the county. Most of the top ranked sites in the county are peat-forming wetlands. Steps should be taken to preserve the best remaining examples of peat-forming wetlands in the county for the special repositories of biological diversity that they are. There is also potential for restoration of those wetlands that have undergone some past disturbances.

Top Priority Natural Areas in Susquehanna County

BALL LAKE – (Ararat Township)

The bog vegetation at this wetland **includes seven plant species of concern**. The relatively undisturbed setting of this bog and the many species of concern documented at the site suggests that this natural community is of high importance for the preservation of biological diversity within the county. Beaver dam-building activity and runoff from a nearby local road may impact the wetland. Damming or draining the wetland would severely impact this important natural community. Remove beaver dams as they are formed to prevent the wetland from becoming flooded. It may be necessary to trap beavers if they persist. A 100 meter undisturbed forested buffer should be established around the wetland. Future development activities within the immediate watershed should be assessed for their impact on this and the other high-quality wetlands nearby. Consider conservation easements on the properties surrounding this bog habitat for future protection of this interesting and fragile ecosystem.

HILLSDALE BOG – (Lathrop Township)

This wetland is relatively small, but it represents one of the few unmodified bogs in the county. The bog itself is composed of several distinct natural communities in concentric zones around the open water center. These include a **Leatherleaf-bog rosemary Peatland Natural Community** and a **Hemlock-mixed hardwood Palustrine Forest Natural Community. Four plant species of concern** were also documented at this location. Preserve the current wetland hydrology of this bog habitat by avoiding dam construction. Preserve the wide, undisturbed forested buffer surrounding the wetland. Avoid fragmenting this important habitat with additional roads or

utility rights-of-way. Monitor the wetland for beaver activity and remove beaver dams as they appear. As fewer and fewer good examples of unmodified classic bog habitats remain in Pennsylvania, those that are left should be cherished for the unique and fragile environmental gems that they are. Property owners adjacent to this wetland should consider applying for tax-reducing conservation easements for the future protection of this unique natural habitat.

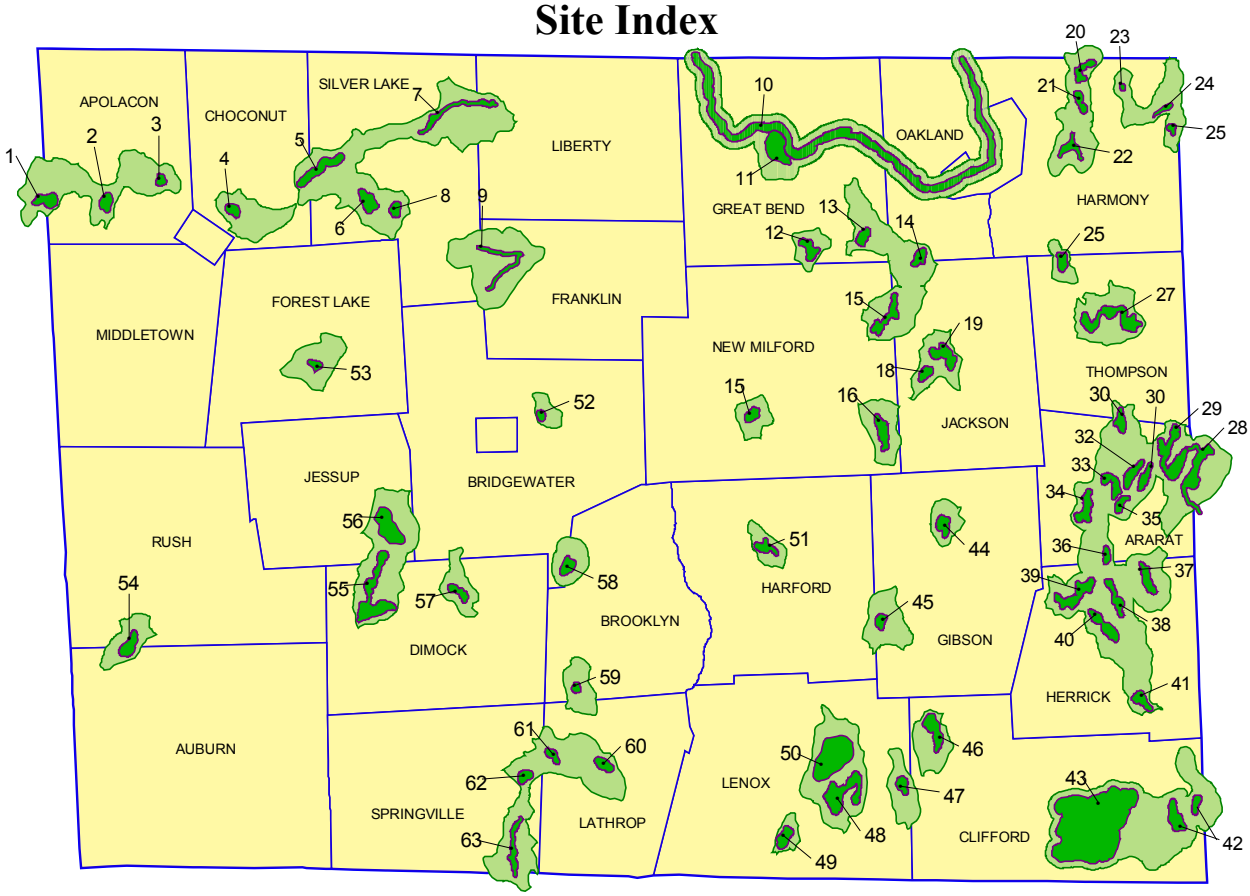
ROBINSON LAKE - (Lenox Township)

This site includes Robinson Lake, Tamarack Swamp and Harding Pond, which are all bogs of glacial origin. Although it's just yards from Interstate-81, Robinson Lake exhibits a remarkably unspoiled habitat. The bog habitat supports **five plant and one animal species of concern** and is itself an uncommon type of natural community in Pennsylvania, **a Black spruce –tamarack Palustrine Wetland.** Evaluate the drainage from I-81 and direct it away from the Robinson Lake wetland. Monitor for beaver activity. Beaver dams should be removed as they appear. It may be necessary to trap and remove beavers if they persist in damming these wetlands. Preserve the remaining forested buffers around these wetlands and replant with native species of trees and shrubs where forested buffers are lacking. Additional biological surveys of these wetlands are encouraged. Property owners may want to consider tax-reducing conservation easements on parcels surrounding these wetlands.

ROMOBE LAKE – (Ararat Township)

This wetland occurs in a relatively undisturbed setting, and supports a good diversity of characteristic bog vegetation including **five plant species of concern and two invertebrate animal species of concern.** The floating islands are dominated by a **Leatherleaf-bog rosemary Peatland Natural Community**. Reduction of wetland quality by changes in hydrology (permanent draining or flooding), or degradation of water quality should be avoided. A 100 meter undisturbed forested buffer around the wetland would help protect the wetland from negative external influences such as non-point sources of pollution and the spread of invasive species of plants. Future development activities within the immediate watershed should be assessed for their impact on this and nearby high-quality wetlands. Consider conservation easements on the properties surrounding this bog habitat for future protection of this interesting and fragile ecosystem.

Site Index



Core Habitat
Supporting Landscape

Above: Site Index by Township
Below: Site Index by USGS Quadrangle Map

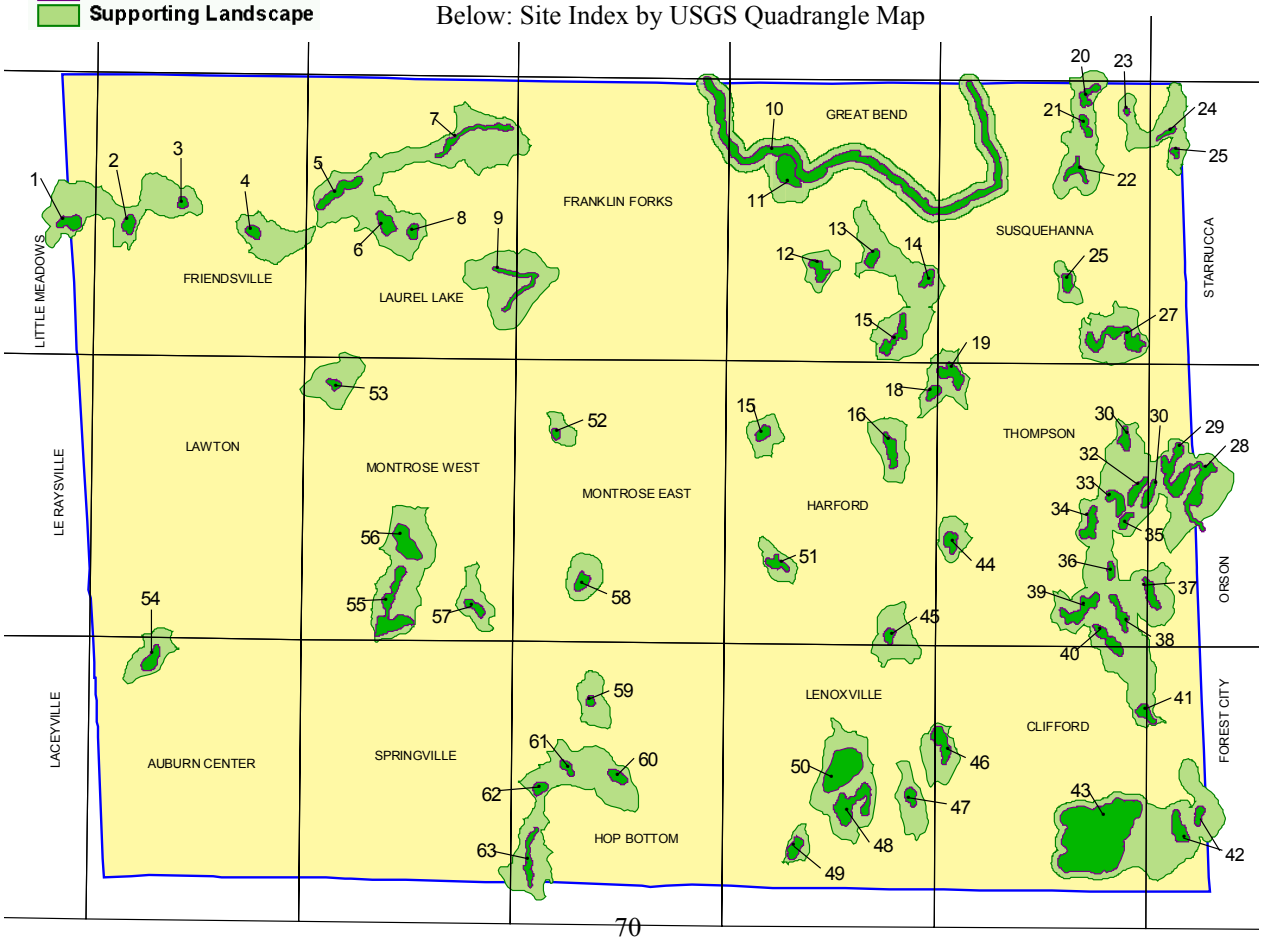


Table 2: Summary of the sites of statewide significance for the protection of biological diversity in Susquehanna County in approximate order of priority from the most important (rank = 1) to the least (rank = 5). The presence of species of special concern and/or exemplary natural communities has been documented at these sites. More in-depth information on each site including detailed site descriptions and management recommendations where appropriate can be found in the text of the report following the maps for each municipality.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
1	BALL LAKE	32	91	Ararat Twp.	The bog vegetation at this wetland **includes seven plant species of concern**. The relatively undisturbed setting of this bog and the many species of concern documented at the site suggests that this natural community is of high importance for the preservation of biological diversity within the county. Beaver dam-building activity and runoff from a nearby local road may impact the wetland. Damming or draining the wetland would severely impact this important natural community. Remove beaver dams as they are formed to prevent the wetland from becoming flooded. It may be necessary to trap beavers if they persist. A 100 meter undisturbed forested buffer should be established around the wetland. Future development activities within the immediate watershed should be assessed for their impact on this and the other high-quality wetlands nearby. Consider conservation easements on the properties surrounding this bog habitat for future protection of this interesting and fragile ecosystem.
1	HILLSDALE BOG	60	171	Lathrop Twp.	This wetland is relatively small, but it represents one of the few unmodified bogs in the county. The bog itself is composed of several distinct natural communities in concentric zones around the open water center. These include a **Leatherleaf-bog rosemary Peatland Natural Community** and a **Hemlock-mixed hardwood Palustrine Forest Natural Community. Four plant species of concern** were also documented at this location. Preserve the current wetland hydrology of this bog habitat by avoiding dam construction. Preserve the wide, undisturbed forested buffer surrounding the wetland. Avoid fragmenting this important habitat with additional roads or utility rights-of-way. Monitor the wetland for beaver activity and remove beaver dams as they appear. As fewer and fewer good examples of unmodified classic bog habitats remain in Pennsylvania, those that are left should be cherished for the unique and fragile environmental gems that they are. Property owners adjacent to this wetland should consider applying for tax-reducing conservation easements for the future protection of this unique natural habitat.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
1	ROBINSON LAKE	48	175	Lenox Township	This site includes Robinson Lake, Tamarack Swamp and Harding Pond, which are all bogs of glacial origin. Although it's just yards from Interstate-81, Robinson Lake exhibits a remarkably unspoiled habitat. The bog habitat supports **five plant and one animal species of concern** and is itself an uncommon type of natural community in Pennsylvania, **a Black spruce –tamarack Palustrine Wetland.** Evaluate the drainage from I-81 and direct it away from the Robinson Lake wetland. Monitor for beaver activity. Beaver dams should be removed as they appear. It may be necessary to trap and remove beavers if they persist in damming these wetlands. Preserve the remaining forested buffers around these wetlands and replant with native species of trees and shrubs where forested buffers are lacking. Additional biological surveys of these wetlands are encouraged. Property owners may want to consider tax-reducing conservation easements on parcels surrounding these wetlands.
1	ROMOBE LAKE	33	91	Ararat Twp.	This wetland occurs in a relatively undisturbed setting, and supports a good diversity of characteristic bog vegetation including **five plant species of concern and two invertebrate animal species of concern.** The floating islands are dominated by a **Leatherleaf-bog rosemary Peatland Natural Community**. Reduction of wetland quality by changes in hydrology (permanent draining or flooding), or degradation of water quality should be avoided. A 100 meter undisturbed forested buffer around the wetland would help protect the wetland from negative external influences such as non-point sources of pollution and the spread of invasive species of plants. Future development activities within the immediate watershed should be assessed for their impact on this and nearby high-quality wetlands. Consider conservation easements on the properties surrounding this bog habitat for future protection of this interesting and fragile ecosystem.
2	DUNN LAKE	29	91	Ararat Twp.	This is a large, open-water glacial lake that has had its water level raised slightly by an artificial dam. There is a good diversity of native aquatic plant species present in the lake including **four species of concern**. Any future development activities should be encouraged to cluster housing away from the lakeshore and leave a 100-meter wide undisturbed forested buffer along the lake edge. A slight and gradual reduction in the water level may improve the habitat for the plant species of concern. All boats should be cleaned of any plant parts before entering the lake ecosystem to prevent the spread of invasive aquatic plants.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
2	FOREST CITY OUTCROPS	42	119	Clifford Twp.	The upper slopes and crest of the hills north of Forest City have sandstone – conglomerate bedrock outcrops within a northern hardwood forest matrix. The rocky openings are dominated by various grasses, sedges, mosses and lichens, which represent a **Little bluestem-Pennsylvania sedge opening Natural Community**. This large, continuously forested area is also valuable for many interior forest animals including neo–tropical migrant birds such as Blue-headed Vireo, Scarlet Tanager, and Black-throated Green Warbler that need undisturbed, large blocks of forest for nesting areas. This large forest is currently free from fragmenting features such as roads and utility rights of way and efforts should be made to keep this unfragmented forest block intact. Residential development, roadways and utility-rights-way should be discouraged through this forest.
2	NORTH POND	58	105 111	Bridgewater & Brooklyn Twps.	This site contains a peat-forming wetland that exhibits bog characteristics and six plant species of concern: the **G5, S2 horned bladderwort (*Utricularia cornuta*);** the **G5, S2 flat-leaved bladderwort (*Utricularia intermedia*);** the **G5, S3 water bulrush *(Schoenoplectus subterminalis);*** the **G4G5, S3 many-fruited sedge (*Carex lasiocarpa*);** the **G5G4, S2 Robbins' spike rush (*Eleocharis robbinsii*);** and the **G5, S3 bog rosemary *(Andromeda polifolia)***. The dominance of the low shrub bog rosemary together with the shrub leatherleaf form a **Leatherleaf-bog rosemary peatland Natural Community.** Maintain the current hydrology of this wetland. Maintain the wide forested buffer surrounding this wetland. Consider conservation easements on the properties surrounding this bog habitat for future protection of this interesting and fragile ecosystem.
2	ORSON MUD POND	28	91	Ararat Twp. & Wayne Co.	This interesting wetland complex contains portions of the headwaters of the East Branch of the Lackawanna River. This diversity of habitats hosts a wide variety of plants and animals **including six plant and one animal species of concern.** Plant species of concern documented at this location include the **globally rare G3, S1 PA-endangered Jacob's ladder (*Polemonium van-bruntiae)*.** Maintain the current wetland hydrology by avoiding permanent draining or flooding. Preserve the forested buffer surrounding the wetland. Additional residential construction should be strongly discouraged with 100 meters of this wetland. Nutrient loads from household septic systems should be monitored for their discharge to the wetland and modified accordingly. Herbicide use should be strongly avoided in this area. Preserve the naturally vegetated edges of the wetland and avoid cutting shrubs and plants to within 100 meters of the waters edge.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
3	CHURCHILL LAKE	26	148 207	Harmony & Thompson Twps.	Churchill Lake contains an extensive floating bog mat. Most of the 12 acre shrubland is dominated by leatherleaf to form a **Leatherleaf-sedge Wetland Natural Community.** Plant species of concern documented at this location include the **G5, S3 PA-rare bog rosemary (*Andromeda polifolia*), the G5, S2 marsh bedstraw (*Galium trifidum*),** and **slender sedge (*Carex lasiocarpa*), a G5, S3 PA-rare species of concern**. The lake is currently in a relatively undisturbed natural condition. A 100-meter undisturbed forested buffer surrounding the lake should be preserved to maintain the high water quality of this natural community. Removal or modification of the forested buffer by the construction of additional residences should be discouraged.
3	FIDDLE LAKE CREEK WETLANDS	38	157	Herrick Twp.	Two plant species of concern were documented within these wetlands. A very good population of the **G5, S2 PA-threatened sweet gale (*Myrica gale*)** was documented on the perimeter and throughout the wetland along with other more common peatland shrubs including bog laurel, leatherleaf and marsh cinquefoil. The **G5, S2 marsh bedstraw (*Galium trifidum*)**, was also documented throughout the wetland. Maintain the current wetland hydrology by avoiding permanent flooding or draining. Preserve the wide forested buffer surrounding the wetland by avoiding further fragmentation by additional roads or utility rights of way.
3	SALT SPRINGS	9	131 197	Franklin & Silver Lake Twps.	Fall Brook tumbles through a narrow ravine in Salt Springs State Park forming several waterfalls along its stony decent. The ravine is flanked by mature old growth hemlock, which casts heavy shade on the stream and adjacent forest floor. The **Gray Comma (*Polygonia progne*), a butterfly of special concern,** was documented within the park. **Four dragonfly species of concern** were also documented as occurring along fall brook in the park, both the heavily shaded hemlock portions and the more open shrubby areas of the creek. Much of the former agricultural lands should be allowed, through succession, to revert to early stage shrub forest, and eventually to a mature forest of native species.
3	STATE GAME LANDS #236 WETLANDS	39	157	Herrick Twp.	The **G5, S3 PA-rare slender sedge (*Carex lasiocarpa*)** was located in an open sedge meadow with a small stream meandering through. A **dragonflyspecies of concern** was also documented at this location. Avoid flooding or draining of this habitat. Recent beaver activity has drowned many similar hemlock swamp forests in Susquehanna County. Dam removal and beaver trapping may be necessary to preserve the quality of this forested wetland habitat. Avoid fragmenting this habitat with additional roads, utility rights-of-way or game management food plots. Preserve water quality entering this wetland habitat by avoiding upstream and uphill development.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
3	SUSQUEHANNA RIVER	10	139 148 191	Great Bend, Harmony & Oakland Twps.	**Eight invertebrate animal species of concern** were documented at various locations in the Susquehanna River. The entire length of the Susquehanna River should be considered suitable habitat for most of these species. The river also provides a valuable migration corridor for many bird species, especially aquatic-dependent birds, but also many neo-tropical passerine migratory species. Water quality should be monitored and pollution sources should be identified where possible. Forested buffers should be maintained and created where absent along the length of the river with logging operations refraining from cutting within 100 meters of the river edge. The effectiveness of the forested riverbanks as a habitat corridor would be diminished by fragmentation of the forest continuity by the construction of houses, businesses and additional roadways along the river. Local planning should discourage construction of new structures and roadways along the river, adjacent slopes and floodplain.
3	WOODBOURNE PRESERVE	57	123	Dimock Twp.	Woodbourne Preserve contains several small patches of old-growth **Northern Hardwood – Conifer Forest Natural Community.** Though relatively small patches, there are very few examples of old growth in eastern Pennsylvania. Woodbourne also has an interesting wetland habitat composed of open shrub-sedge swamp leading to an open water pond with fragments of floating bog vegetation islands. **Four dragonfly species of concern** were also documented at Woodbourne Preserve. Preserve and repair the forested buffer around the preserve. Monitor for deer damage and encourage hunting on preserve as needed.
4	BUMPS CORNERS WETLAND	53	127	Forest Lake Twp.	The area is a northern hardwoods-hemlock forest grading into an extensive **Hemlock Palustrine Forest Natural Community**. There is a large diversity of plants throughout the entire area and the hemlock swamp is of high quality and size. Overall, this site is very diverse and has tremendous value to a variety of plants and animals. Maintain the current wetland hydrology. Beaver dams should be removed as they appear to avoid flooding. Many similar habitats in the county have been reduced to standing dead trees as the result of beaver activity. Avoid fragmenting the surrounding forest with additional roads, utility rights-of-way or residential development.
4	BURNWOOD POND	36	91 157	Ararat & Herrick Twps.	The wetland on this site is partially within State Game Lands # 236. A marsh occurs at the northern end of the shallow water pond adjacent to the open water lake. Several small channels wind through the grass and sedge dominated marsh before reaching the pond. A good quality population of the **G5, S2 PA-threatened lesser panicled sedge (*Carex diandra*)** was documented within this wetland. The wetland is currently well buffered from external sources of disturbance by a wide forested buffer.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
4	HEMLOCK CREEK WETLAND	25	148	Harmony Twp.	This site is a wetland nestled between two hills. Two plant species of concern were documented within this forested wetland habitat. A population of the **G5, S2 PA-threatened red currant (*Ribes triste*)** occurs in scattered patches on both the elevated hummocks and the hollows between the hummocks. The **G5, S3 soft-leaved sedge (*Carex disperma*)** was documented growing on the elevated hummocks and downed logs. No disturbances were observed in this apparently pristine habitat. Preserve the Forested buffer surrounding this wetland complex. Maintain the current hydrology by monitoring for beaver. It may be necessary to remove beavers to prevent flooding of this habitat.
4	LEWIS LAKE	41	157	Herrick Twp.	Lewis Lake is a 50-acre lake that has been dammed at the southern end. Summer cottages and year-round residences ring the lakeshore. Despite the disturbed nature of the lakeshore, a good-quality population of the **G5, S2 PA PA-threatened sweet-gale (*Myrica gale*)** persists along the boggy margins of the water's edge. Inform property owners on how to identify this shrub species and its importance as a Pennsylvania rarity. Avoid the use of herbicides in and near the lake.
4	LINDAVILLE MARSH	59	111	Brooklyn Twp.	This marsh wetland is dominated by cat-tails, sedges and rushes providing an excellent habitat **for two animal species of concern**. Both of these species are highly habitat specific, and were more common in the past before many wetlands were drained for conversion to agricultural uses. These species are still susceptible to reduction across the state due to loss of marsh wetland habitats. As with most wetland habitats in the county, maintain the current wetland hydrology, preserve the remaining forested buffer and reestablish a forested buffer where it is lacking to protect the wetland from external sources of disturbances.
4	LOWE LAKE	40	157	Herrick Twp.	This glacially formed natural lake has a floating mat of bog vegetation occurring on its western edge. The eastern shore of the lake is developed with closely placed residences along the length of the shorefront. The relatively undisturbed western shore supports **five plant species of concern**. Advise lake residents on importance of uncommon plant species and their habitat. Avoid the use of herbicides in or near the lake. Avoid destruction of the bog mat vegetation on the western edge of the wetland by fragmentation of the lakeshore with additional development. Monitor septic systems of the cottage community to avoid nutrient enrichment of this naturally low-nutrient environment. Consider conservation easement on the western edge of the lake for future protection of this interesting habitat.
4	NORTH BRANCH HEMLOCK CREEK SLOPES	24	148	Harmony Twp.	This steep north facing slope has a sugar maple dominated forested canopy over moist soils and a flora characteristic of more northerly habitats. A population of the **G5?, S1 great-spurred violet (*Viola selkirkii*)** and the **G5, S1 kidney-leaved white violet (*Viola renifolia*)** were documented in this habitat. Prior to this survey, the kidney-leaved white violet was considered extirpated in PA, with no recently documented occurrences in the state. The forested slopes should be protected from logging and road construction activities. This site is partially on State Game Lands #70.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
4	PAYNE POND	45	135	Gibson Twp.	The wetland at this location is a classic kettle hole bog that was formed when ice was buried in glacial till deposits. Occurring on the floating vegetation mat at this bog is a very good population of the **G5, S3 PA-rare bog rosemary (*Andromeda polifolia*)**. This habitat is also strongly dominated by the evergreen shrub leatherleaf, which together with the bog rosemary form a **Leatherleaf-bog rosemary peatland Natural Community**. The **G5, S3 PA-rare slender sedge (*Carex lasiocarpa)*** was also documented at this site. Reforestation of the wetland borders will help protect the bog habitat from external causes of disturbance such as non-point sources of pollution, nutrient enrichment and erosional sedimentation. Beaver dams should be removed as they occur to avoid flooding the bog habitat. Additional surveys for species of concern should be conducted on this interesting habitat.
4	PINE SWAMP	30	91	Ararat Twp.	A small, open water, beaver created pond at this location is flanked by a larger sedge meadow and shrub swamp which grades into a forested wetland as it progresses upstream. Two plant species of concern and **two animal species of concern** were documented at this area. The **G5, S2 marsh bedstraw (*Galium trifidum*)**, and the **G5, S1 marsh willow-herb (*Epilobium palustre*)** both occur within the sedge meadow-shrub swamp zones of the wetland. The two animal species use the entire wetland and the adjacent woodlands as their primary and secondary habitat. The wetland is currently well buffered by a wide undisturbed forested buffer. As with most wetland sites in the county, protection of the habitat for these species of concern includes maintaining the current wetland hydrology by avoiding draining or flooding, and preservation of the wide undisturbed forested buffer surrounding the wetland.
4	SCHOOLEY POND	62	203	Springville Twp	This naturally occurring lake has residences and cottages around most of its perimeter, many with boat docks. Despite the apparent disturbances to the lake habitat, there is an excellent quality population of the **G5, S1 PA-endangered Torrey's Bulrush (*Schoenoplectus torreyi*)** that occurs along the shallow water shoreline. The high levels of aquatic plants and algae may prompt boat owners to attempt control methods. Mechanical or hand removal would be acceptable where non-native species are the targets for removal. Chemical controls, especially herbicides should not be used in or near the lake. Septic systems of surrounding homes and cottages should be monitored for the effect of their output on the lake ecosystem. Problem systems should be upgraded.
4	SGL #140 WETLAND	3	87	Apolacon Twp.	The wetland on this State Game Land property consists of a bog that has water levels artificially raised by beaver and human dam building activity. A large population of **bog rosemary (*Andromeda polifolia*), a G5, S3 PA-rare** plant species of concern occurs scattered over the floating island. Together with the leatherleaf, this characterizes a **Leatherleaf-bog rosemary Peatland Natural Community**. A 100-meter undisturbed forested buffer should be maintained around the wetland. Nearby Game Commission food plots may contain the invasive shrubs multiflora rose and autumn olive, which should be destroyed as soon as possible.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
4	WEIR POND – SHELLY PRESERVE	27	207	Thompson Twp.	This wetland complex includes a pond with a well developed inlet and outlet. The pond vegetation has probably been affected by beaver activity over the years. The site contains **three plant species of concern, three animal species of concern** and also a **Graminoid Marsh Natural Community**. Much of this site is protected as a nature preserve. Conserve and repair a 100 meter forested buffer around all wetlands and tributary streams. Use only native trees and shrubs, preferably from local sources, for replanting efforts. Deer hunting should be encouraged to decrease herbivory pressure on understory plants and tree seedlings. Beaver activity should be monitored, and may need to be trapped if water levels are raised significantly.
5	BRANT SLOPES	22	148	Harmony Twp.	This steep, south facing slope above Starrucca Creek has an abandoned railroad grade along the slope. The **G5, S2 Canadian milkvetch (*Astragalus canadensis*)** occurs along the abandoned railroad bed where vehicle traffic has not worn away the vegetation. This species should persist at this location where vehicle traffic does not trample it completely. Additional surveys for this species in more natural conditions as along Starrucca Creek are encouraged.
5	BRUSHVILLE LAKE	14	163 191	Jackson & Oakland Twps.	This wetland had been dammed in the past to create an open water pond. The dam has recently been breached, exposing large areas of very shallow water and pond bottom muck. A population of the **G5, S2 marsh bedstraw (*Galium trifidum*)** was documented growing along an old beaver dam adjacent to a hemlock swamp forest. The wet hemlock area supports the **G5, S3 PA-rare soft-leaved sedge (*Carex disperma*)**, which is growing at the base of several hemlock and white pine trees in the swamp forest. Avoid flooding or logging of the hemlock swamp forest. Additional biological surveys in the hemlock swamp forest and the newly exposed pond bottom are encouraged.
5	DEACON CREEK WETLANDS	13	139	Great Bend Twp.	This wetland occurs at a relatively high elevation in the saddle between two hill tops. A **G5, S2 plant species of concern marsh bedstraw (*Galium trifidum*)** was documented along the shore of a small open water portion of the wetland. The wetland has a very good upstream forested buffer, most of which is in State Game Lands #35. Avoid flooding or draining of this wetland. Avoid fragmentation of the large forested blocks of State Game Lands #35 with additional roads and utility rights-of-way.
5	DOC LUTZ WOODS	56	167	Jessup Twp.	This site contains an **animal species of concern**. Any logging activities should take place in the fall and early winter to avoid the most active spring and summer nesting season.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
5	DUNDAFF CREEK HEADWATERS	43	119	Clifford Twp.	The wetlands at the headwaters of Dundaff Creek appear to be primarily beaver influenced impoundments with occasional large expanses of shrub swamp and sedge-grass marshes within a northern hardwood forest matrix. One of the wetlands appears to be surrounded by a large hemlock swamp forest. This wetland may be more of a peatland or bog habitat with extensive shrub cover. An **animal species of concern** was documented as using these habitats in 1985. Fragmentation of the surrounding forest matrix with additional roads or utility-rights-of-way should be strongly discouraged. Modification of the wetland hydrology by permanent flooding or draining should be avoided. Future biological surveys of this area are encouraged.
5	EAST LAKE WETLANDS	15	163 187	Jackson & New Milford Twps.	This area provides excellent habitat for wetland birds. A good population of the **G5, S2 PA-rare small bedstraw (*Galium trifidum*)** and a **dragonfly species of concern** were documented in the open wet meadow and will continue to persist there if similar ecological conditions continue to persist. The wetlands can be best protected from external disturbances by preserving the forested buffer on its eastern edge and by reforesting the western edge, which is currently in agricultural fields right up to the edge of the wetland.
5	ELK LAKE WETLANDS	55	123 167	Dimock & Jessup Twp.	A series of open water lakes, forested wetlands, shrub swamps and sedge meadows occur within this area. The **G5, S2 plant species of concern dodder (*Cuscuta campestris*)** was documented along the stream that enters Big Elk Lake. A **dragonfly species of concern** was documented in the northernmost large wetland opening and likely utilizes portions of the other wetland habitats as well. Avoid dam construction on wetlands. Preserve and repair forested buffer surrounding wetlands. Create forested buffer along creek between two upper wetlands. Trees will shade the creek, cooling water, which will hold more oxygen for aquatic animals. A forested buffer will also help protect the water quality from runoff pollution and sedimentation from roads, residences and agricultural fields.
5	GILLESPIE'S POND	16	187	New Milford Township	This artificially dammed, open water lake was used in the past as a mill pond. Around most of the lake is a very narrow strip of wetland vegetation. A few floating leaved aquatic plants as well as filamentous algae occur in the lake water. The small stream entering the lake fans out into a delta as it enters the lake, forming a small shallow water area that supports some wetland plants. Among these is the **G5, S2 marsh bedstraw (*Galium trifidum*)**. Uphill activities should be scrutinized for their effect on water quality. Septic systems of nearby residences as well as upslope mining activities should be monitored for the effect of their outflow on the aquatic habitat.
5	HARTLEY POND	49	175	Lenox Township	This wetland is primarily an open water pond with some acidic wetland plant species occurring along the perimeter. A **G5, S3 dragonfly species of concern** was documented at this location. Preserve the wide forested buffer surrounding the wetland. Avoid fragmenting this large forested block with additional roads and utility rights-of-way. Additional surveys for species of concern at this location are encouraged.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
5	HATHAWAY LAKE	35	91	Ararat Twp.	This open water lake has a small population of **many-fruited sedge (*Carex lasiocarpa*), a G5, S3 plant species of concern** along its shoreline. Conservation efforts should concentrate on protecting the forested buffer around the lake. This will help maintain the water quality by slowing runoff and filtering sediment and nutrients before they enter the lake.
5	ISLAND PLAIN WETLAND	11	139	Great Bend Twp.	Within this forested swamp the **G5, S3 PA-rare soft-leaved sedge (*Carex disperma*)** was documented, growing on the elevated bases of hemlock and pine trees. The wetland habitat also supports **two animal species of concern.** Any logging activities should take place in the fall and early winter to avoid the most active spring and summer nesting season.
5	LAKE OF THE MEADOWS	1	87	Apolacon Twp. & Bradford Co.	This lake is a flooded bog remnant. On the floating islands is a small population of the **G5, S3 PA-rare plant species of concern, bog rosemary (*Andromeda polifolia*).** Together with the leatherleaf, this characterizes a **Leatherleaf-bog rosemary Peatland Natural Community**. This bog wetland has been severely impacted by artificial flooding, resulting in small floating remnants of the past natural community. Reduction of the water level may over time allow much of the bog vegetation to recolonize its historic habitat.
5	LITTLE RHINEY CREEK	7	181 197	Liberty & Silver Lake Twps	Running east to west across the township, Little Rhiney Creek has several beaver influenced wetland openings of various size and composition. A **G5, S1S2 dragonfly species of concern** was documented using the wetland openings along the creek. Maintain a wide undisturbed forested buffer along this and all streams, creeks and rivers in the county for the preservation of water quality and biodiversity.
5	LITTLE ROARING BROOK WETLANDS	21	148	Harmony Twp.	These two large, open wetlands have been influenced by periodic beaver activity. The **G5, S3 soft-leaved sedge (*Carex disperma*)** grows along the wet, shaded, hemlock forested margins of the wetland openings. A **dragonfly species of concern** also was documented using the wetland opening as its primary habitat. Fence the wetland and adjacent forest in a 100 meter buffer around the wetland form livestock grazing. Funding for this may be available through CREP or related programs.
5	MITCHELL CREEK HEADWATERS	12	139	Great Bend Twp.	Several wetlands occur within this portion of the large undisturbed forest of State Game Lands #35. The **G5, S3 soft-leaved sedge (*Carex disperma*)** was documented in a forested wetland with a heavy hemlock canopy and saturated soils. Avoid logging within 100 meters of the wetland opening, forested wetland and adjacent streams. Beaver dams should be removed and beavers trapped to avoid flooding of this forested wetland. Avoid fragmenting this large undisturbed forested area with additional roads and utility rights-of-way.
5	MONROE CREEK WETLANDS	63	203	Springville Twp.	A small population of the **G5, S3 soft-leaved sedge (*Carex disperma*)** grows on the elevated moss mounds in a small hemlock swamp forest adjacent to a larger marsh. The area has a good diversity of plants and also contains good marsh-bird habitat. Agricultural fields are adjacent to much of the creek with little forested buffer. Restore a 100 meter forested buffer where it is lacking. Avoid construction of permanent dams.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
5	MONTROSE HIGH SCHOOL WETLAND	52	105	Bridgewater Twp.	A small forested wetland near the Montrose High School consists primarily of a hemlock canopy over a mound and pool microtopography that makes up a **Hemlock Palustrine Forest Natural Community** of surprising quality. The deep muck soils, pools and sphagnum moss mounds support an interesting array of plants of a more northern affinity. The proximity of this quality natural environment to the local high school makes it a valuable outdoor component of Biology classes. As with most wetlands in the county, the integrity of the natural community can be preserved by maintaining the wetland hydrology, and preserving and expanding the forested buffer surrounding the wetland. Activities in the uphill portions of the watershed should be scrutinized for their potential impact on this scenic natural community.
5	POTTER LAKE	44	135	Gibson Twp.	Potter Lake is a large, primarily open-water bog-like habitat that has had its water levels raised by beaver and man-made dams to the point where much of the original bog vegetation is currently drowned. A small population of the **G5, S3 PA-rare slender sedge (*Carex lasiocarpa*)** and **two dragonfly species of concern** were documented at this location. The bog vegetation at this site would likely improve with a slight reduction in the water level of the lake. Beaver dams may need to be removed when they occur to allow the bog vegetation to recover from the current flooded conditions. The existing wide forested buffer should be preserved to protect the wetland from increased nutrient enrichment.
5	ROARING RUN HEADWATERS	23	148	Harmony Twp.	This isolated headwater wetland supports a dense herbaceous layer including two plant species of concern, the **G5, S3 PA-rare soft-leaved sedge (*Carex disperma*)** and the **G5, S1S2 mountain starwort (*Stellaria borealis*)**. Preserve a 100-meter undisturbed forested buffer around the wetland and tributaries leading into this wetland complex. Maintain the current wetland hydrology by removing beaver dams as they appear. Beaver removal may become necessary if they persist.
5	ROUND HILL WETLANDS	20	148	Harmony Twp.	The site includes a small population of the **G5, S3 bog rosemary (*Andromeda polifolia*).** This habitat is not currently threatened by any nearby activities. Succession, over time, may lead to a more forested environment. The wetland habitat was likely subject to natural wildfires in the past, which helped keep the undergrowth from completely closing the wetland opening. A carefully executed prescribed burn could potentially return the shrubland to more open conditions. Avoid fragmenting the habitat with roads or utility rights-of-way.
5	ROUTE 171 WETLANDS	31	207	Thompson Twp.	A wetland complex along Route 171 has a diversity of wetland habitats. This diversity of habitats provides suitable environments for a large array of species. A **G5, S2 dragonfly species of concern** was documented using shallow water pools within the herbaceous openings. Maintain the current wetland hydrology. Avoid permanent flooding or draining of this complex wetland habitat. Preserve and increase the undisturbed forested buffer around the wetland. If the surrounding land use changes from agriculture to residential, a wide forested buffer should be provided to isolate the wetland from external sources of disturbance.

County Rank	Site Name (Site #)	Site #	Page #	Municipality(ies)	PA Heritage Ranks and Site Importance
5	STEINBACHS CORNERS WETLAND	17	187	New Milford Township	This wetland habitat is ecologically rich and provides important habitat for a variety of wildlife and plant species. The area consists of an open wet meadow with a stream running through it. The habitat is excellent for dragonflies and damselflies and wetland plants and birds. A population of the **G5, S2 marsh bedstraw, (*Galium trifidum*)** was documented in this wetland habitat. Preservation of a 100-meter forested buffer surrounding the wetland will best help protect this important habitat from negative external disturbances. Logging or development of the wetland perimeter should be avoided. The current wetland hydrology should be maintained by avoiding draining or flooding of this habitat.
5	TEA POND	47	175	Lenox Twp.	Information regarding this area is based on aerial photo interpretation and previous surveys. Tea Pond is a small **kettlehole bog natural community** surrounded by a red maple-blueberry swamp forest. The bog appears to a have a well developed ring of floating bog vegetation. The **G5, S3 PA-rare bog rosemary (*Andromeda polifolia*)** was documented at the site during surveys in 1986. Repair the forested buffer around the bog. Use native species from local sources for replanting efforts. Maintain the current water level of the bog. Avoid flooding or draining of this habitat. This bog is a good candidate for recovery if the forest buffer is reestablished.
5	TINGLEPAUGH SWAMP	34	91	Ararat Twp.	State Gamelands #236 contains a large beaver impacted wetland complex that includes forested swamps, shrub swamps, sedge meadows, mud flats and open water. This site supports a population of the **G5, S3 PA-rare plant soft leaved sedge (*Carex disperma*)**, which occurs in the forested hemlock swamp at the edge of the wetland opening. The wetland has apparently undergone periodic flooding from beaver activity as evidenced by the numerous dead trees within the wetland. The temporary periodic flooding and draining due to beaver activity will likely keep these wetlands in various states of succession. Permanent flooding or draining would likely destroy this natural community. Maintain the undisturbed forested buffer surrounding the wetland. Remove the invasive shrubs multiflora rose and autumn olive as soon as possible to prevent their further expansion. Native replacements could include shrubs that already occur adjacent to this wetland.
5	TUNKHANNOCK CREEK WOODLAND	50	175	Lenox Twp.	This site contains a **dragonfly species of concern.** This large forested slope along the floodplain of Tunkhannock Creek is a mixture of conifers and hardwoods. Interstate-81 runs along the Tunkhannock and right through this area. Any logging activities should take place in the fall and early winter to avoid the most active spring and summer nesting season.
5	WEST BRANCH LACKAWANNA RIVER HEADWATERS	37	157	Herrick Twp.	This large wetland contains a wide-open bluejoint-reed canary grass marsh, which is likely the result of cyclic impoundment due to beaver activity. The small stream and occasional pools provide habitat for a **G5, S1S2 dragonfly species of concern.** Preserve an undisturbed forested buffer around this wetland. Avoid construction of permanent dams. Avoid fragmenting the habitat with additional roads and utility rights-of-way.

Table 3. **Areas of Local Significance** in Susquehanna County based on size, diversity of wildlife and plant life, water quality protection, and recreation potential (these sites do not have documented populations of species of special concern although most of these areas have potential for rare species to occur).

County Rank[1]	Site Name	Site #	Page #	Municipality(ies)	PA Heritage Ranks[2] and Site Importance
High	Butler Lake	19	163	Jackson Twp.	Information on this site was derived from aerial photo interpretation. This apparent bog habitat has seen some recent conversion of its shoreline by residential development. An extensive floating bog mat continues to exist on the western and southern portions of the wetland. In all likelihood, characteristic species of plants restricted to bog habitats are present on this fragile floating environment. This bog is threatened by recreational development pressure. Flooding by dam construction or draining should not be permitted. A single boat launch should be established on the northeastern edge of the wetland where there is the narrowest band of bog vegetation. The other boat docks should be removed. Ground surveys of this potentially ecologically important habitat should be a priority for future biological surveys in the Township.
High	Carmault Lake	2	87	Apolacon Twp.	This site was not ground surveyed during the period of this project. A description of this area is based on aerial photo interpretation. Carmault Lake appears to be a natural lake of glacial origin. It is currently in an excellent ecological context, being surrounded by a large unfragmented forest. Maintain the unfragmented forested buffer surrounding this natural lake. Refrain from developing the lake shoreline. Consider conservation easements on the lake and adjacent landscape.
High	Union Church Bog	61	171	Lathrop Twp.	The wetland at this location appears to be partially an open water pond with a floating bog mat at the northern end. The bog mat likely support characteristic acidic wetland plant species such as leather leaf and pitcher plant, but may also provide suitable habitat for rare plant species. Biological surveys of the wetland and adjacent forested swamp are recommended to determine the plant and animal composition. Maintain the current wetland hydrology by avoiding permanent flooding or draining. Preserve and expand the existing forested buffer around the wetland by replanting with native species of trees and shrubs from local seedling sources.
Medium	Choconut Lake	4	115	Choconut Twp.	This glacial lake has a good quality forested buffer, though small roads have been created around the lake to support a recreational summer camp. The water is deep and clear and supports many common species of aquatic plants. The site supports numerous species of dragonflies and damselflies, which should be surveyed more thoroughly in the future. Avoid additional development of the lake shore to preserve the water quality and natural integrity of this glacial lake.

County Rank[1]	Site Name	Site #	Page #	Municipality(ies)	PA Heritage Ranks[2] and Site Importance
Medium	Cranberry Lake	8	197	Silver Lake Twp.	There is a distinct ring of floating vegetation on portions of Cranberry Lake, suggesting that this is a flooded bog habitat. Conserve and repair the remaining forested buffer. Gradually and slightly lower the water level to help return the lake to its former bog habitat. Monitor septic outflow of adjacent residences and upgrade systems as needed to preserve and improve water quality. A biological survey of the bog vegetation is encouraged.
Medium	Silver Lake	6	197	Silver Lake Twp.	This open water glacially-formed lake may have an interesting assemblage of aquatic plants and a good diversity of dragonflies and damselflies. The western side of the lake is composed of a large unfragmented forest block of mixed hemlock, white pine and hardwoods. Preserve and repair the remaining forested buffer surrounding the lake. Future residential development should consider cluster housing in existing developed areas to conserve the remaining undeveloped lake shore. Monitor septic outflow of adjacent residences and upgrade systems as needed to preserve and improve water quality.
Medium	Tuscarora Lake	54	103 195	Auburn & Rush Twps.	Tuscarora Lake was not ground surveyed during the period of this project, but information regarding this wetland was interpreted from aerial photos of the area. This wetland appears to be a former bog habitat that has been flooded in the past by a man-made dam to create an open water lake. Remnants of the former bog vegetation in the form of floating islands appear to persist within the lake. Species of plants restricted to bog habitats may still occur on these floating islands, and will likely persist in this fragmented condition.
Low	Little Butler Lake	18	163	Jackson Twp.	Little Butler Lake is a former kettle hole bog that was converted to a lake several decades ago by the construction of a dam. The dam, though well intentioned, flooded the bog, drowning much of the native and interesting bog vegetation. Despite the past disturbances, some of the former bog vegetation remains as fragmented floating islands. This open water lake may return to its former bog habitat in several hundred years, but this process could be accelerated by the removal of the dam and a return to the previous water level. Reforesting the western edge of the lake would help protect the water quality from degradation due to non-point sources of pollution such as runoff from roads, residences and agricultural fields.

County Rank[1]	Site Name	Site #	Page #	Municipality(ies)	PA Heritage Ranks[2] and Site Importance
Low	Mud Pond	46	119	Clifford Twp.	There is a remnant ring of floating bog vegetation in the middle of this open water pond. The floating vegetation mats support characteristic acidic wetland species such as leatherleaf, cranberry, and pitcher plants. This typical bog vegetation likely covered more of the open water portion of the pond, but changes in the hydrology have flooded the wetland creating the open water pond. Preserve the forested buffer surrounding the wetland. A slight and gradual decrease in the water level may accelerate the regrowth of the former bog vegetation. Biological surveys in the wetland south of the road are encouraged.
Low	Tyler Lake Headwaters	51	145	Harford Twp.	The large wetland on the north end of Tyler Lake appears to have been subject to repeated beaver influence. A diversity of habitats has been created by the cyclic ebb and flow of the water level at this site. This diversity of wetland habitats provides habitat for a wide variety of plant and animal species. Maintain the current wetland hydrology by avoiding construction of permanent dams. Preserve the forested buffer surrounding the wetland by avoiding construction of roads, residential development and utility rights-of-way.

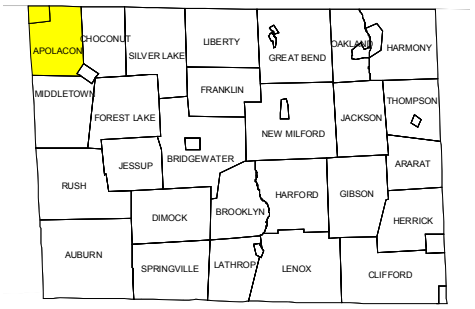
Natural Areas of Susquehanna County by Township

Numerous wetlands dot the Susquehanna County landscape. Many of these are bog habitats, several of which are of very high quality. Many plants and animals uncommon to Pennsylvania are contained in these environments. These areas represent some of the most important habitats for the preservation of biodiversity in Susquehanna County.

APOLACON TOWNSHIP and Little Meadows Borough

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
LAKE OF THE MEADOWS (5)	Plant: Bog rosemary (*Andromeda polifolia*)	G5	S3	PR	2004-11-12	C
	Natural Community: Leatherleaf-bog rosemary peatland	GNR	S2S3	N	2004-11-12	C
SGL #140 WETLAND (4)	Plant: Bog rosemary (*Andromeda polifolia*)	G5	S3	PR	2004-8-04	E
	Natural Community: Leatherleaf-bog rosemary peatland	GNR	S2S3	N	2004-8-04	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks



Locally Significant: Carmault Lake

Managed Lands: State Game Lands #140

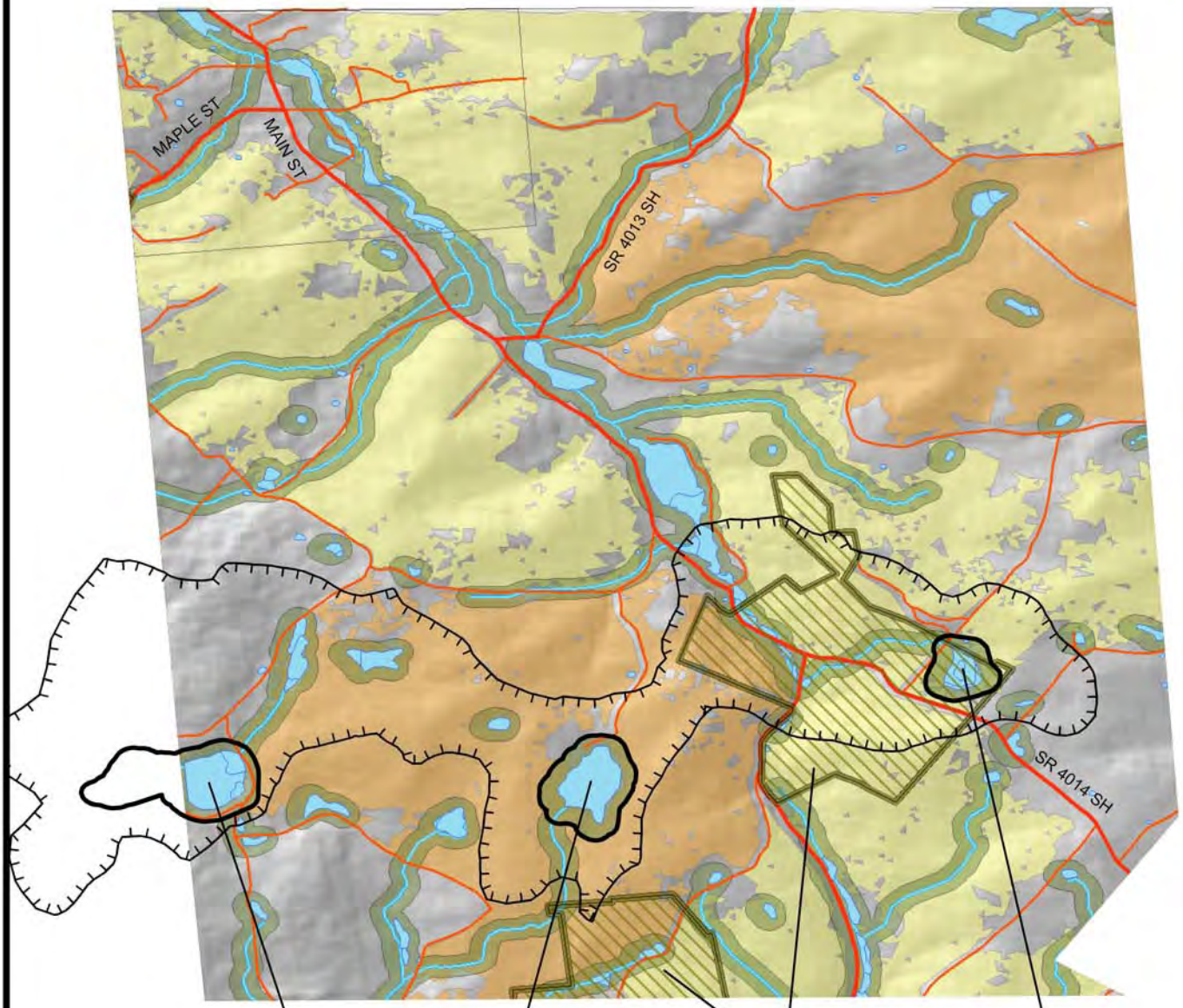
Other: High Quality Cold Water Fisheries: Cork Hill Creek,
Bow Bridge Creek

Aquatic Classification Project Results:
Fish: Warm Water Community 1—North Branch Wyalusing Creek, Apalachin Creek, Wappasening Creek;
Fish: Warm Water Community 2—Gaylord Creek;
Invertebrate: Rolledwinged stonefly / Small minnow mayfly —Apalachin Creek, Wappasening Creek

APOLACON TOWNSHIP MAP

Apolacon Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks:
square miles

- 1-3
- 3-5
- >5

Scale:1:60,000

0 0.5 1 2 Miles

APOLACON TOWNSHIP

Apolacon Township lies in the extreme northwestern corner of the county and is largely a rural township of dispersed settlement. Uses of the land include agriculture, timber harvest, and non-coal quarries. Apalachin Creek runs through the northern half of the township, with two tributaries designated High Quality Cold Water Fisheries. The North Branch of Wyalusing Creek originates within portions of State Game Lands #140. Several lakes are dispersed throughout the township, including Minkler Lake, Lake of Meadows, and Carmault Lake. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Several large forested blocks, in particular the one bordered on the north by T693, provide connectivity to neighboring townships for movement of wildlife and integrity of natural plant communities. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds.

The short shrubs leatherleaf and bog rosemary form thick patches on the floating bog mat at State Game Lands #140, to constitute a leatherleaf-bog rosemary peatland natural community. Photo: Bud Sechler

Floating bog mat at State Game Lands # 140, Apolacon Township.

LAKE OF THE MEADOWS (Apolacon Township and Bradford County

This lake, straddling the Bradford-Susquehanna County border, is a flooded bog remnant. The small floating vegetation mats in the lake are the relics of the vegetation that historically covered much more of this lake. Beaver activity frequently plays a part in partially drowning this fragile habitat type, relegating the bog vegetation to a floating ring within the lake. Enhancement of beaver dams by human activity has reduced this bog habitat to a few floating islands. The islands are buoyed by thick layers of sphagnum moss, and dominated by a tangle of the short shrub, leatherleaf. Also on the floating mats is a small population of the **G5, S3 PA-rare plant species of concern, bog rosemary (*Andromeda polifolia*)**. Together with the leatherleaf, this characterizes a **Leatherleaf-bog rosemary Peatland Natural Community**. Associated plant species include cotton grass, swamp rose, cranberries, poison sumac and the insectivorous pitcher plant.

- Threats and Disturbances:

This bog wetland has been severely impacted by artificial flooding, resulting in small floating remnants of the past natural community. Houses line the southern edge of the wetland. Much of the forested buffer has been removed or fragmented by roads and residences.

- Conservation Recommendations:

The floating mats will likely persist as remnants of the bog habitat as long as the water quality is not severely altered. Creation and preservation of a forested buffer around this wetland could help protect the water quality. Much of the bog vegetation can persist in the seedbank of the habitat between beaver induced flooding cycles. Reduction of the water level may over time allow much of the bog vegetation to recolonize its historic habitat.

SGL #140 WETLAND (Apolacon Township)

The wetland on this State Game Land property consists of a former bog that has water levels artificially raised by beaver and human dam building activity. The raised water levels have flooded the outer portions of the bog, creating open water conditions over much of the wetland. A large floating island persists in the wetland, which represents a relict of the former bog vegetation that likely used to cover much of this wetland. The island is dominated by leatherleaf, a common bog shrub species. A large population of **bog rosemary (*Andromeda polifolia*), a G5, S3 PA-rare plant species of concern**, also occurs scattered over the floating island. Together with the leatherleaf, this characterizes a **Leatherleaf-bog rosemary Peatland Natural Community.**

- Threats and Disturbances:

The natural community on this floating island is of good size and quality. It is primarily on State Game Lands property, and most of it is protected from development pressure. There are food plots created to the south of the wetland that skirt the southern edge of the wetland. A few private residences occur on the northern shore of the wetland.

- Conservation Recommendations:

A 100-meter undisturbed forested buffer surrounding the wetland will help protect the wetland and bog remnant from the effects of nonpoint sources of pollution and also help protect the wetland from being colonized by undesirable invasive species of plants. Game Commission food plots in the county sometimes have areas planted in the invasive shrubs multiflora rose and autumn olive. If either of these two shrubs currently occur in the food plots, they should be destroyed as soon as possible. Houses adjacent to the wetland should have wastewater treatment systems that have minimal impact on aquatic habitats. The water level at the site should be maintained. Additional surveys for species of concern at this location are recommended

Locally Significant Site:

Carmault Lake – (Apolacon Township)

This site was not ground surveyed during the period of this project. A description of this area is based on aerial photo interpretation. Carmault Lake appears to be a natural lake of glacial origin. It is currently in an excellent ecological context, being surrounded by a large unfragmented forest

- Threats and Disturbances:

The lake and adjacent upland forest is currently in excellent condition with few disturbances. Development pressures could reduce the quality of this natural landscape feature. Removal or modification of the forested buffer surrounding the lake would decrease the ecological value of this habitat.

- Conservation Recommendations:

Maintain the unfragmented forested buffer surrounding this natural lake. Refrain from developing the lake shoreline. Consider conservation easements on the lake and adjacent landscape.

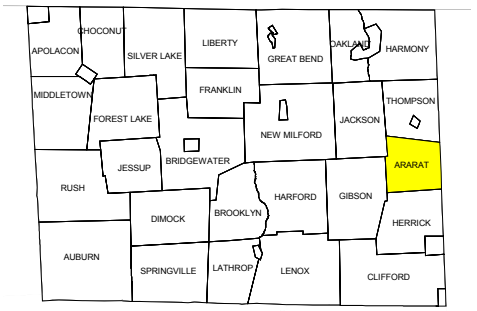
ARARAT TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
BALL LAKE (1)	Natural Community: Glacial Bog	GNR	S3	N	1988-6-23	B
	Plant: Bog-rosemary (*Andromeda polifolia*)	G5	S3	PR	1985-8-05	B
	Plant: Many-fruited sedge (*Carex lasiocarpa*)	G5	S3	PR	1985-6-13	E
	Plant: Mud Sedge (*Carex limosa*)	G5	S2	TU	1992-7-20	B
	Plant: Few-flowered Sedge (*Carex pauciflora*)	G5	S1	PE	1988-6-23	B
	Plant: Sweet-gale (*Myrica gale*)	G5	S2	PT	1989-7-26	B
	Plant: Robbins' Spike-rush (*Eleocharis robbinsii*)	G4G5	S2	PT	1985-8-05	B
	Plant: Horned Bladderwort (*Utricularia cornuta*)	G5	S2	N	1985-8-05	E
BURNWOOD POND (4)	Plant: Lesser Panicled Sedge (*Carex diandra*)	G5	S2	PT	1991-6-25	B
DUNN LAKE (2)	Plant: Many-fruited sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-6-18	E
	Plant: Water Lobelia (*Lobelia dortmanna*)	G4	S2	PT	2005-7-11	B
	Plant: Bayonet rush (*Juncus militaris*)	G4	S1	PE	2005-7-11	C
	Plant: Horned bladderwort (*Utricularia cornuta*)	G5	S2	N	2005-7-11	B
HATHAWAY LAKE (5)	Plant: Many-fruited sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-6-22	C

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
ORSON MUD POND (2)	Animal: Red-waisted Whiteface Dragonfly (*Leucorrhinia proxima*)	G5	S2	N	2005-7-20	E
	Plant: Floating-heart (*Nymphoides cordata*)	G5	S2	PT	1989-7-27	D
	Plant: Sweet-gale (*Myrica gale*)	G5	S2	PT	2005-7-20	B
	Plant: Many-fruited sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-7-20	B
	Plant: White water-crowfoot (*Ranunculus aquatilis var. diffusus*)	G5T5	S3	N	2005-7-20	E
	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-7-20	E
	Plant: Jacobb's-ladder (*Polemonium van-bruntiae*)	G3	S1	PE	1996-7-08	D
	Plant: Blunt-leaved pondweed (*Potamogeton obtusifolius*).	G5	S1	PE	2005-7-20	E
PINE SWAMP (4)	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-7-20	E
	Animal: Red-waisted Whiteface Dragonfly (*Leucorrhinia proxima*)	G5	S3S4	N	2005-7-20	E
	Animal species of concern	G5	S2	N	2005-7-20	E
	Plant: Marsh willow-herb (*Epilobium palustre*)	G5	S1	N	2005-7-20	E
ROMOBE LAKE (1)	Natural Community: Leatherleaf-bog rosemary Peatland	GNR	S2	N	2005-6-26	E
	Plant: Many-fruited sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-6-26	E
	Plant: Horned Bladderwort (*Utricularia cornuta*)	G5	S2	N	2005-6-26	E
	Plant: Mud Sedge (*Carex limosa*)	G5	S2	TU	2005-6-26	E

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
	Plant: Bog-rosemary (*Andromeda polifolia*)	G5	S3	PR	2005-6-26	E
	Plant: Rough cotton-grass (*Eriophorum tenellum*)	G5	S1	PE	2005-6-26	E
	Animal: Slaty Skimmer dragonfly (*Libellula incesta*)	G5	S3?	N	2005-6-26	E
	Animal: Bog copper butterfly (*Lycaena epixanthe*)	G4G5	S2	N	2005-6-26	E
TINGLEPAUGH SWAMP (5)	Plant: Soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2004-7-21	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

Managed Lands: State Game Lands #236

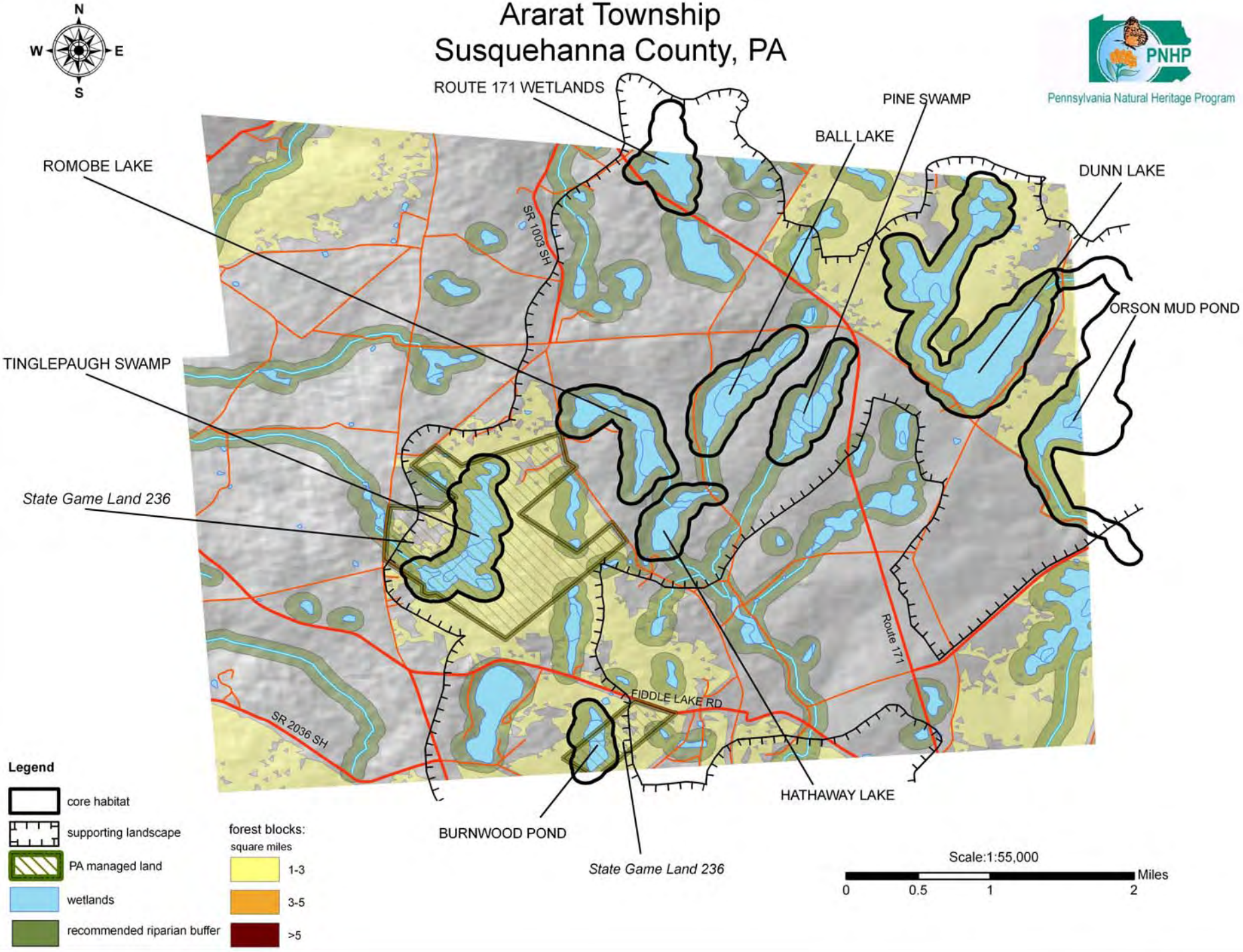
High Quality Cold Water Fisheries: East Branch Lackawanna River

Aquatic Classification Project Results:
Fish: Warm Water Community 1—Tunkhannock Creek, Starucca Creek;
Fish: Cool Water Community 2—East and West Branch Lackawanna River;
Invertebrate: Brushlegged mayfly / fingernet caddisfly —West Branch Lackawanna River

Ararat Township is notable for its lakes, including Dunn Pond, Ball Lake, Hathaway Lake, and Fiddle Lake. The forest blocks in the township are fragmented by scattered agricultural lands, roads, and other developments, but a few significantly sized blocks remain. One is concentrated around the State Game Lands #236. Conservation efforts to buffer the edges of the Game Lands from development and disturbance are important to the long-term quality of the wildlife and land resources within the Game Lands. Another significant block provides natural protection for several lakes and wetlands in the northeastern corner of the township, including the drainage area for the High Quality East Branch Lackawanna River. Headwater resources of the West Branch Lackawanna River are located in the central portion of the township. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands and headwater streams, and avoiding fragmentation of the largest forest blocks with additional roads. The abundance of water resources in this township put maintenance of water quality high in importance to the natural resources of the township and downstream neighbors. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin.

ARARAT TOWNSHIP MAP

Ararat Township
Susquehanna County, PA



BALL LAKE (Ararat Township)

This site was not ground surveyed during the course of this inventory. The site description is based on aerial photos and historical surveys of the area. This wetland has good quality characteristic bog vegetation that has had only slight modification from a small beaver dam. The wetland consists of an open water area dominated by floating vegetation such as fragrant water lily, but of primary importance is the quaking bog vegetation present on the margins of the open water. The bog mat floats on top of the water, as is characteristic of bogs, quaking underfoot like a big waterlogged sponge. The bog vegetation includes seven plant species of concern in a relatively undisturbed context. The plant species of concern documented at this site include the **G5, S1 PA-endangered few-flowered sedge (*Carex pauciflora*)**. Though this species is considered secure on a global scale, occurring more frequently in the northern US and Canada, it is only currently known to occur in a few bog habitats in northern Pennsylvania. Also at this site are two other uncommon sedges, the **G5, S3 many-fruited sedge (*Carex lasiocarpa*)** and the **G5, S2 mud sedge (*Carex limosa*)**. Other plant species of concern documented at this site include two shrubs; the **G5, S3 PA-rare bog rosemary (*Andromeda polifolia*)**, and the **G5, S2 PA-threatened sweet gale (*Myrica gale*)**. Additionally, the site also contains a **G4G5, S2 PA-threatened species Robbins' spike-rush (*Eleocharis robbinsii*)**, and the **G5, S2 horned bladderwort (*Utricularia cornuta*)**, an insectivorous plant species. All of these uncommon plant species are characteristic of bog–type wetlands in Pennsylvania, and are unlikely to be found in any other type of habitat in the state.

- Threats and Disturbances:

The only disturbance described at this site is due to beaver dam-building activity. Runoff from a nearby local road may impact the wetland.

- Conservation Recommendations:

The relatively undisturbed setting of this bog and the many species of concern documented at the site suggests that this natural community is of high importance for the preservation of biological diversity within the county. The current wetland hydrology should be maintained. The water level should not be raised or lowered. Damming or draining the wetland would severely negatively impact this important natural community. Remove beaver dams as they are formed to prevent the wetland from becoming flooded. It may be necessary to trap beavers if they persist. A 100 meter undisturbed forested buffer around the wetland would help protect the wetland from negative external influences such as non-point sources of pollution and the spread of invasive species of plants. Future development activities within the immediate watershed should be assessed for their impact on this and the other high-quality wetlands nearby. Consider conservation easements on the properties surrounding this bog habitat for future protection of this interesting and fragile ecosystem.

Ball Lake

BURNWOOD POND – (Ararat and Herrick Townships)

The wetland on this site is partially within State Game Lands # 236. A marsh occurs at the northern end of the shallow water pond adjacent to the open water lake. Several small channels wind through the grass and sedge dominated marsh before reaching the pond. A good quality population of the **G5, S2 PA-threatened lesser panicled sedge (*Carex diandra*)** was documented within this wetland. The wetland is currently well buffered from external sources of disturbance by a wide forested buffer.

- Threats and Disturbances:

Changes in the wetland hydrology, such as permanent flooding or draining would reduce the quality of the habitat for this species at this site. Residential development upstream could effect water quality of this wetland.

- Conservation Recommendations:

Preserve the wide undisturbed forested buffer surrounding the wetland. Maintain the current wetland hydrology. The temporary periodic flooding and draining due to beaver activity will likely keep these wetlands in various states of succession. Permanent flooding or draining would likely destroy this natural community.

DUNN LAKE (Ararat Township)

This is a large open-water glacial lake that has had its water level raised slightly by an artificial dam. There is a good diversity of native aquatic plant species present in the lake including several species of concern. The **G4, S1 PA-endangered bayonet rush (*Juncus militaris*) and the G4, S2 PA-threatened water lobelia (*Lobelia dortmanna*)** are both emergent aquatic plant species that have been documented as persisting in Dunn Lake for several decades. These species live in the shallow water margins of the lake. The **horned bladderwort (*Utricularia cornuta*) is a G5, S2 plant species of concern** that is rooted within the substrate of the lakebed, but floats submerged in the water with only its flowering parts protruding above the surface of the water. The **G5, S3 PA-rare many-fruited sedge (*Carex lasiocarpa*)** also occurs along the margins of the lake, but is found alongside the drier, occasionally submerged banks of the lake.

- Threats and Disturbances:

A local gravel road runs along the southern edge of the lake. A boat dock and other boat launching areas occur alongside the road. Boats moved from one waterway to another have the potential to spread invasive aquatic plant species, which could negatively impact the rare native plants at the lake. Despite the raised water levels from the dam at the north end of the lake, the rare plants persist at the site. The lake is currently well buffered from external sources of pollution by an undisturbed forest. Removal or modification of this forested buffer by development of the lakeshore would detrimentally impact the water quality of this aquatic habitat. An influx of nutrients, chemicals and sediment would likely result from lakeshore development, detrimentally impacting the water quality and this aquatic habitat.

A portion of the Dunn Lake wetland complex

- Conservation Recommendations:

Besides the roadway skirting the southern edge, there is a good undisturbed forested buffer surrounding the lake. Any future development activities should be encouraged to cluster housing away from the lakeshore and leave a wide undisturbed forested buffer along the lake edge. A slight and gradual reduction in the water level may improve the habitat for the plant species of concern. All boats should be cleaned of any plant parts before entering the lake ecosystem. An ounce of weed prevention is worth a pound of cure.

HATHAWAY LAKE (Ararat Township)
This open water lake has a small population of **many-fruited sedge (*Carex lasiocarpa*), a G5, S3 plant species of concern** along its shoreline. The lake is also noteworthy because of the high numbers of freshwater mussels found in the lake. Large populations of two species of mussels, eastern floater (*Pyganodon cataracta*) and eastern elliptio (*Elliptio complanata*), were observed in the shallow margins of the lake. These freshwater mussel species are considered common in Pennsylvania, but are noteworthy due to the large size of the populations.

- Threats and Disturbances:

There is a dam at the outlet of the lake, artificially raising the water level. The lake has a wide forested buffer on the west between the lake and a local road. There is a narrower tree line on the eastern side, buffering the lake from agricultural fields. There was also evidence of beaver activity, but this will not likely negatively impact this plant species.

- Conservation Recommendations:

The plant species of concern found at this site appears to be thriving in the current conditions. Efforts should concentrate on protecting the forested buffer around the lake. This will help maintain the water quality by slowing runoff and filtering sediment and nutrients before they enter the lake.


Carex lasiocarpa – Hathaway Lake

Dominant and characteristic species of Hathaway Lake

Scientific name	Common Name	*Scientific name*	Common Name
	Shrubs		
Alnus incana	speckled alder	*Viburnum recognitum*	northern arrow-wood
Chamaedaphne calyculata	leatherleaf	*Vaccinium corymbosum*	highbush blueberry
Spiraea alba	narrow-leaved meadow-sweet		
	Herbs		
Brasenia schreberi	watershield	*Leersia oryzoides*	rice cutgrass
Calla palustris	wild calla	*Lysimachia terrestris*	swamp loosestrife
Carex comosa	bristly sedge	*Myosotis scorpioides*	true forget-me-not
Carex echinata	little prickly sedge	*Nuphar lutea*	yellow cowlily
Carex gynandra	sedge	*Onoclea sensibilis*	sensitive fern
Carex stipata	stalk-grain sedge	*Phalaris arundinacea*	reed canary grass
Carex stricta	tussock sedge	*Pontederia cordata*	pickerel weed
Carex lasiocarpa	slender sedge	*Potentilla palustris*	marsh cinquefoil
Dulichium arundinaceum	three-way sedge	*Sparganium chlorocarpum*	greenfruit bur-reed
Iris versicolor	blueflag	*Triadenum virginicum*	marsh St. John's wort
Juncus effusus	soft rush		
	Mammals		
Castor canadensis	American beaver		
	Reptiles		
Chelydra serpentina	snapping turtle	*Chrysemys picta*	painted turtle
	Mollusks		
Elliptio complanata	eastern elliptio	*Pyganodon cataracta*	eastern floater

ORSON MUD POND – (Ararat Township and Wayne County)

This interesting wetland complex contains portions of the headwaters of the East Branch of the Lackawanna River. Sections of the wetland complex are peat accumulating, but with the flow of water bringing nutrient laden water to the wetland, it creates a fen rather than a bog habitat. Beaver activity has periodically raised the water level along the stream resulting in several ponded areas. The open water areas are bordered by a variety of wetlands including sedge meadows, shrub swamps and forested swamps. This diversity of habitats hosts a wide variety of plants and animals including six plant species and one animal species of concern. Plant species of concern documented at this location include the **globally rare G3, S1 PA-endangered Jacobs ladder (*Polemonium van-bruntiae*)**, a good quality population of the **G5, S2 PA-threatened sweet gale (*Myrica gale*)**, the **G5, S3 many-fruited sedge (*Carex lasiocarpa*)** and the **G5, S2 marsh bedstraw (*Galium trifidum*)**, all of which occur along the edges of the open water portions of the wetland. Within the water of the ponds and streams occur an interesting collection of aquatic plant species including the **G5, S2 PA-threatened floating heart (*Nymphoides cordata*)**, the **G5, S3 White water-crowfoot (*Ranunculus aquatilis var. diffusus*)** and the **G5, S1 PA-endangered blunt-leaved pondweed (*Potamogeton obtusifolius*)**. A dragonfly species of concern, the **G5, S2 Red-waisted Whiteface (*Leucorrhinia proxima*)** was also documented at this location.

- Threats and Disturbances:

Roads occur on three sides of this wetland complex. Activities upstream in the Lackawanna River as well as the adjacent uplands can have a significant impact on the habitat for these species. Currently, the wetland is well buffered from external disturbances by a forested buffer. Removal or modification of the forested buffer can have a significant impact on the quality of the habitat for these species. Two houses have recently been constructed on the edges of the wetland.

- Conservation Recommendations:

Maintain the current wetland hydrology by avoiding permanent draining or flooding. Periodic water level changes due to beavers can also negatively influence the habitat at this location. Beavers may need to be trapped if raised water levels threaten to drown the adjacent lowlands. Preserve the forested buffer surrounding the wetland. Additional residential construction should be strongly discouraged with 100 meters of this wetland. Nutrient loads from household septic systems should be monitored for their discharge to the wetland and modified accordingly. Herbicide use should be strongly avoided in this area. Preserve the naturally vegetated edges of the wetland and avoid cutting shrubs and plants to within 100 meters of the waters edge.

Dominant and characteristic species of Orson Mud Pond

Shrubs			
Alnus incana	speckled alder	*Rosa palustris*	swamp rose
Aronia arbutifolia	red chokeberry	*Spiraea latifolia*	northern meadow-sweet
Aronia melanocarpa	black chokeberry	*Vaccinium corymbosum*	highbush blueberry
Cephalanthus occidentalis	buttonbush	*Vaccinium macrocarpon*	large cranberry
Chamaedaphne calyculata	leatherleaf	*Viburnum cassinoides*	witherod
Ilex verticillata	winterberry holly	*Viburnum recognitum*	northern arrow-wood
Myrica gale	sweet-gale		
Herbs			
Brasenia schreberi	watershield	*Nuphar lutea*	yellow cowlily
Calamagrostis canadensis	blue-joint reedgrass	*Osmunda cinnamomea*	cinnamon fern
Carex atlantica	prickly bog sedge	*Phalaris arundinacea*	reed canary grass
Carex comosa	bristly sedge	*Pontederia cordata*	pickerel weed
Carex gynandra	sedge	*Potentilla palustris*	marsh cinquefoil
Carex lasiocarpa	slender sedge	*Ranunculus aquatilis var diffusus*	white water-crowfoot
Cicuta bulbifera	bulb-bearing water-hemlock	*Scirpus cyperinus*	wool-grass
Decodon verticillatus	hairy swamp loosestrife	*Scutellaria galericulata*	hooded skullcap
Dulichium arundinaceum	three-way sedge	*Sium suave*	hemlock water-parsnip
Galium trifidum	marsh bedstraw	*Solanum dulcamara*	climbing nightshade
Glyceria canadensis	Canada manna-grass	*Thelypteris palustris*	marsh fern
Iris versicolor	blueflag	*Typha latifolia*	broad-leaf cattail
Juncus effusus	soft rush	*Utricularia macrorhiza*	greater bladder-wort
Lysimachia thyrsiflora	water loosestrife		
Birds			
Aix sponsa	wood duck	*Dumetella carolinensis*	gray catbird
Catharus fuscescens	veery	*Empidonax traillii*	willow flycatcher
Ceryle alcyon	belted kingfisher	*Hirundo rustica*	barn swallow
Columba livia	rock dove	*Lophodytes cucullatus*	hooded merganser
Cyanocitta cristata	blue jay		
Amphibians		**Reptiles**	
Rana clamitans	green frog	*Chrysemys picta*	painted turtle

PINE SWAMP – (Ararat Township)

A small, open water, beaver created pond at this location is flanked by a larger sedge meadow and shrub swamp which grades into a forested wetland as it progresses upstream. Two plant species of concern and two animal species of concern were documented at this area. The **G5, S2 marsh bedstraw (*Galium trifidum*)**, and the **G5, S1 marsh willow-herb (*Epilobium palustre*)** both occur within the sedge meadow-shrub swamp zones of the wetland. A dragonfly species of concern, the G5, S3S4 red waisted whiteface dragonfly, and two animal species use the entire wetland and the adjacent woodlands as their primary and secondary habitat. The wetland is currently well buffered by a wide undisturbed forested buffer.

- Threats and Disturbances:

No current disturbances were observed at this location. Potential threats include flooding or draining of the wetland, removal or modification of the surrounding forested buffer, or conversion from it present use as woodlot and passive recreation to development.

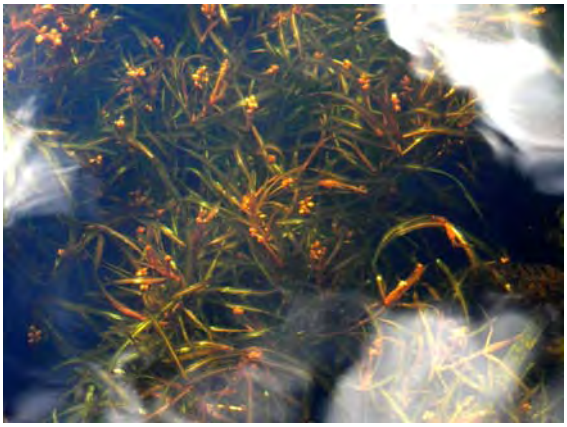
- Conservation Recommendations:

As with most wetland sites in the county, protection of the habitat for these species of concern includes maintaining the current wetland hydrology by avoiding draining or flooding, and preservation of the wide undisturbed forested buffer surrounding the wetland. The temporary periodic flooding and draining due to the ebb and flow of beaver activity will likely keep these wetlands in various states of succession. Permanent flooding or draining would likely destroy this natural community. Construction of roads or additional residences within 100 meters of this wetland should be strongly discouraged.

Dominant & characteristic species of Pine Swamp

Scientific Name	Common Name
	Trees
Acer rubrum	red maple
Acer saccharum	sugar maple
Tsuga canadensis	eastern hemlock
	Shrubs
Aronia melanocarpa	black chokeberry
Rosa multiflora	multiflora rose
Rubus hispidus	bristly dewberry
Vaccinium corymbosum	highbush blueberry
Vaccinium macrocarpon	large cranberry
	Herbs
Calla palustris	wild calla
Carex atlantica	prickly bog sedge
Carex comosa	bristly sedge
Carex crinita	fringed sedge
Carex gynandra	sedge
Carex lacustris	lake-bank sedge
Carex lurida	shallow sedge
Carex scoparia	pointed broom sedge
Carex stricta	tussock sedge
Carex utriculata	sedge
Dryopteris cristata	crested shield-fern
Dulichium arundinaceum	three-way sedge
Epilobium palustre	marsh willow-herb
Galium trifidum	marsh bedstraw
Hypericum boreale	northern St. John's-wort
Iris versicolor	blueflag
Juncus effusus	soft rush
Lysimachia terrestris	swamp loosestrife
Nuphar lutea	yellow cowlily
Onoclea sensibilis	sensitive fern
Potentilla palustris	marsh cinquefoil
Sagittaria latifolia	broadleaf arrowhead
Schoenoplectus tabernaemontani	soft-stem bulrush
Scirpus cyperinus	woolgras
Scutellaria galericulata	hooded skullcap
Sium suave	hemlock water-parsnip
Spiraea latifolia	northern meadow-sweet
Triadenum virginicum	marsh St. John's wort
Typha latifolia	broad-leaf cattail
	Amphibians
Hyla crucifer	spring peeper
Notophthalmus viridescens	eastern newt
Rana catesbeiana	bullfrog
Rana clamitans	green frog
Rana palustris	pickerel frog

Orson Mud Pond



Blunt-leaved pondweed in Orson Mud Pond

ROMOBE LAKE - (Ararat Township)

This bog-like wetland has distinctive bog vegetation on a series of floating islands. The wetland has slightly elevated water levels due to a man-made dam, which likely flooded the outer edges of the bog vegetation. The floating islands are remnants of the bog vegetation that likely covered much of the open water at this location. The floating mats support a good diversity of characteristic bog vegetation including five plant species of concern. The floating islands are dominated by leatherleaf, a common evergreen shrub of acidic wetlands, interspersed with the **G5, S3 PA-rare shrub bog rosemary (*Andromeda polifolia*)**. Together, these two shrub components make up a **Leatherleaf-bog rosemary Peatland Natural Community** that dominates much of the floating mats at this site. Among the plant species of concern at this location is the **G5, S1 PA-endangered rough cotton-grass (*Eriophorum tenellum*).** This relative of the more common tawny cotton-grass is considered globally secure, but is quite rare in Pennsylvania where it is currently only known from a few sites in the state. This habitat also contains two uncommon sedges, the **G5, S3 many-fruited sedge (*Carex lasiocarpa*),** the **G5, S2 mud sedge (*Carex limosa*)** and the **G5, S2 horned bladderwort (*Utricularia cornuta*)**, an insectivorous plant species. The **G4G5, S2 bog copper butterfly (*Lycaena epixanthe*)** was also observed on the vegetation mats. This is a butterfly that depends on cranberry plants for its only food source while in its larval stage. The host plant of this species, cranberry, occurs frequently throughout these wetlands. A host plant specialist, the distribution of bog copper is linked directly to the habitat of the cranberry. Loss of cranberry wetlands can severely diminish occurrences of this species. **The G5, S3 Slaty Skimmer dragonfly (*Libellula incesta*)** was also documented at this location. This species uses the wetland as its primary habitat. Reduction of wetland quality by changes in hydrology (permanent draining or flooding), or degradation of water quality could severely impact this population.

- Threats and Disturbances:

Despite the existence of an artificial dam, the bog vegetation appears to be in good condition. There are patches of cat-tails, which suggests that nutrients are entering the normally nutrient poor environment. Several houses are clustered along a small section of the shoreline. An abandoned rail line runs along one edge of the wetland.

- Conservation Recommendations:

This is an example of a good quality bog habitat in a relatively undisturbed surrounding. The current wetland hydrology should be maintained or slightly and gradually lowered to allow the bog vegetation to recolonize the wetland. Avoid building permanent dams or drainage channels. Remove beaver dams as they are formed to prevent the wetland from becoming overly flooded. It may be necessary to trap beavers if they persist. Further development should be discouraged adjacent to this bog-wetland. Cutting and the use of herbicides along the pond shoreline should be avoided. Access from the abandoned rail line should be limited to avoid the spread of invasive species of plants and destruction of this fragile habitat. A 100 meter undisturbed forested buffer around the wetland would help protect the wetland from negative external influences such as non-point sources of pollution and the spread of invasive species of plants. Future development activities within the immediate watershed should be assessed for their impact on this and nearby high-quality wetlands. Consider conservation easements on the properties surrounding this bog habitat for future protection of this interesting and fragile ecosystem.

Dominant and characteristic plant species of Romobe Lake

	Trees		
Acer rubrum	red maple	*Betula populifolia*	gray birch
	Shrubs		
Alnus incana	speckled alder	*Spiraea latifolia*	northern meadow-sweet
Andromeda polifolia	bog-rosemary	*Spiraea tomentosa*	hardhack spiraea
Aronia melanocarpa	black chokeberry	*Vaccinium corymbosum*	highbush blueberry
Chamaedaphne calyculata	leatherleaf	*Vaccinium macrocarpon*	large cranberry
Kalmia polifolia	pale laurel	*Vaccinium oxycoccos*	small cranberry
Rosa palustris	swamp rose		
	Herbs		
Brasenia schreberi	watershield	*Nuphar lutea*	yellow cowlily
Calla palustris	wild calla	*Nymphaea odorata*	American water-lily
Carex atlantica	prickly bog sedge	*Onoclea sensibilis*	sensitive fern
Carex canescens	hoary sedge	*Pogonia ophioglossoides*	rose pogonia
Carex lasiocarpa	slender sedge	*Pontederia cordata*	pickerel weed
Carex limosa	mud sedge	*Potentilla palustris*	marsh cinquefoil
Carex stricta	tussock sedge	*Rhynchospora alba*	white beakrush
Carex trisperma	three-seed sedge	*Sagittaria latifolia*	broadleaf arrowhead
Carex utriculata	sedge	*Sarracenia purpurea*	northern pitcher-plant
Drosera intermedia	spoon-leaved sundew	*Symplocarpus foetidus*	skunk cabbage
Drosera rotundifolia	roundleaf sundew	*Thelypteris palustris*	marsh fern
Dulichium arundinaceum	three-way sedge	*Triadenum virginicum*	marsh St. John's wort
Eriophorum tenellum	rough cotton-grass	*Typha latifolia*	broad-leaf cattail
Iris versicolor	blueflag	*Utricularia cornuta*	horned bladderwort
Lysimachia terrestris	swamp loosestrife	*Utricularia macrorhiza*	greater bladder-wort
Menyanthes trifoliata	bog buckbean		

TINGLEPAUGH SWAMP – (Ararat Township)

State Gamelands #236 contains a large, beaver impacted wetland complex that includes forested swamps, shrub swamps, sedge meadows, mud flats and open water. This site supports a population of the **G5, S3 PA-rare plant soft leaved sedge (*Carex disperma*)**, which occurs in the forested hemlock swamp at the edge of the wetland opening. The wetland has apparently undergone periodic flooding from beaver activity as evidenced by the numerous dead trees within the wetland.

- Threats and Disturbances:

This site is almost completely within State Game Lands #236, which should help keep the immediate wetland from conversion to residential development. There is potential for destructive flooding of this wetland to create an open water habitat. Much of the surrounding upland has been planted in the invasive shrub species multiflora rose and autumn olive. These two shrub species can potentially invade the wetland margins, displacing native species of plants.

- Conservation Recommendations:

Maintain the current wetland hydrology. The temporary periodic flooding and draining due to beaver activity will likely keep these wetlands in various states of succession. Permanent flooding or draining would likely destroy this natural community. Maintain the undisturbed forested buffer surrounding the wetland. Remove the invasive shrubs multiflora rose and autumn olive as soon as possible to prevent their further expansion. Native replacements could include shrubs that already occur adjacent to this wetland like northern arrow-wood (*Viburnum recognitum*), steeplebush (*Spiraea tomentosa*), meadow-sweet (*Spiraea alba*), high bush blueberry (*Vaccinium corymbosum*), speckled alder (*Alnus incana*) and winterberry holly (*Ilex verticillata*).

Dominant and characteristic plant species of Tinglepaugh Swamp

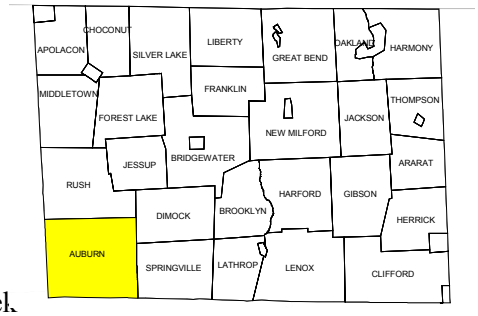
Trees	
Acer rubrum	red maple
Acer saccharum	sugar maple
Betula alleghaniensis	yellow birch
Fagus grandifolia	American beech
Tsuga canadensis	eastern hemlock
Shrubs	
Alnus incana	speckled alder
Ilex verticillata	winterberry holly
Rosa multiflora	multiflora rose
Spiraea alba	narrow-leaved meadow-swee
Spiraea latifolia	northern meadow-sweet
Spiraea tomentosa	hardhack spiraea
Vaccinium corymbosum	highbush blueberry
Viburnum cassinoides	witherod
Viburnum recognitum	northern arrow-wood
Herbs	
Callitriche palustris	vernal water starwort
Carex echinata	little prickly sedge
Carex folliculata	long sedge
Carex gynandra	sedge
Carex lacustris	lake-bank sedge
Carex lurida	shallow sedge
Carex stipata	stalk-grain sedge
Carex stricta	tussock sedge
Carex utriculata	sedge
Dulichium arundinaceum	three-way sedge
Juncus effusus	soft rush
Lysimachia terrestris	swamp loosestrife
Osmunda cinnamomea	cinnamon fern
Phalaris arundinacea	reed canary grass
Potentilla palustris	marsh cinquefoil
Rubus hispidus	bristly dewberry
Scirpus cyperinus	Wool-grass

Tinglepaugh Swamp

AUBURN TOWNSHIP

Site Name	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
None						

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: Tuscarora Lake

Managed Lands: None

Aquatic Classification Project Results:

Fish: Warm Water Community 1—Tuscarora Creek, Meshoppen Creek
Fish: River and Impoundment Community—West Branch Meshoppen Creek
Invertebrate: Rolledwinged stonefly / Small minnow mayfly —Riley Creek, West Branch Meshoppen Creek
Invertebrate: Brushlegged mayfly / fingernet caddisfly —Meshoppen Creek

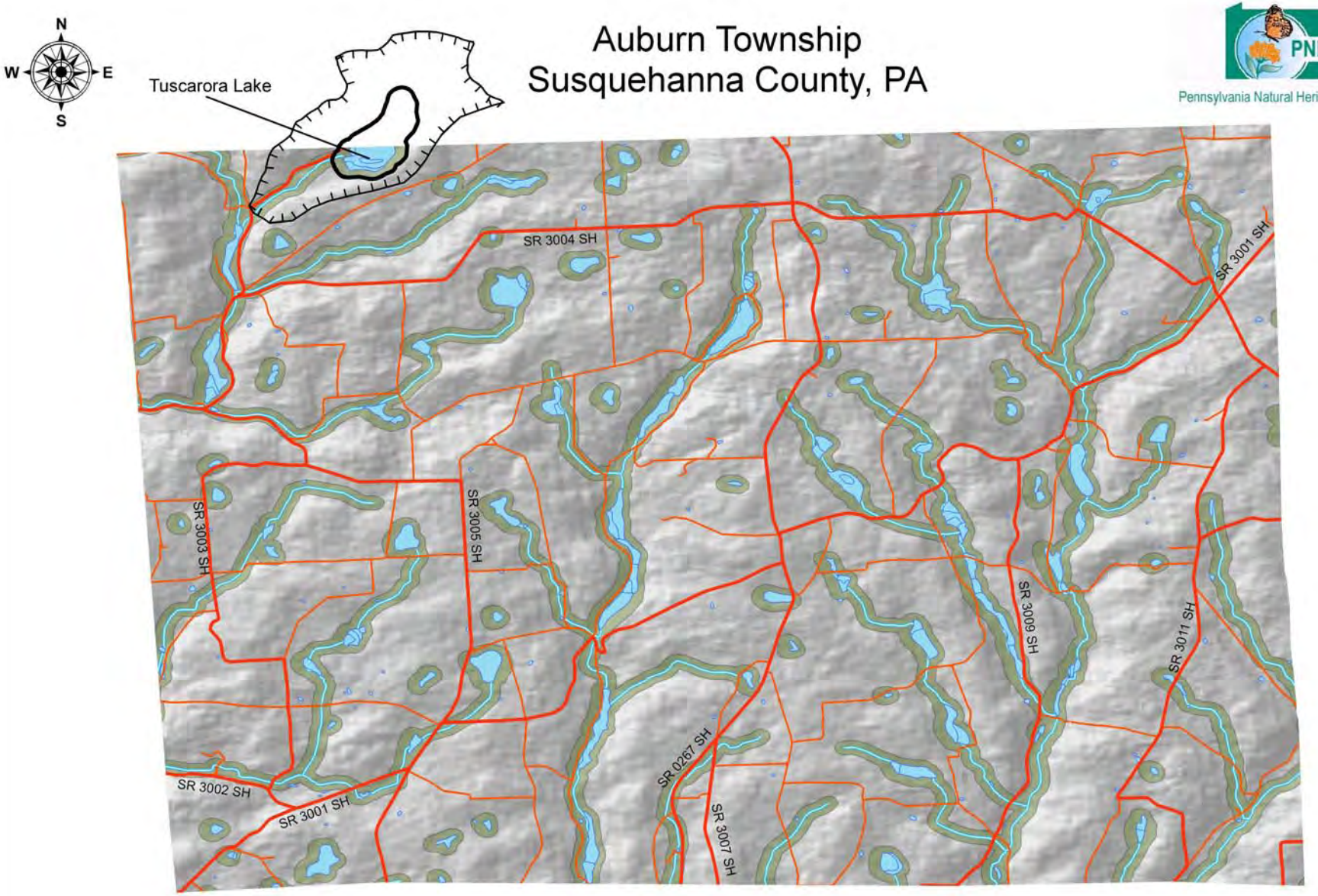
Auburn Township is drained primarily by tributaries of Meshoppen Creek. The township is dominated by cleared land, agriculture, and roads, which have fragmented most of the forest and wetland areas. The abundance of water resources in this township put maintenance of water quality high in importance to the natural resources of the township and downstream neighbors. Though fragmented, most of the remaining woodlands in the township follow the drainages and many include wetlands and lakes, such as White Pond, Nick Pond, and Carlin Pond. Therefore, the focus of conservation in this township should be maintaining and providing buffers to streams and wetlands. Restoration efforts should focus on riparian plantings along creeks and providing buffers to natural wetlands. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor.

Locally Significant Sites:

Tuscarora Lake – (Auburn and Rush Townships)
Tuscarora Lake was not ground surveyed during the period of this project, but information regarding this wetland was interpreted from aerial photos of the area. This wetland appears to be a former bog habitat that has been flooded in the past by a man-made dam to create an open water lake. Remnants of the former bog vegetation in the form of floating islands appear to persist within the lake. Species of plants restricted to bog habitats may still occur on these floating islands, and will likely persist in this fragmented condition

Auburn Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

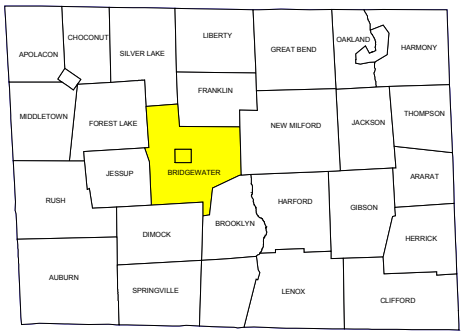
Scale:1:80,000

0 0.5 1 2 Miles

BRIDGEWATER TOWNSHIP and Montrose Borough

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
MONTROSE HIGH SCHOOL WETLAND (5)	Natural Community: Hemlock Palustrine Forest	GNR	S3	N	2005-6-14	E
NORTH POND (2)	Natural Community: Leatherleaf-bog rosemary peatland	GNR	S2	N	2005-6-16	E
	Plant: Bog rosemary *(Andromeda polifolia)*	G5	S3	PR	2005-6-16	E
	Plant: Many-fruited sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-6-16	E
	Plant: Water bulrush *(Shoenoplectus subterminalis)*	G4G5	S3	N	2005-6-16	E
	Plant: Horned bladderwort (*Utricularia cornuta*)	G5	S2	N	2005-6-16	E
	Plant: Flat-leaved bladderwort (*Utricularia intermedia*)	G5	S2	PT	2005-6-16	E
	Plant: Robbins" spike rush (*Eleocharis robbinsii*)	G4G5	S2	PT	2005-6-16	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

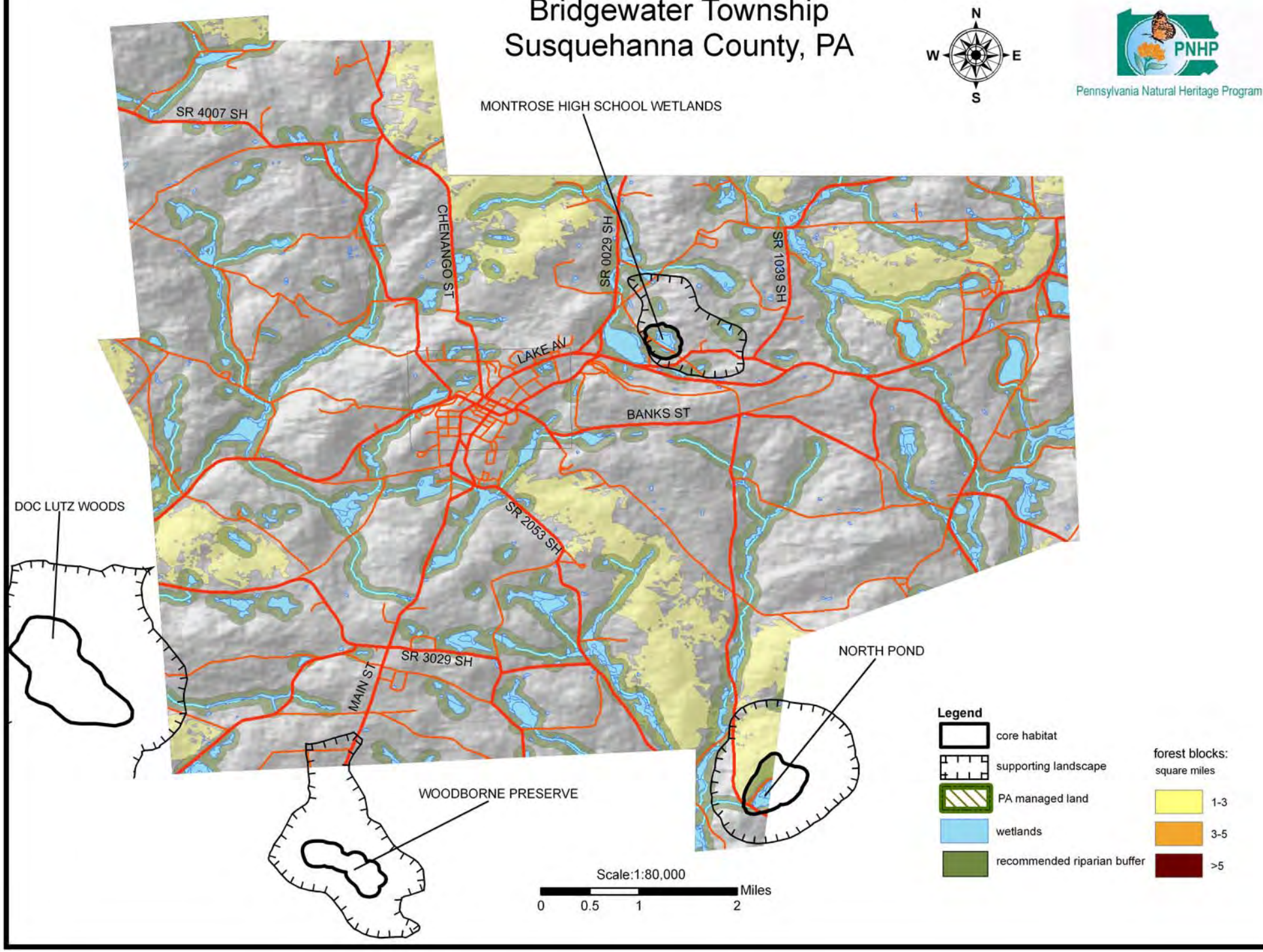
Managed Lands: None

Aquatic Classification Project Results:

Fish: Warm Water Community 1—Snake Creek, West Branch Meshoppen Creek, East Branch Wyalusing Creek;
Fish: Cool Water Community 1—Silver Creek;
Invertebrate: Rolledwinged stonefly / Small minnow mayfly —West Branch Meshoppen Creek;
Invertebrate: Brushlegged mayfly / fingernet caddisfly —Snake Creek

BRIDGEWATER TOWNSHIP MAP

Bridgewater Township
Susquehanna County, PA



BRIDGEWATER TOWNSHIP

Bridgewater Township is more populous than much of the county, being home to the county seat, Montrose. Much of the township is in agriculture, with the northeastern portion more forested. The headwaters of several county streams originate here, including East and South Branch Wyalusing Creek and Meshoppen Creek. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. In particular, protection and maintenance of the forest blocks highlighted in this report will support the maintenance of water quality in the township's streams. Efforts to additionally restore riparian buffers along additional stretches of stream will improve these corridors for wildlife and water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Development in the township is increasing more than most parts of the county, so efforts to plan around these natural features become increasingly important.

Early coral-root (*Corallorhiza trifida*), an uncommon, but not rare saprophytic orchid found in Montrose High School Wetlands

Rich plant diversity in the Hemlock Palustrine Forest of Montrose High School Wetland

MONTROSE HIGH SCHOOL WETLAND – (Bridgewater Township)

A small forested wetland near the Montrose High School consists primarily of a hemlock canopy over a mound and pool microtopography that makes up a **Hemlock Palustrine Forest Natural Community** of surprising quality. The saturated soils of this forest provide the hemlock trees over this wetland with a weak hold on their position. The trees are frequently toppled by high winds, forming pools where the roots had been and elevated mounds where they are lifted. Sphagnum mosses cover the ground forming mounds or hummocks upon which other plants grow, being slightly elevated within the wetland. The deep muck soils, pools and sphagnum mounds support an interesting array of plants of a more northern affinity. Cinnamon ferns form dense patches under portions of the hemlock canopy. Beneath and between the ferns grow an interesting mix of plant species.

- Threats and Disturbances:

This wetland habitat is bordered by roads, agricultural fields and scattered residences. Most of the uphill area of Birchard Hill, which drains into the wetland, is forested with some areas in pasture and conifer plantations. The proximity of this wetland to roads and agricultural fields makes it susceptible to colonization by introduced and invasive species of plants. Clearing of the upland forest for residential development could detrimentally impact the quality of the wetland habitat.

- Conservation Recommendations:

The proximity of this quality natural environment to the local high school makes it a valuable outdoor component of Biology classes. As with most naturally occurring wetlands in the county, the integrity of the natural community can be preserved by maintaining the wetland hydrology, and preserving and expanding the forested buffer surrounding the wetland. Activities in the uphill portions of the watershed should be scrutinized for their potential impact on this scenic natural community.

Dominant & characteristic species of plants at Montrose High School Wetland

Scientific Name	Common Name
	Trees
Acer rubrum	red maple
Betula alleghaniensis	yellow birch
Tsuga canadensis	eastern hemlock
	Shrubs
Alnus incana	speckled alder
Ilex verticillata	winterberry holly
Kalmia angustifolia	sheep-laurel
Lindera benzoin	spicebush
Spiraea tomentosa	hardhack spiraea
Toxicodendron radicans	eastern poison ivy
	Herbs
Aralia nudicaulis	wild sarsaparilla
Arisaema triphyllum	jack-in-the-pulpit
Asclepias incarnata	swamp milkweed
Calla palustris	wild calla
Carex debilis	white-edge sedge
Carex gynandra	sedge
Carex prasina	drooping sedge
Carex scoparia	pointed broom sedge
Carex trisperma	three-seed sedge
Carex vulpinoidea	fox sedge
Chelone glabra	white turtlehead
Clintonia borealis	bluebead lily
Coptis trifolia	goldthread
Corallorhiza trifida	early coralroot
Dryopteris carthusiana	spinulose shield fern
Juncus effusus	soft rush
Ludwigia palustris	marsh seedbox
Lysimachia terrestris	swamp loosestrife
Maianthemum canadense	wild lily-of-the-valley
Medeola virginiana	indian cucumber-root
Onoclea sensibilis	sensitive fern
Osmunda cinnamomea	cinnamon fern
Phalaris arundinacea	reed canary grass
Polygonum sagittatum	arrow-leaved tearthumb
Saxifraga virginiensis	Virginia saxifrage
Thelypteris noveboracensis	New York fern
Trientalis borealis	star-flower

NORTH POND (Bridgewater & Brooklyn Townships)

This site contains a peat-forming wetland that exhibits bog characteristics and six plant species of concern: the **G5, S2 horned bladderwort (*Utricularia cornuta*);** the **G5, S2 flat-leaved bladderwort (*Utricularia intermedia*);** the **G5, S3 water bulrush *(Schoenoplectus subterminalis);*** the **G4G5, S3 many-fruited sedge (*Carex lasiocarpa*);** the **G5G4, S2 Robbins' spike rush (*Eleocharis robbinsii*);** and the **G5, S3 bog rosemary *(Andromeda polifolia)***. The dominance of the low shrub bog rosemary together with the shrub leatherleaf form a **Leatherleaf-bog rosemary peatland Natural Community**, an uncommon type of plant assemblage in Pennsylvania, but more common in portions of New England and Canada. The wetland is primarily surrounded by a wide undisturbed forest. Much of the open water of the wetland is dominated by floating aquatic plants such as yellow pond lily, fragrant water lily, pickerel weed and water-shield. The southern shore of the pond contains a fragile floating vegetation mat that has grown on the sphagnum moss substrate that is very slowly colonizing the open water of the pond. The vegetation mat supports characteristic acid-tolerant bog vegetation such as leatherleaf, large cranberry, bog buckbean, rose pogonia, and the insectivorous pitcher plant. Stunted hemlocks, white pines, sugar and red maples increase in size with distance from the leading edge of the bog mat. The rare plant elements documented at this location are found scattered throughout the vegetation mat and the shoreline of the pond.

- Threats and Disturbances:

The water level may have been raised slightly by beaver activity, and beaver dams should be removed as they occur. Beavers can severely damage bog vegetation by flooding the habitat and eating and cutting the adjacent trees and other vegetation. There are a few widely–spaced residences and boat docks on the banks of the wetland.

- Conservation Recommendations:

Maintain the current hydrology of this wetland. Permanent flooding or draining should be avoided. Remove beaver dams as they occur to discourage permanent settlement. Further residential development should be discouraged adjacent to this bog-wetland. Homeowners should avoid cutting and the use of herbicides near the pond shoreline. Maintain the wide forested buffer surrounding this wetland. The forested buffer helps protect the wetland from siltation and contamination from non-point sources of pollution. Consider conservation easements on the properties surrounding this bog habitat for future protection of this interesting and fragile ecosystem.

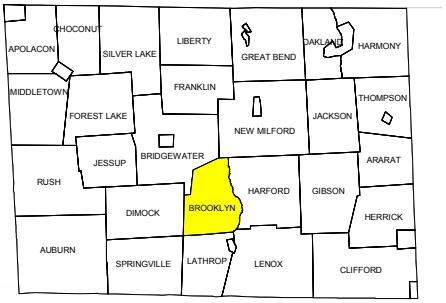
Dominant & characteristic plant species of North Pond

Scientific Name	Common Name
	Trees
Acer rubrum	red maple
Acer saccharum	sugar maple
Fagus grandifolia	American beech
Pinus strobus	eastern white pine
Prunus serotina	black cherry
Quercus rubra	northern red oak
Tsuga canadensis	eastern hemlock
	Shrubs
Alnus incana	Speckled alder
Andromeda polifolia	bog-rosemary
Aronia arbutifolia	red chokeberry
Aronia melanocarpa	black chokeberry
Cephalanthus occidentalis	buttonbush
Chamaedaphne calyculata	leatherleaf
Ilex verticillata	winterberry holly
Kalmia latifolia	mountain-laurel
Rosa palustris	swamp rose
Rubus hispidus	bristly dewberry
Vaccinium macrocarpon	large cranberry
	Herbs
Brasenia schreberi	watershield
Carex echinata	little prickly sedge
Carex lacustris	lake-bank sedge
Carex lasiocarpa	slender sedge
Carex lurida	shallow sedge
Dulichium arundinaceum	three-way sedge
Juncus effusus	soft rush
Lysimachia terrestris	swamp loosestrife
Menyanthes trifoliata	bog buckbean
Nuphar lutea	yellow cowlily
Nymphaea odorata	American water-lily
Onoclea sensibilis	sensitive fern
Osmunda cinnamomea	cinnamon fern
Pogonia ophioglossoides	rose pogonia
Pontederia cordata	pickerel weed
Sarracenia purpurea	northern pitcher-plant
Thelypteris palustris	marsh fern
Triadenum virginicum	marsh St. John's wort

BROOKLYN TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
LINDAVILLE MARSH (4)	Animal species of concern	G5	S2S3B	N	2005-7-21	E
	Animal species of concern	G5	S3B	N	2005-7-21	E
NORTH POND (2)	Natural Community: Leatherleaf-bog rosemary peatland	GNR	S2	N	2005-6-16	E
	Plant: Bog rosemary *(Andromeda polifolia)*	G5	S3	PR	2005-6-16	E
	Plant: Many-fruited sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-6-16	E
	Plant: Water bulrush *(Schoenoplectus subterminalis)*	G4G5	S3	N	2005-6-16	E
	Plant: Horned bladderwort (*Utricularia cornuta*)	G5	S2	N	2005-6-16	E
	Plant: Flat-leaved bladderwort (*Utricularia intermedia*)	G5	S2	PT	2005-6-16	E
	Plant: Robbins" spike rush (*Eleocharis robbinsii*)	G4G5	S2	PT	2005-6-16	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

Managed Lands: None

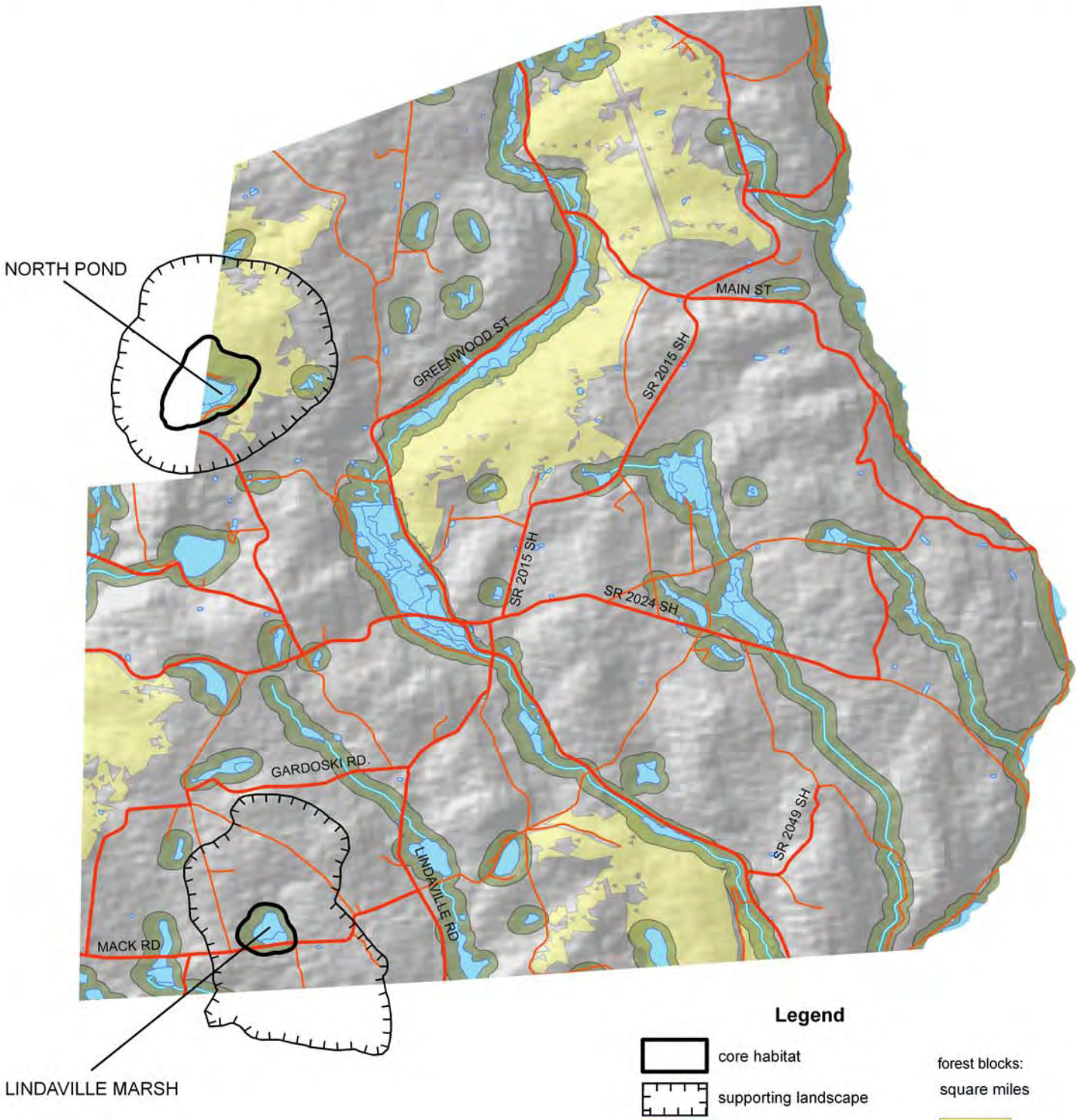
Aquatic Classification Project Results:

Fish: Warm Water Community 1—Horton Creek & Martins Creek

BROOKLYN TOWNSHIP MAP

Brooklyn Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



BROOKLYN TOWNSHIP

Brooklyn Township is characterized by numerous water resources, including wetlands, lakes, and streams, set in a landscape mosaic of agriculture and forestland. The township is drained by Hop Bottom Creek, Dry Creek, and Martins Creek along the eastern boundary and includes headwater streams and lakes such as Ely Lake and Jones Lake. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. Maintenance and restoration of riparian buffers along the creeks are important to the water quality and flow of these watersheds. The two largest intact forest blocks follow the banks of Hop Bottom Creek and can be a starting point for riparian conservation here. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. Restoration efforts should focus on riparian plantings along creeks and providing buffers to natural wetlands. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor.

Green frog among bog plants at North Pond

Part of a Leatherleaf-bog rosemary Peatland Natural Community at North Pond

Horned bladderwort at North Pond

North Pond, a kettlehole bog.

LINDAVILLE MARSH - (Brooklyn Township)

This marsh wetland is dominated by cat-tails, sedges and rushes providing an excellent habitat for **two animal species of concern**. Both of these species are highly habitat specific, primarily utilizing large marshes with emergent vegetation like cat-tails. Both species were also more common in the past before many wetlands were drained for conversion to agricultural uses. These species are still susceptible to reduction across the state due to loss of marsh wetland habitats.

- Threats and Disturbances:

This wetland is bordered by agricultural fields and a few residences on the east and south, but has a good forested buffer on the north and west. Modification of the current wetland hydrology by draining or flooding would reduce the habitat available for these species. Removal of the remaining forested buffer could negatively affect the habitat for these species as well.

- Conservation Recommendations:

As with most wetland habitats in the county, maintain the current wetland hydrology by avoiding flooding or draining. Preserve the remaining forested buffer and reestablish a forested buffer on the western and southern edge of the wetland to protect the wetland from external sources of disturbances.

NORTH POND (Bridgewater & Brooklyn Townships)

This site contains a peat-forming wetland that exhibits bog characteristics and six plant species of concern: the **G5, S2 horned bladderwort (*Utricularia cornuta*);** the **G5, S2 flat-leaved bladderwort (*Utricularia intermedia*);** the **G5, S3 water bulrush *(Schoenoplectus subterminalis);*** the **G4G5, S3 many-fruited sedge (*Carex lasiocarpa*);** the **G5G4, S2 Robbins' spike rush (*Eleocharis robbinsii*);** and the **G5, S3 bog rosemary *(Andromeda polifolia)***. The dominance of the low shrub bog rosemary together with the shrub leatherleaf form a **Leatherleaf-bog rosemary peatland Natural Community**, an uncommon type of plant assemblage in Pennsylvania, but more common in portions of New England and Canada. The wetland is primarily surrounded by a wide undisturbed forest. Much of the open water of the wetland is dominated by floating aquatic plants such as yellow pond lily, fragrant water lily, pickerel weed and water-shield. The southern shore of the pond contains a fragile floating vegetation mat that has grown on the sphagnum moss substrate that is very slowly colonizing the open water of the pond. The vegetation mat supports characteristic acid-tolerant bog vegetation such as leatherleaf, large cranberry, bog buckbean, rose pogonia, and the insectivorous pitcher plant. Stunted hemlocks, white pines, sugar and red maples increase in size with distance from the leading edge of the bog mat. The rare plant elements found at this location are found scattered throughout the vegetation mat and the shoreline of the pond.

- Threats and Disturbances:

The water level may have been raised slightly by beaver activity, and beaver dams should be removed as they occur. Beavers can severely damage bog vegetation by flooding the habitat and eating and cutting the adjacent trees and other vegetation. There are a few widely–spaced residences and boat docks on the banks of the wetland.

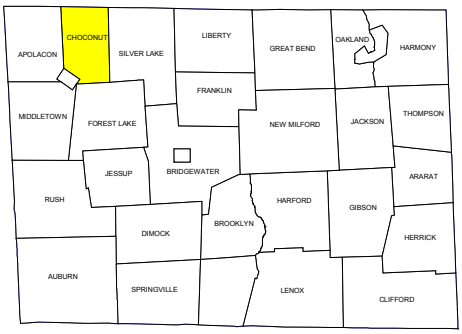
- Conservation Recommendations:

Maintain the current hydrology of this wetland. Permanent flooding or draining should be avoided. Remove beaver dams as they occur to discourage permanent settlement. Further development should be discouraged adjacent to this bog-wetland. Homeowners should avoid cutting along the pond shoreline. Maintain the wide forested buffer surrounding this wetland. Consider conservation easements on the properties surrounding this bog habitat for future protection of this interesting and fragile ecosystem.

CHOCONUT TOWNSHIP and Friendsville Borough

Site Name	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
None						

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks



Locally Significant: Choconut Lake
St. Joseph ravine

Managed Lands: None

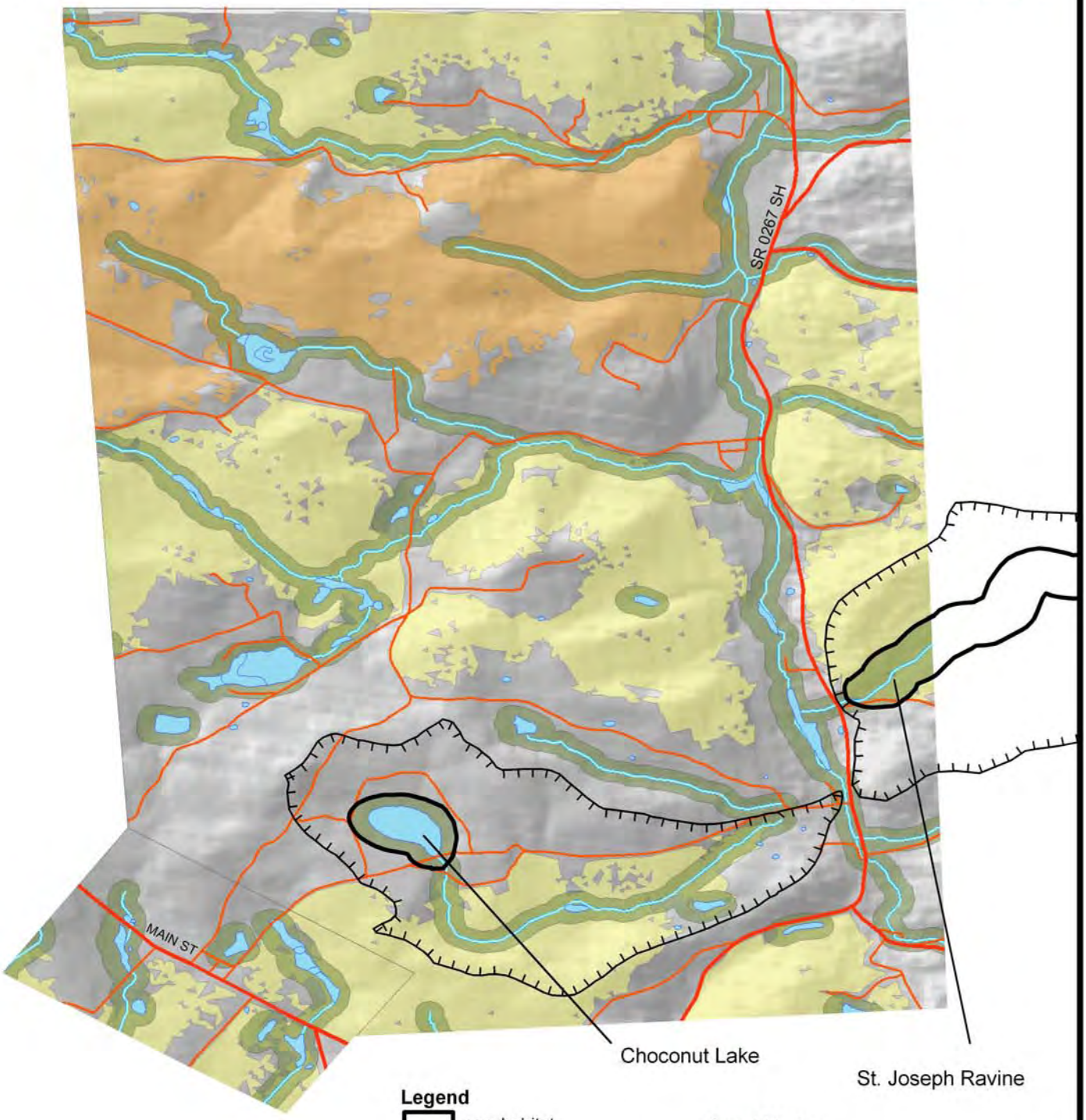
Aquatic Classification Project Results:
Fish: Warm Water Community 2—Gaylord Creek;
Invertebrate: Rolledwinged stonefly / Small minnow mayfly —Apalachin Creek, Wappasening Creek

Choconut Township is a rural area made up of approximately 60% forest and 22% agriculture. Choconut Creek runs the length of the township along the eastern side, and several tributaries feed it from the rest of the township lands. Open and agricultural portions of the township tend to be along these floodplains. Large lakes are dispersed throughout the township, including Stanley Lake and Choconut Lake. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Several large forested blocks, in particular the one bordered on the north by T693, provide connectivity to neighboring townships for movement of wildlife and integrity of natural plant communities. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. Conservation efforts within the township could concentrate on replanting riparian buffers along the Choconut Creek watershed. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor.

CHOCONUT TOWNSHIP MAP

Choconut Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

Scale:1:55,000

0 0.5 1 2 Miles

Locally significant sites:

Choconut Lake (Choconut Township)

Choconut Lake, like many of Susquehanna County's lakes, is an open, deep-water lake of glacial origin. The lake was likely formed as glaciers retreated from their southern advance into Susquehanna County. The basin of the lake may be the result of a large chunk of glacial ice buried in loose rocks and rubble that was pushed ahead of the advancing glacier. The lake is currently surrounded by a fairly intact forested buffer, despite some small camp cottages at one end and a narrow lane that circles the lake. The lake hosts a good variety of native aquatic vegetation as well as a large and active population of dragonflies and damselflies.

- Threats and Disturbances:

A small camp development is concentrated in one location along the southern shore of the lake. The small road that rings the lake may allow invasive species of plants to infiltrate the forest.

- Conservation Recommendations.

Outflow from camp facilities should be tested periodically for their impact on water quality at the lake and improvements implemented as needed. Further development of the lake shore should be discouraged. Future developments should be clustered in a single location away from the lake shore to provide a buffer between residential discharge and the lake. The lane ringing the lake should be left as an unimproved access lane, or allowed to grow over.

St. Joseph Ravine (Choconut & Silver Lake Townships)

St. Joseph Ravine is a hemlock/white pine/mixed northern hardwood forest with higher concentrations of hemlocks alongside the stream and mixed hardwoods and white pine dominating the upland areas. This scenic forested ravine with wet rock outcrops and waterfalls has a variety of wildflowers and plants of a more northern affinity. The site also contains an excellent diversity of neo–tropical migrant songbirds. The area appears especially important to hemlock-dependent songbirds such as Black-throated Green Warblers, Blackburnian Warbler, and Blue-headed Vireo. Overall, the forested ravien and slopes contribute greatly to local biodiversity, providing a contiguous forest with a high quality stream that is well-buffered. The low numbers of exotic invasive plants also increases the biodiversity of this area.

- Threats and Disturbances:

No disturbances were apparent at this forested ravine. Logging of the stream bottom or adjacent slopes would greatly decrease the quality of this natural habitat.

- Conservation Recommendations:

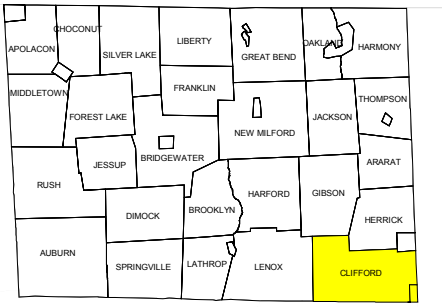
Preserve the forested continuity of this habitat. Avoid logging to within 100 meters of the creek edge and on adjacent steep slopes.

Choconut Lake, Choconut Township

CLIFFORD TOWNSHIP and Forest City Borough

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
DUNDAFF CREEK HEADWATERS (5)	Animal species of concern	G5	S2S3B, S3N	N	1985-06-11	E
FOREST CITY OUTCROPS (2)	Natural Community: Little Bluestem-Pennsylvania Sedge Opening	GNA	S2	N	2005-06-12	BC

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: Mud Pond

Managed Lands: None

Other: High Quality Cold Water Fishery: Lackawanna River

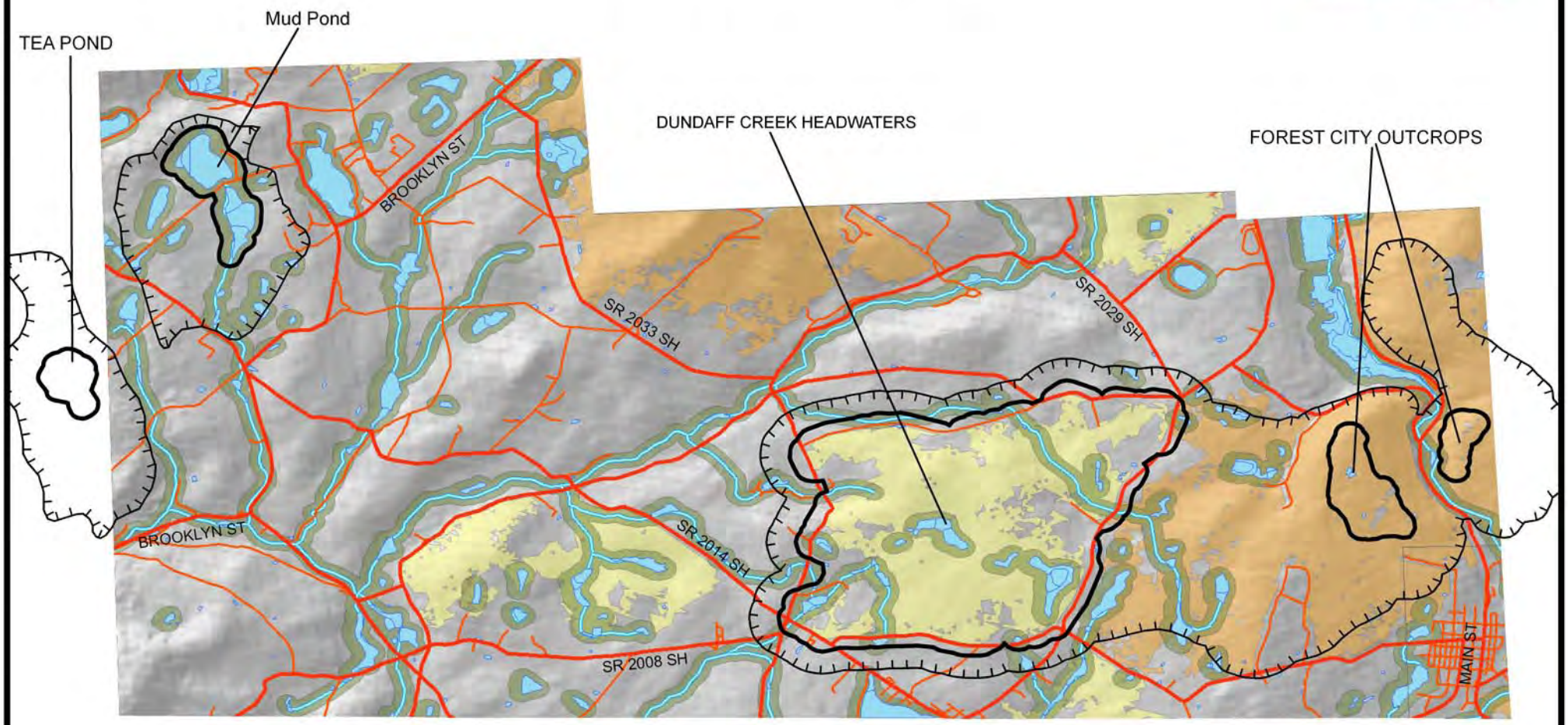
Aquatic Classification Project Results:

Fish: Warm Water Community 1—East Branch Tunkhannock Creek
Fish: Cold Water Community—East Branch Tunkhannock Creek-Dundaff
Fish: Cool Water Community 2—Lackawanna River
Invertebrate: Brushlegged mayfly / fingernet caddisfly —Lackawanna River

CLIFFORD TOWNSHIP MAP

Clifford Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

Scale:1:80,000

0 0.5 1 2 Miles

Clifford Township is drained primarily by several tributaries to the East Branch Tunkhannock Creek. The forest blocks in the township are fragmented by scattered agricultural lands, roads, and other developments, but a few significantly-sized blocks remain. One that provides connectivity of the large forest block at Elk Hill to neighboring townships is important to the movement of wildlife in a natural corridor. Several forested blocks provide natural riparian buffers for the streams and wetlands in the township, including the drainage area for the High Quality Lackawanna River along the eastern border. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands and headwater streams, and avoiding fragmentation of the largest forest blocks with additional roads. The abundance of water resources in this township put maintenance of water quality high in importance to the natural resources of the township and downstream neighbors. Restoration efforts should focus on riparian plantings along creeks and providing buffers to natural wetlands. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor.

Lichens and mosses are a significant component of the natural community at Forest City Outcrops. Pictured are two species of reindeer lichen: Cladina rangiferina and Cladina caroliniana
Photo: John Kunsman

Forest City Outcrops- Photo: John Kunsman

DUNDAFF CREEK HEADWATERS – (Clifford Township)

This site was not ground surveyed during the period of this project. Information was distilled from aerial photo interpretation and past survey information. The wetlands at the headwaters of Dundaff Creek appear to be primarily beaver influenced impoundments with occasional large expanses of shrub swamp and sedge-grass marshes within a northern hardwood forest matrix. One of the wetlands appears to be surrounded by a large hemlock swamp forest. This wetland may be more of a peatland or bog habitat with extensive shrub cover. An **animal species of concern** was documented as using these habitats in 1985.

- Threats and Disturbances:

Agricultural fields fragment portions of the forest surrounding these wetlands. Residential development is accelerating along local roads and surrounding Crystal Lake to the south. Many wetlands in the county are in danger of conversion to flooded, open water ponds for recreational development. Permanent flooding of these wetlands and removal or modification of the forested canopy surrounding the wetlands would virtually eliminate the suitable habitat for the species of concern at this location.

- Conservation Recommendations:

Fragmentation of the surrounding forest matrix with additional roads or utility-rights-of-way should be strongly discouraged. Modification of the wetland hydrology by permanent flooding or draining should be avoided. Future biological surveys of this area are encouraged.

FOREST CITY OUTCROPS – (Clifford Township)

The upper slopes and crest of the hills north of Forest City have sandstone – conglomerate bedrock outcrops within a northern hardwood forest matrix. The thinness of the soil associated with these outcrops has resulted in lack of tree and shrub growth for several acres. What trees have managed to find a foothold in the rock are of stunted stature. The rocky openings are dominated by various grasses, sedges, mosses and lichens. This open, bedrock hilltop represents a **Little bluestem-Pennsylvania sedge opening Natural Community**. This community type frequently occurs in a larger community complex called a Ridgetop dwarf-tree forest, characterized by stunted trees and shrubs frequently including pitch pine and scrub oak. This large, continuously forested area is valuable for many bird species, including neo–tropical migrant landbirds that need interior forests for breeding areas. Species such as Blue-headed Vireo, Scarlet Tanager, and Black-throated Green Warbler need undisturbed, large blocks of forest for nesting areas.

- Threats and Disturbances:

There is evidence of past logging and mining activity, with mine spoil piles occasional on the hillside. A pond, the apparent result of quarrying activities occurs near the top of the slope. Some introduced invasive species of plants are present and deer browse is heavy in places.

- Conservation Recommendations:

The lack of soil on the bedrock outcrop will likely prevent succession to a more forested type in the near future. This large forest is currently free from fragmenting features such as roads and utility rights of way and efforts should be made to keep this unfragmented forest block intact. Residential development, roadways and utility-rights-way should be discouraged.

Locally Sigificant Site:

Mud Pond – (Clifford Township)

There is a remnant ring of floating bog vegetation in the middle of this open water pond. The floating vegetation mats support characteristic acidic wetland species such as leatherleaf, cranberry, and pitcher plants. This typical bog vegetation likely covered more of the open water portion of the pond, but changes in the hydrology have flooded the wetland creating the open water pond. Floating leaved aquatic plant species are plentiful on the water surface. Piles of empty freshwater mussel shells (*Pyganodon cataracta*) were seen scattered along the shoreline and on the edges of the floating islands. These were likely the work of river otters that were also observed at this wetland.

- Threats and Disturbances:

The wetland has been flooded, reducing the quality of this remnant bog habitat. Flooding of the portion of the wetland south of the road would be detrimental to that habitat. Removal or modification of the forested buffer would decrease the quality of the wetland habiatat.

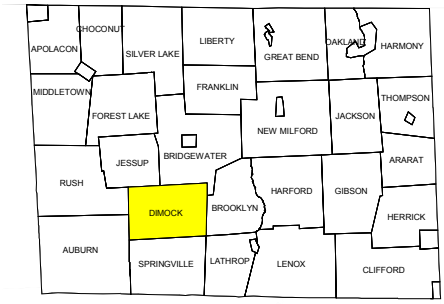
- Conservation Recommendations:

Preserve the forested buffer surrounding the wetland. A slight and gradual decrease in the water level may accelerate the regrowth of the former bog vegetation. Biological surveys in the wetland south of the road are encouraged.

DIMOCK TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
ELK LAKE WETLANDS (5)	Animal: Lilypad Clubtail dragonfly (*Arigomphus furcifer*)	G5	S2	N	2005-6-21	E
	Plant: Dodder (*Cuscuta campestris*)	G5T5	S2	N	2002-07-28	E
WOODBOURNE PRESERVE (3)	Natural Community: Northern hardwood-conifer forest	GNR	S3	N	1983-8-13	B
	Animal: Lilypad Clubtail Dragonfly (*Arigomphus furcifer*)	G5	S2	N	1987-7-11	E
	Animal: Halloween Pennant dragonfly (*Celithemis eponina*)	G5	S2S3	N	2005-07-14	E
	Animal: Slaty Skimmer Dragonfly (*Libellula incesta*)	G5	S3?	N	1987-7-11	E
	Animal: Azur Bluet Damselfly (*Enallagma aspersum*)	G5	S3S4	N	1987-7-11	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

Managed Lands: Woodbourne Forest (The Nature Conservancy)

Aquatic Classification Project Results:
Fish: Warm Water Community 1—Meshoppen Creek
Fish: River and Impoundment Community—West Branch Meshoppen Creek
Invertebrate: Rolledwinged stonefly / Small minnow mayfly—West Branch Meshoppen Creek; Meshoppen Creek

Dimock Township is characterized by numerous water resources, including wetlands, lakes, and streams, set in a largely agricultural landscape. Tributaries to White Creek and Meshoppen Creek flow north to south through the municipality. Lakes include Big and Little Elk Lakes, Indian Lake, Broadhead Pond, and Stone Pond. Maintenance and restoration of riparian buffers along the creeks are important to the water quality and flow of these watersheds. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. Significant forested areas remain along the mainstem of Meshoppen Creek and should be protected from further fragmentation in order to maintain the quality of the watershed.

DIMOCK TOWNSHIP MAP

PNHP
Pennsylvania Natural Heritage Program

Dimock Township
Susquehanna County, PA

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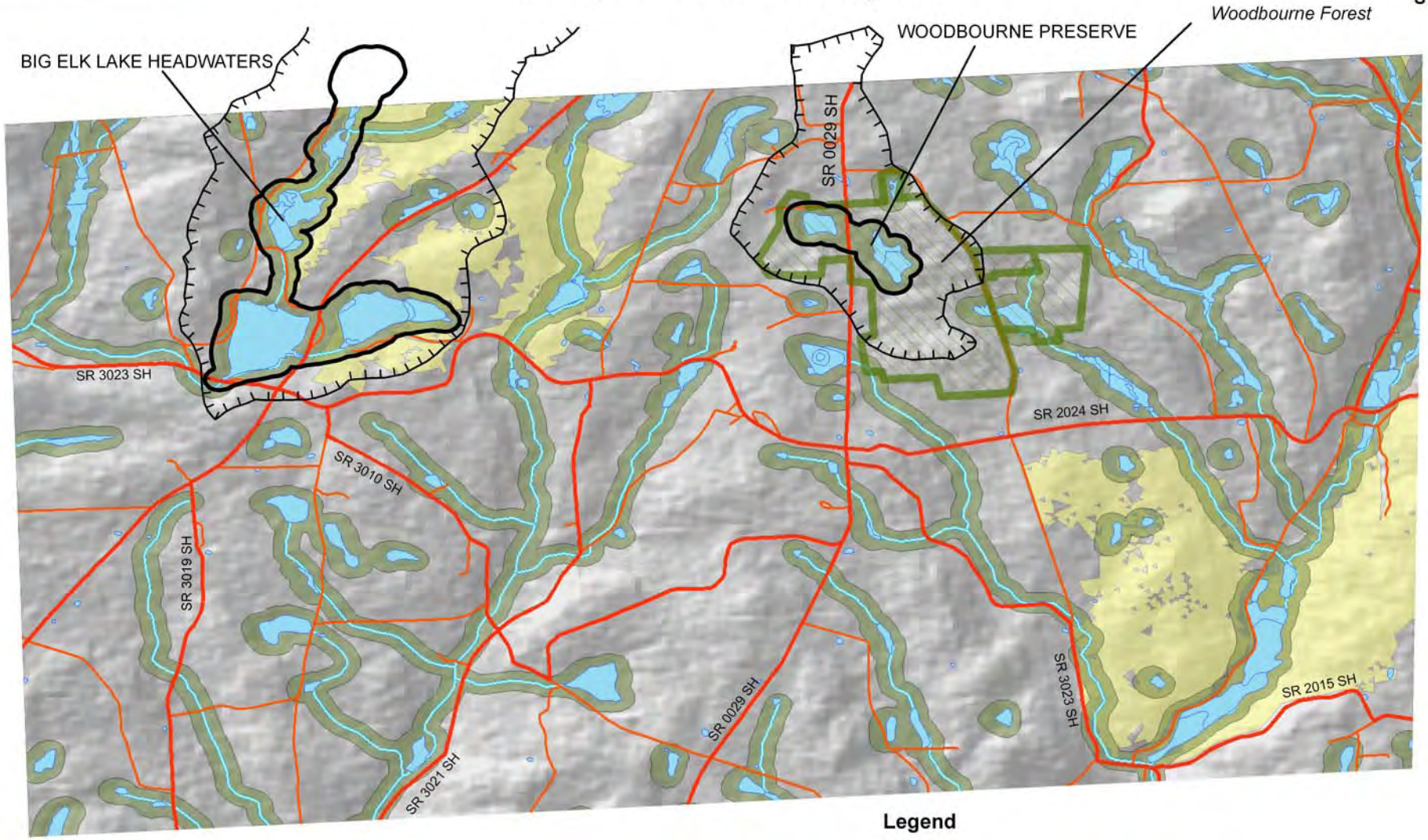


Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

Scale:1:60,000

0 0.5 1 2 Miles

ELK LAKE WETLANDS – (Dimock and Jessup Townships)

A series of open water lakes, forested wetlands, shrub swamps and sedge meadows occur within this area. Big Elk Lake is an open water glacial lake that has many residences around its perimeter. Little Elk Lake is more natural with fewer houses and the eastern portion of the lake remaining a natural shrub swamp. The main tributary to Big Elk Lake has several large wetland openings that have seen past and ongoing beaver activity. One of these wetlands is currently a sedge meadow, a stage reached when beavers have been absent for a decade or more. This habitat is dominated by grasses, sedges, rushes and cat-tails. A narrow but deep water channel cuts through the wetland opening. Dragonflies, damselflies and butterflies are abundant, especially where the creek forms small pools. Numerous large tree stumps occur in the wetland, suggesting that this habitat had once been a forested wetland. Further downstream, another wetland occurs that has a forest of standing dead trees in open water, suggesting recent flooding by beaver activity. The **G5, S2 plant species of concern dodder (*Cuscuta campestris*)** was documented along the stream that enters Big Elk Lake. A **Lilypad Clubtail Dragonfly, a G5, S2 animal species of concern** was documented in the northernmost large wetland opening and likely utilizes portions of the other wetland habitats as well.

- Threats and Disturbances:

The upper wetland openings have seen periodic flooding and draining due to cyclic beaver activity. They are mostly surrounded by good forested buffers with portions of the area between them in agricultural production. Numerous residences surround Big Elk Lake. A small local road passes by the western of the wetland chain. Scattered residences occur throughout the area. Permanent flooding or draining of these wetlands could detrimentally affect the quality of the habitat for many species present at these wetlands.

- Conservation Recommendations:

Avoid dam construction on wetlands. Periodic flooding and draining due to beaver activity will not largely interfere with the ecosystem processes at work on the wetlands along this creek, but permanent flooding or draining could severely disturb these habitats. Preserve and repair forested buffer surrounding wetlands. Create forested buffer along creek between two upper wetlands. Trees will shade the creek, cooling water, which will hold more oxygen for aquatic animals. A forested buffer will also help protect the water quality from runoff pollution and sedimentation from roads, residences and agricultural fields.

Dominant and caharacteristic plants of Big Elk Lake Headwaters

		Trees	
Acer saccharum	sugar maple	*Prunus serotina*	black cherry
Betula alleghaniensis	yellow birch	*Tilia americana*	American basswood
Fagus grandifolia	American beech	*Tsuga canadensis*	eastern hemlock
		Shrubs	
Amelanchier arborea	serviceberry	*Spiraea tomentosa*	hardhack spiraea
Fraxinus americana	white ash	*Viburnum lentago*	nannyberry
Hamamelis virginiana	witch-hazel	*Viburnum recognitum*	northern arrow-wood
Spiraea alba	narrow-leaved meadow-sweet		
		Herbs	
Carex comosa	bristly sedge	*Eupatorium purpureum*	sweet joe-pye weed
Carex debilis	white-edge sedge	*Galium trifidum*	marsh bedstraw
Carex gynandra	sedge	*Juncus effusus*	soft rush
Carex leptalea	bristly-stalk sedge	*Lysimachia terrestris*	swamp loosestrife
Carex lurida	shallow sedge	*Onoclea sensibilis*	sensitive fern
Carex prasina	drooping sedge	*Osmunda cinnamomea*	cinnamon fern
Carex projecta	necklace sedge	*Phalaris arundinacea*	reed canary grass
Carex scabrata	rough sedge	*Polygonum arifolium*	halberd-leaf tearthumb
Carex scoparia	pointed broom sedge	*Polygonum sagittatum*	arrow-leaved tearthumb
Carex stipata	stalk-grain sedge	*Schoenoplectus tabernaemontani*	soft-stem bulrush
Carex stricta	tussock sedge	*Scirpus cyperinus*	wool-grass
Carex swanii	swan sedge	*Scutellaria galericulata*	hooded skullcap
Carex trisperma	three-seed sedge	*Thelypteris noveboracensis*	New York fern
Carex utriculata	sedge	*Thelypteris palustris*	marsh fern
Carex vulpinoidea	fox sedge	*Triadenum virginicum*	marsh St. John's wort
Chelone glabra	white turtlehead	*Verbena urticifolia*	white vervain
Eupatorium perfoliatum	common boneset		

WOODBOURNE PRESERVE – (Dimock Township)

Woodbourne Preserve contains several small patches of old-growth **Northern Hardwood – Conifer Forest Natural Community.** Though relatively small patches, there are very few examples of old growth in eastern Pennsylvania. Little is known about forest canopy invertebrates or soil flora and fauna of old growth forests, and this might be investigated at Woodbourne. Woodbourne also has an interesting wetland habitat composed of open shrub-sedge swamp leading to an open water pond with fragments of floating bog vegetation islands. **Four odonate species of concern** were also documented at Woodbourne Preserve: the **G5, S2 Lilypad Clubtail dragonfly (*Arigomphus furcifer*); the G5, S2S3 Halloween Pennant dragonfly (*Celithemis eponina*); the G5, S3 Slaty Skimmer dragonfly (*Libellula incesta*); and the G5, S3S4 Azur Bluet damselfly (*Enallagma aspersum*).** Cope Pond, across the road from the main portion of the Woodbourne Preserve is a small open water pond with a man-made dam. There are remnant floating islands of bog vegetation, which suggest that prior to the construction of the dam, this was a small kettlehole bog. The bog vegetation is minimal, but there is a good diversity of dragonflies and damselflies at this wetland.

- Threats and Disturbances:

A busy road passes through the Woodbourne preserve property. Much of the surrounding land is in agricultural fields and pastures. Little forested buffer protects the preserve from external sources of disturbance. Deer browse appears excessive in some areas. Beaver activity could further flood the wetland portions of the preserve.

- Conservation Recommendations:

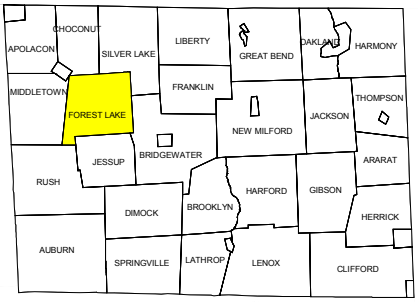
Preserve and repair the forested buffer around the preserve. Monitor for deer damage and encourage hunting on preserve as needed.

A wetland opening within Woodbourne Preserve

FOREST LAKE TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
BUMPS CORNERS WETLAND (4)	Natural Community: Hemlock Palustrine Forest	GNR	S3	N	2005-6-15	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

Managed Lands: None

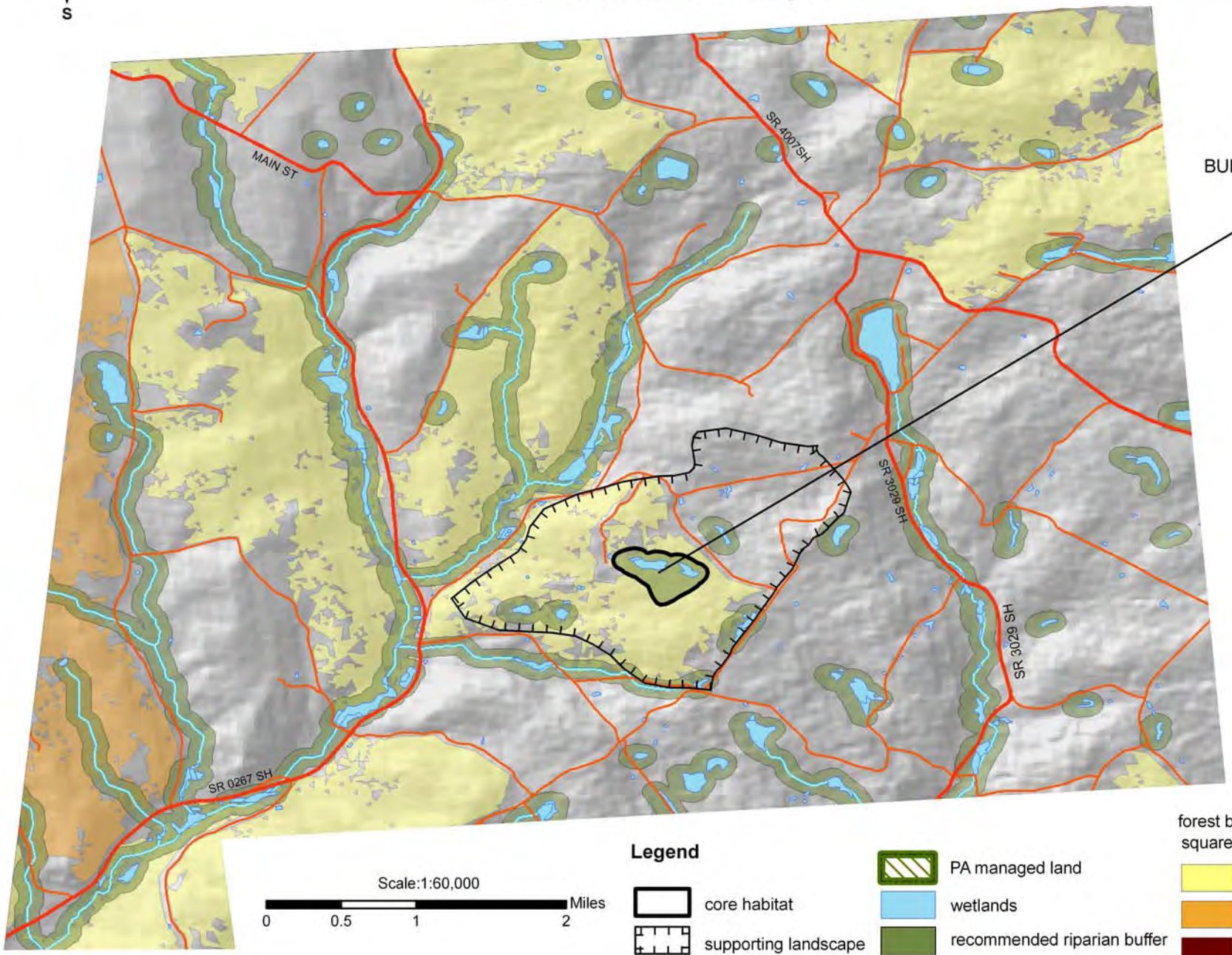
Aquatic Classification Project Results:
Fish: Warm Water Community 1—Middle Branch Wyalusing Creek, East Branch Wyalusing Creek

The western portion of Forest Lake Township contains the largest forest blocks in the municipality, providing forested buffers for the Middle Branch Wyalusing Creek and its tributaries. The eastern portion of the township has a more diverse landscape of land uses, including agriculture, timber harvest, and non-coal quarries. It contains the namesake Forest Lake and Forest Lake Creek. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. Maintenance and restoration of riparian buffers along both of these major tributaries to Wyalusing Creek are important to the water quality and flow of these watersheds. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

FOREST LAKE TOWNSHIP MAP

Forest Lake Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



BUMPS CORNERS WETLAND – (Forest Lake Township)

The area is a northern hardwoods-hemlock forest grading into an extensive **Hemlock Palustrine Forest Natural Community**. This hemlock swamp is characteristic of many hemlock swamps found in the county, with cinnamon fern, highbush blueberry, and wild calla being especially dominant plants underneath the extensive hemlock overstory. There is a large diversity of plants throughout the entire area and the hemlock swamp is of high quality and size. Birds were abundant in this area as well. Northern bird species that depend on a hemlock forest component observed at this site include Blackburnian Warbler, Black-throated Green Warbler, and Northern Waterthrush. Overall, this site is very diverse and has tremendous value to a variety of plants and animals.

- Threats and Disturbances:

No disturbances were apparent. Flooding by man-made or beaver dams could drown this forested swamp. Logging of the canopy would also negatively impact this shade adapted natural community.

- Conservation Recommendations:

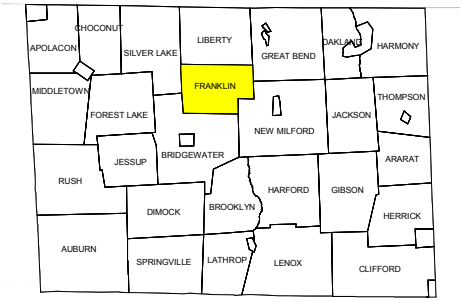
Maintain the current wetland hydrology. Beaver dams should be removed as they appear to avoid flooding. Many similar habitats in the county have been reduced to standing dead trees as the result of beaver activity. Beavers may need to be trapped out if they persist. Avoid fragmenting the surrounding forest with additional roads, utility rights-of-way or residential development.

Hemlock Palustrine Forest at Bumps Corners Wetland (Photo: Bud Secheler-PNHP)

FRANKLIN TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
SALT SPRINGS (3)	Animal: Grey Comma Butterfly (*Polygonia progne*)	G5	SU	N	2001-8-26	E
	Animal : Ocellated Darner Dragonfly (*Boyeria grafiana*)	G5	S3	N	2003	E
	Animal: Halloween Pennant Dragonfly (*Celithemis eponina*)	G5	S2S3	N	2003	E
	Animal: Lilypad Clubtail Dragonfly (*Arigomphus furcifer*)	G5	S2	N	2003	E
	Animal: Band-winged Meadowhawk Dragonfly (*Sympetrum semicinctum*)	G5	S3S4	N	2003	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

Managed Lands: Salt Springs State Park

Aquatic Classification Project Results:

Fish: Warm Water Community 1—Snake Creek, Susquehanna River, Salt Lick Creek

Fish: Cool Water Community 1—Silver Creek

Invertebrate: Rolledwinged stonefly / Small minnow mayfly —Susquehanna River

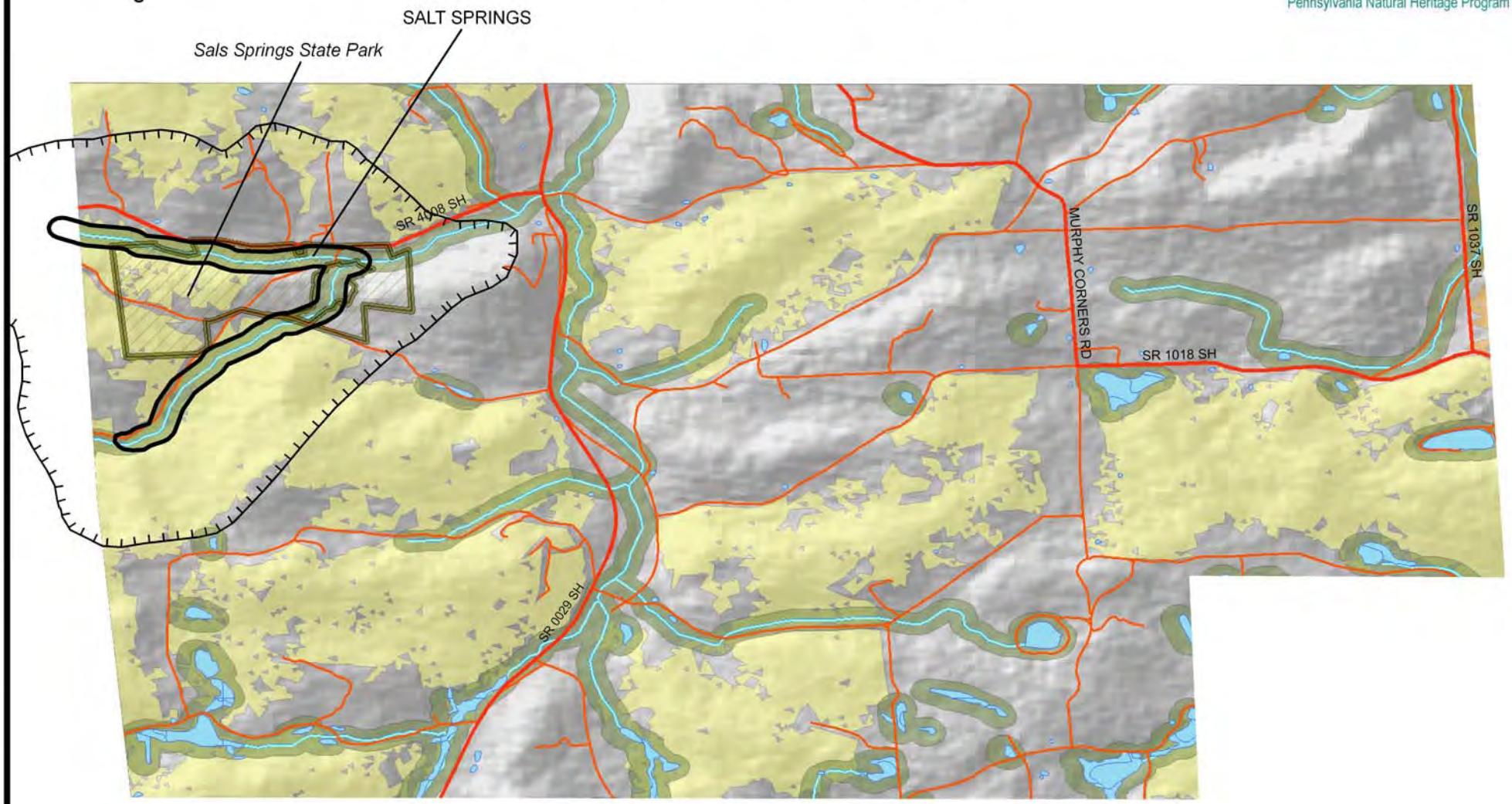
Invertebrate: Brushlegged mayfly / fingernet caddisfly —Snake Creek

Franklin Township is home to Salt Springs State Park, the one state park in Susquehanna County, and more than half of the land area of the township is covered by forest. Buffering the land around the park from development and land disturbance, as well as protecting the water quality of the watersheds running through the park are important to the long-term quality of the natural resources within the park. Snake Creek and its tributaries drain the heart of the township, joined by Silver Creek and Fall Brook from Salt Springs State Park. Conservation efforts within the township could concentrate on maintaining or replanting riparian buffers along these creeks. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

FRANKLIN TOWNSHIP MAP

Franklin Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Scale:1:55,000

0 0.5 1 2 Miles

Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

SALT SPRINGS – (Franklin and Silver Lake Townships)

Fall Brook tumbles through a narrow ravine in Salt Springs State Park forming several waterfalls along its stony descent. The ravine is flanked by mature old growth hemlock, which casts heavy shade on the stream and adjacent forest floor. Much of the park is in a hemlock-white pine forest cover, but the park also includes numerous acres in northern hardwood forest, shrub swamps, old pastures, fields and orchards. The herbaceous layer underneath the hemlocks is generally sparse and reflects a more northerly distribution. The **Gray Comma (*Polygonia progne*), a butterfly of special concern,** was documented within the park. This species is more commonly found north of Pennsylvania, but it can be found in cool, rich, deciduous woodlands in Pennsylvania. The larvae of this butterfly feed on currant and gooseberry shrubs (*Ribes* species). Four dragonfly species of concern were also documented as occurring along Fall Brook in the park, both the heavily shaded hemlock portions and the more open shrubby areas of the creek. These included the **G5, S2 Lilypad Clubtail dragonfly (*Arigomphus furcifer*); the G5, S2S3 Halloween Pennant dragonfly (*Celithemis eponina*); the G5, S3 Ocellated Darner dragonfly (*Boyeria grafiana*); and the G5, S3S4 Band-winged Meadowhawk dragonfly (*Sympetrum semicinctum*).**

A small mammal survey of the park documented a good diversity of animals, but also revealed that the old fields and pastures adjacent to the ravine strongly influence the animal composition of the ravine. While woodland species of small mammals such as the rock vole would have been expected in the deep shade of the ravine, the high number of meadow voles (a species usually associated with grasslands and old agricultural fields), documented in the ravine suggest an undue influence of the fields on the ravine habitat.

- Threats and Disturbances:

The site is primarily within a state park and as such is not threatened from many types of disturbance. The prevalence of the agricultural habitats influences the more natural areas of the park. Many introduced and invasive species of plants can spread from these agricultural areas.

- Conservation Recommendations:

Much of the former agricultural lands should be allowed, through succession, to revert to early stage shrub forest, and eventually to a mature forest of native species, thereby reducing the amount of habitat available to grassland species surrounding the virgin hemlock areas. Invasive species of trees, shrubs and other plants found throughout the park should be removed or destroyed to allow a more native forest composition to thrive.

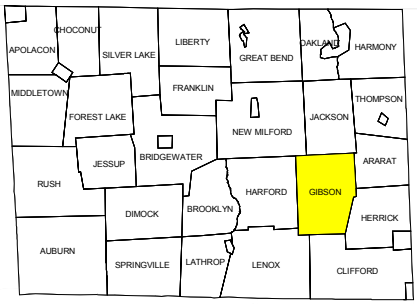
Gray Comma butterfly (*Polygonia progne*)

Lilypad clubtail dragonfly (*Arigomphus furcifer*)

GIBSON TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
PAYNE POND (4)	Plant: Bog rosemary (*Andromeda polifolia*)	G5	S3	PR	2005-6-15	E
	Plant: Slender sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-6-15	E
	Natural Community: Leatherleaf-bog rosemary peatland	GNR	S2	N	2005-6-15	E
POTTER LAKE (5)	Animal (damselfly): Lilypad Forktail (*Ischnura kellicotti*)	G5	S1	N	2005-6-15	E
	Animal (dragonfly): Slaty Skimmer (*Libellula incesta*)	G5	S3	N	2005-6-15	E
	Plant: Slender sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-6-15	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

Managed Lands: None

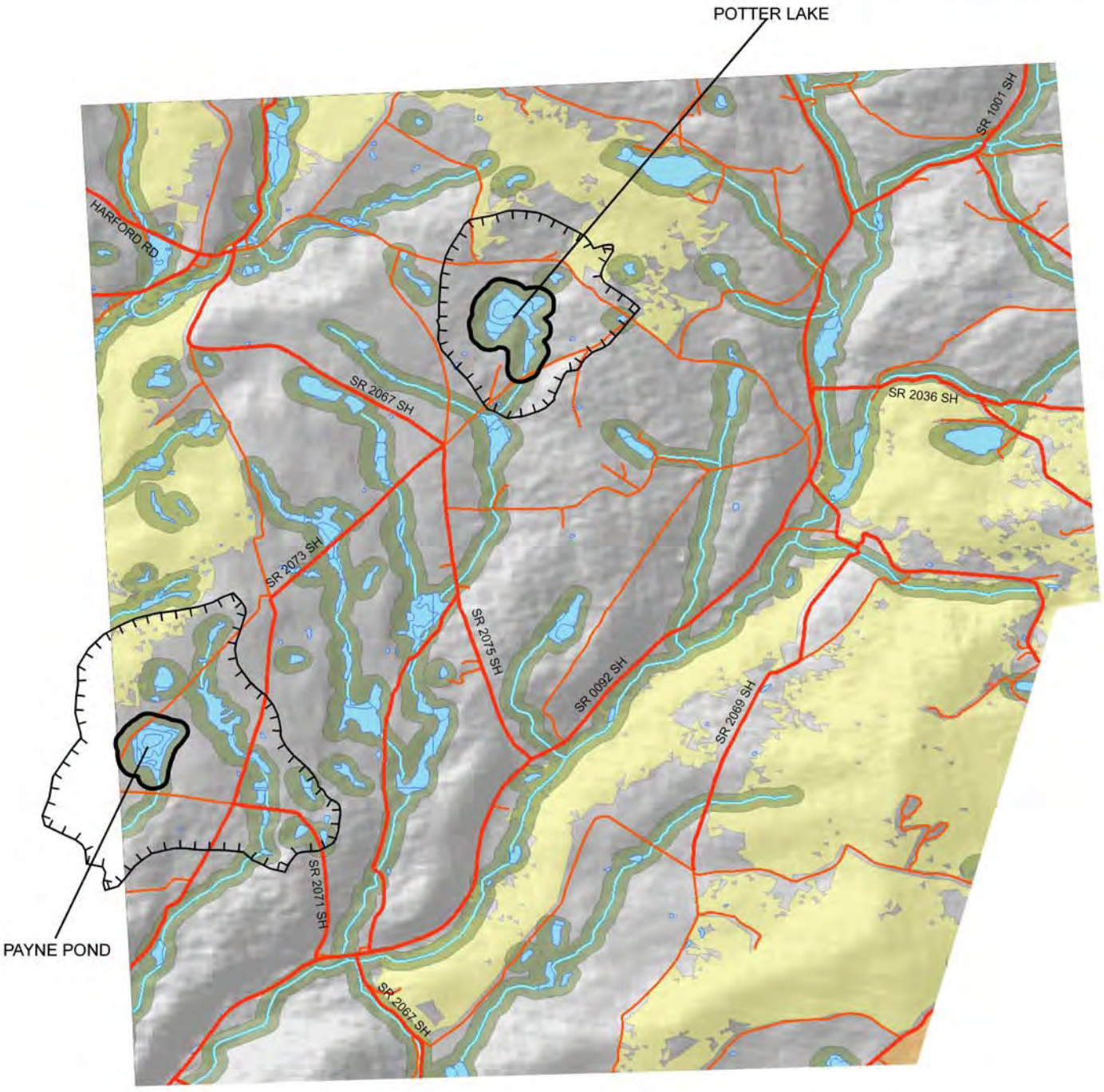
Aquatic Classification Project Results:
Fish: Warm Water Community 1—Tunkhannock Creek
Fish: Cool Water Community 1—Butler Creek

Gibson Township is characterized by numerous water resources, including wetlands, lakes, and streams, set in a landscape mosaic of agriculture and forestland. The township's primary watershed is the Tunkhannock Creek and its tributaries. Maintenance and restoration of riparian buffers along the creeks are important to the water quality and flow of these watersheds. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. One of the largest intact forest blocks follows the southeastern banks of Tunkhannock Creek, forming a critical starting point for riparian conservation here. Another block forms a riparian buffer for Butler Creek in conjunction with lands in Harford Township. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Other forest blocks include many of the township's isolated wetlands and should be preserved as important buffers to these wetlands. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads and utility rights-of-way.

GIBSON TOWNSHIP MAP

Gibson Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

forest blocks: square miles

- 1-3
- 3-5
- >5

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

Scale:1:65,000

0 0.5 1 2 Miles

PAYNE POND – (Gibson Township)

The wetland at this location is a classic kettle hole bog that was formed when ice was buried in glacial till deposits. As the glaciers retreated and the ice melted, it formed a deep water-filled depression. Vegetation gradually grew over the margins of the pond, forming floating mats in a ring around a deep-water center. Peat forming plants such as sphagnum mosses and various sedges typically dominate this type of wetland. The acidic, nutrient poor conditions in the wetland restrict plant decomposition. As plants die, they pile up in the wetland and form floating islands that are eventually colonized by other plants characteristic of bogs that can tolerate acidic, nutrient poor conditions. Short trees and tall shrubs such as red maple, white pine, spiraea, viburnum and high bush blueberry dominate the outer edges of the bog habitat. Occurring on the floating vegetation mat at this bog is a very good population of the **G5, S3 PA-rare bog rosemary (*Andromeda polifolia*)**. This habitat is also strongly dominated by the evergreen shrub leatherleaf, which together with the bog rosemary form a **Leatherleaf-bog rosemary peatland Natural Community**. This community type is uncommon in Pennsylvania occurring more frequently in the heavily glaciated regions of New England and Canada. The **G5, S3 PA-rare slender sedge (*Carex lasiocarpa)*** was also documented at this site. This species is also characteristic of bog-like habitats and frequently occurs at the leading edges of the vegetation building on top of the water's surface.

Dominant & characteristic plant species of Payne Pond

Scientific name	Common Name
	Trees
Acer rubrum	red maple
Betula populifolia	gray birch
Pinus strobus	eastern white pine
	Shrubs
Alnus incana	speckled alder
Andromeda polifolia	bog-rosemary
Aronia arbutifolia	red chokeberry
Aronia melanocarpa	black chokeberry
Chamaedaphne calyculata	leatherleaf
Ilex verticillata	winterberry holly
Kalmia polifolia	pale laurel
Spiraea latifolia	northern meadow-sweet
Toxicodendron vernix	poison sumac
Vaccinium corymbosum	highbush blueberry
Vaccinium macrocarpon	large cranberry
	Herbs
Calla palustris	wild calla
Carex comosa	bristly sedge
Carex lasiocarpa	slender sedge
Decodon verticillatus	hairy swamp loosestrife
Dulichium arundinaceum	three-way sedge
Osmunda cinnamomea	cinnamon fern
Thelypteris palustris	marsh fern

- Threats and Disturbances:

The floating vegetation mats on this bog wetland are in remarkably good condition despite the nearly complete lack of forested buffer surrounding the wetland. The forest that at one time surrounded the wetland was cut long ago and converted to agricultural uses. Much of this land still remains in pasture. A few scattered residences are nearby and rural roads run along the western and southern edges of the wetland. With the lack of a vegetated buffer, the wetland is subject to sediment and nutrient laden runoff or non-point sources of pollution. Nutrient enrichment could allow other species of plants to dominate the wetland, decreasing the quality of this bog habitat.

Bog rosemary at Payne Pond

Payne Pond

- Conservation Recommendations:

Reforestation of the wetland borders will help protect the bog habitat from external causes of disturbance such as non-point sources of pollution, nutrient enrichment and erosional sedimentation. Care should be taken to use native species of local genetic stock for reforestation efforts. Local sources of tree and shrub stock could be transplanted from adjacent woodlots. As trees become established around the wetland, beaver activity may increase. Beaver dams should be removed as they occur to avoid flooding the bog habitat. Additional surveys for species of concern should be conducted on this interesting habitat.

POTTER LAKE – (Gibson Township)

Potter Lake is a large, primarily open-water bog-like habitat that has had its water levels raised by beaver and man-made dams to the point where much of the original bog vegetation is currently drowned. What remains of the bog vegetation are fragmented portions of floating vegetation mats that are dominated by plants of more nutrient rich habitats like cat-tails and alder shrubs. Despite these disturbances the habitat supports one plant species of concern and two aquatic animal species of concern. A small population of the **G5, S3 PA-rare slender sedge (*Carex lasiocarpa*)** was found growing on the shoreline of the lake near a small beaver dam with other wetland vegetation. Also documented from this habitat were **two invertebrate animal species of concern** that use the lake as their primary habitat. These are the **G5, S1 Lilypad Forktail damselfly (*Ischnura kellicotti*), and the G5 S3 Slaty Skimmer dragonfly (*Libellula incesta*).**

- Threats and Disturbances:

The lake is mostly well buffered from external disturbances by a wide forested buffer. Despite this apparent protection, the lake appears to receive nutrient input based on the dominance of the floating bog vegetation by cat-tails. Removal of the forested buffer by extensive logging or development of the lake shore could further undermine the typically low nutrient aspect of the bog habitat. Changes to the hydrology such as flooding or draining could also detrimentally impact the quality of this interesting habitat.

- Conservation Recommendations:

The bog vegetation at this site would likely improve with a slight reduction in the water level of the lake. Beaver dams may need to be removed when they occur to allow the bog vegetation to recover from the current flooded conditions. The existing wide forested buffer should be preserved to protect the wetland from increased nutrient enrichment.

Slaty Skimmer dragonfly (*Libellula incesta*)

Lilypad Forktail damselfly (*Ischnura kellicotti*)
Top: female, Bottom: male

GREAT BEND TOWNSHIP, Great Bend Borough & Halstead Borough

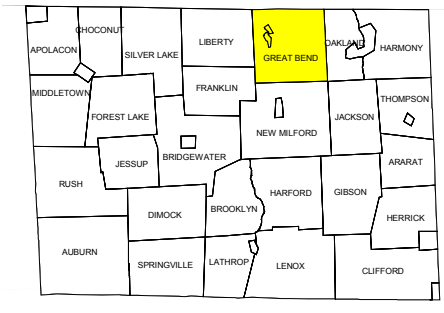
Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
DEACON CREEK WETLANDS (5)	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-7-19	E
SUSQUEHANNA RIVER (3)	Animal: Yellow Lampmussel (*Lampsilis cariosa*)	G3G4	S3S4	N	2004-8-11	A
	Animal: Eastern Lampmussel (*Lampsilis radiata*)	G5	S1	N	2004-8-11	D
	Animal: Elktoe mussel (*Alasmidonta marginata*)	G4	S4	N	2004-8-11	BC
	Animal: Treangle Floater mussel (*Alasmidonta undulata*)	G4	S3S4	N	2004-8-11	CD
	Animal: Black-banded Bandwing Dragonfly (*Calopteryx aequabilis*)	G5	S2	N	1986-6-11	B
	Animal: Midget Snaketail Dragonfly (*Ophiogomphus howei*)	G3	S1	N	1988-6-13	C
	Animal: Abbreviated Clubtail Dragonfly (*Gomphus abbreviatus*)	G3G4	S2	N	1986-6-19	B
	Animal: Harris' Checkerspot Butterfly (*Chosyne harrisii*)	G4	S3	N	1988-6-13	E
ISLAND PLAIN WETLANDS (5)	Animal species of concern	G5	S3S4B	N	2002	E
	Plant: Soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2004-8-04	E
	Animal: Lance-tipped Darner Dragonfly (*Aeshna constricta*)	G5	S3S4	N	2004-8-04	E
MITCHELL CREEK HEADWATERS (5)	Plant: Soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2004-7-29	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: None

Managed Lands: State Game Lands #35

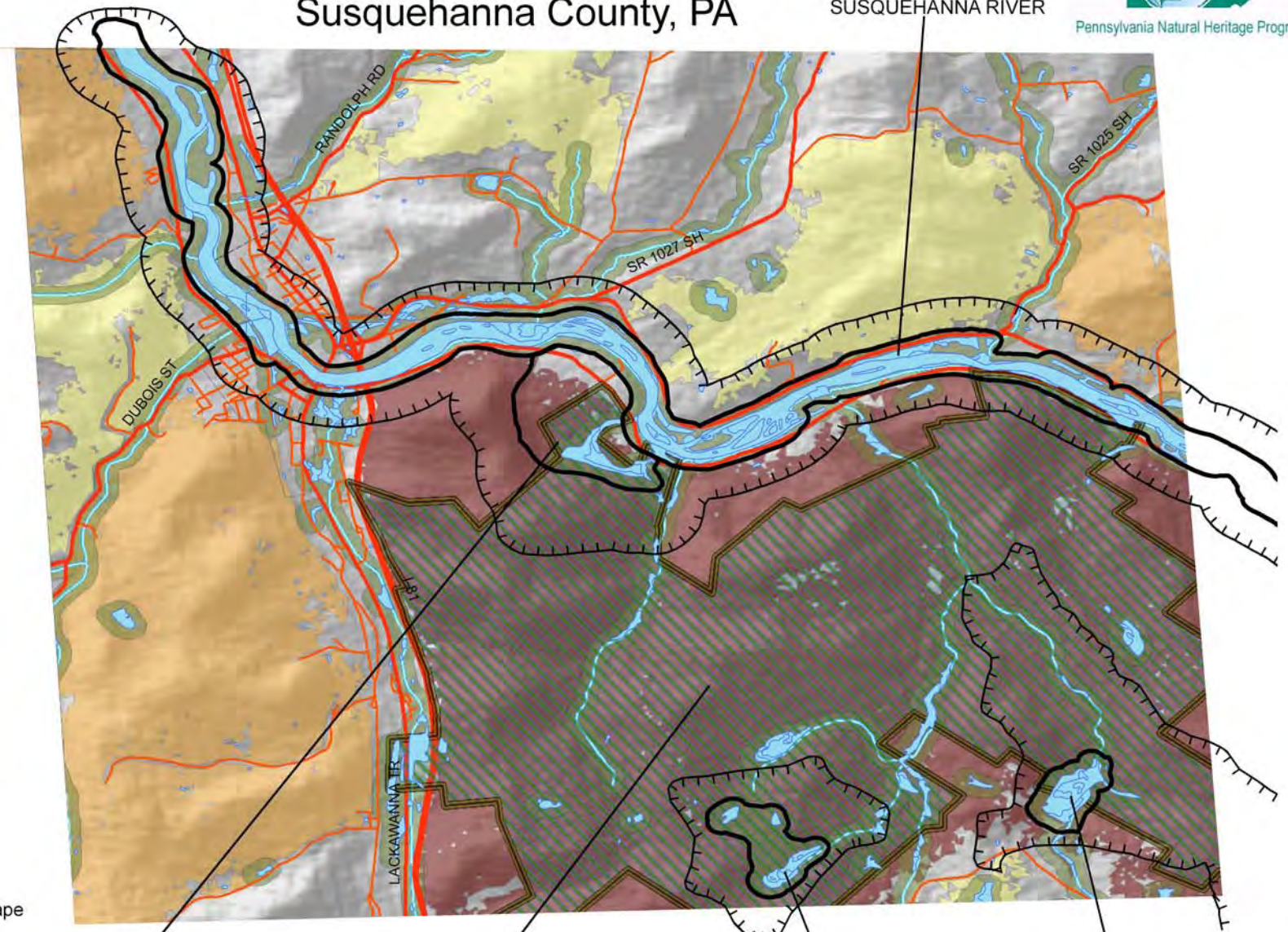
Other: High Quality Cold Water Fishery: Salt Lick Creek



GREAT BEND TOWNSHIP MAP

Great Bend Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

forest blocks:
square miles

- 1-3
- 3-5
- >5
- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

Scale:1:70,000

0 0.5 1 2 Miles

GREAT BEND TOWNSHIP

Aquatic Classification Project Results

Fish: Warm Water Community 1—Salt Lick Creek, Susquehanna River
Invertebrate: Rolledwinged stonefly / Small minnow mayfly —Susquehanna River
Mussel: Eastern Elliptio Community—Susquehanna River/Chenango River

Great Bend Township is host to the namesake bend of the Susquehanna River as it dips into northern Pennsylvania. The township is almost entirely forested, with the most significantly sized forest block contained by the large State Game Lands #35. Conservation efforts to buffer the edges of the Game Lands from development and disturbance are important to the long-term quality of the wildlife and land resources within the Game Lands. Much of the river bank in this area is characterized by extreme slopes that have prevented cultivation or development and preserved a forested floodplain. Maintaining an intact forested floodplain along the river can preserve much of the township's important biodiversity. Forested buffers should be maintained, widened and created where absent along the length of the river with logging operations minimizing cuttin gwithin 100 meters of the river edge. The large blocks of forested uplands should be preserved intact by avoiding unnecessary fragmentation of the landscape with additional roads or building developments. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Protection of Salt Lick Creek from roadside and other disturbance runoff is critical to maintaining its status as a high quality waterway.

A crayfish finds a temporary home in an empty mussel shell.

Island Plain Wetlands

The Susquehanna River in the county is rich with freshwater mussels including the Eastern Lampmussel (*Lampsilis radiata).*

DEACON CREEK WETLANDS – (Great Bend Township)

This wetland occurs at a relatively high elevation in the saddle between two hill tops. There is evidence of cyclic beaver impoundment which forms alternatively an open water pond and a sedge meadow-shrub swamp as it partially dries down. A **G5, S2 plant species of concern, marsh bedstraw (*Galium trifidum*),** was documented along the shore of a small open water portion of the wetland. The wetland has a very good upstream forested buffer, most of which is in State Game Lands #35. The wetland is surrounded primarily by a hemlock and white pine forest that grades into a northern hardwoods forest dominated by sugar maple, yellow birch, beech and hemlock with distance from the wetland.

- Threats and Disturbances:

A utility rights-of-way passes through the forest to the east of the wetland opening. Dam construction for an open water pond is always a potential threat to these types of wetlands.

- Conservation Recommendations:

Avoid flooding or draining of this wetland. Avoid fragmentation of the large forested blocks of State Game Lands #35 with additional roads and utility rights-of-way.

ISLAND PLAIN WETLANDS – (Great Bend Township)

The large, crescent-shaped wetland at this location may be the consequence of a shift in the course of the Susquehanna River resulting in an oxbow wetland that likely floods with river water during high water events. An open water pond is created by a dam adjacent to the road. Heading away from the road, the open water pond gives way to a graminoid marsh dominated by sedges, grasses and cat-tails. This in turn becomes a shrub swamp, which grades into an extensive forested swamp dominated by hemlock and white pine. Within the forested swamp the **G5, S3 PA-rare soft-leaved sedge (*Carex disperma*)** was documented, growing on the elevated bases of hemlock and pine trees. The wetland habitat also supports **a G5, S3S4BS4N animal species of concern. A G5, S3S4 animal species of concern, the Lance-tipped Darner dragonfly (*Aeshna constricta*)** was also documented at this location.

- Threats and Disturbances:

Logging is a potential threat, which may cause the herons to abandon this rookery or change the composition of the forested wetland. Creation of an elevated dam at this location would drown the wetland and forested swamp, reducing the habitat available to the species of concern.

- Conservation Recommendations:

Logging should be avoided within 200 meters of the rookery, and refrain from 100-meters of the wetland including the forested swamp. Any logging activities should take place in the fall and early winter to avoid the most active spring and summer nesting season. Rookeries are extremely sensitive to logging and nests may be abandoned if such disturbances continue. Great Blue Herons are not extremely loyal to a nesting location and may not use the site year after year. Follow-up surveys are needed to verify nesting activity each year.

MITCHELL CREEK HEADWATERS – (Great Bend Township)

Several wetlands occur within this portion of the large undisturbed forest of State Game Lands #35. The **G5, S3 soft-leaved sedge (*Carex disperma*)** was documented in a forested wetland with a heavy hemlock canopy and saturated soils. The forested wetland exhibited characteristic pit and mound microtopography where mounds of sphagnum moss cover tree roots and fallen logs providing a slightly drier habitat within the saturated muck soil pools. The soft-leaved sedge was found growing on these elevated hummocks under the shade of the hemlock and yellow birch canopy.

- Threats and Disturbances:

Logging of the forested canopy would likely reduce the preferred habitat of this species. Flooding by beaver activity would have the same effect by drowning the forest canopy.

- Conservation recommendations:

Avoid logging within 100 meters of the wetland opening, forested wetland and adjacent streams. Beaver dams should be removed and beavers trapped to avoid flooding of this forested wetland. Many similar forested wetlands in the county have been flooded by beaver activity. Avoid fragmenting this large undisturbed forested area with additional roads and utility rights-of-way.

SUSQUEHANNA RIVER (Great Bend, Harmony and Oakland Townships)

Eight invertebrate animal species of concern were documented at various locations in the Susquehanna River. These animal species included four freshwater mussel species of concern: **the G3G4, S3S4 Yellow Lampmussel (*Lampsilis cariosa*); the G5, S1 Eastern Lampmussel (*Lampsilis radiata*): the G4,S4 Elktoe mussel (*Alasmidonta marginata*) and the G4, S3S4 Treangle Floater mussel (*Alasmidonta undulata*).** Also documented form this location were **the G5, S2 Black-banded Bandwing Dragonfly (*Calopteryx aequabilis*), the G3, S1 Midget Snaketail Dragonfly (*Ophiogomphus howei*), the G3G4, S2 Abbreviated Clubtail Dragonfly (*Gomphus abbreviatus*) and the G4, S3 Harris' Checkerspot Butterfly (*Chosyne harrisii*).**

The entire length of the Susquehanna River should be considered suitable habitat for most of these species. Additional surveys are recommended to better estimate populations of these animals of concern in the river. The river also provides a valuable migration corridor for many bird species, especially aquatic-dependent birds, but also many neo-tropical passerine migratory species.

The Susquehanna River is subject to frequent flooding and seasonal low water levels. Scouring of the banks and islands by ice and flooding has created pockets of specialized habitats along the river floodplain. Several islands have distinctive "Big bluestem - Indian grass River Grasslands," which are natural tall grassland communities created as the result of these natural disturbances. The two plant species the community type is named for dominate these habitats and also include switch grass and Indian hemp. The habitat tends to grade into a "Water willow – Smartweed Riverbed Community" on the lowest island elevations, and into a "Black willow Scrub/shrub Wetland," and "River birch – Sycamore Floodplain Scrub" as the elevation increases and the habitat becomes drier. These natural communities are part of the "Riverbed – Bank – Floodplain Community Complex" (Fike 1999), a broadly defined mosaic of community types that typify the natural vegetation along the Susquehanna River in Susquehanna County.

- Threats and Disturbances:

There are numerous examples of disturbance along the Susquehanna River. These animal species of concern are affected by non-point sources of pollution including sedimentation from cultivated and developed land along the river, runoff from roadways, pesticide runoff from agricultural fields, discharge of chemical pollutants and thermal pollution. The main threat to these animals is reduction of water quality. The banks, floodplains and islands of the river have the invasive introduced plant species Japanese knotweed and purple loosestrife. Control of established populations of these species is very difficult. Eradication of pioneer populations is the best way to control the spread of these species of plants.

- Conservation Recommendations:

Any of the above types of disturbances should be minimized where possible. Also, monitoring of these populations should continue into the future. Loss of individuals and reductions in population sizes should lead to an investigation into possible causes. Water quality should be monitored and pollution sources should be identified where possible. Forested buffers should be maintained and created where absent along the length of the river, with logging operations refraining from cutting within 100 meters of the river edge. River bank forests help buffer the watershed from the effects of non-point sources of pollution including runoff from agricultural, residential and roadway settings. In addition, the river floodplain and corridor is usually an area of significantly higher biodiversity than the adjoining uplands. Much of the area's important biodiversity can be preserved by maintaining an intact, forested floodplain along the river. The effectiveness of the forested riverbanks as a habitat corridor would be diminished by fragmentation of the forest continuity by the construction of houses, businesses and additional roadways along the river. Local planning should discourage construction of new structures and roadways along the river, adjacent slopes and floodplain.

Freshwater Mussels in the Susquehanna River

Eastern elliptio (*Elliptio complanata*)

Portions of the Susquehanna River in Susquehanna County have very good populations of freshwater mussels. One method of surveying for mussels is to look through the bottom of a bucket that has been replaced with plexiglass. This allows for an unobstructed look at the river bottom. All that is typically seen of mussels is the hinge edge, which is barely protruding above the surface of the gravel substrate.

Eastern floater

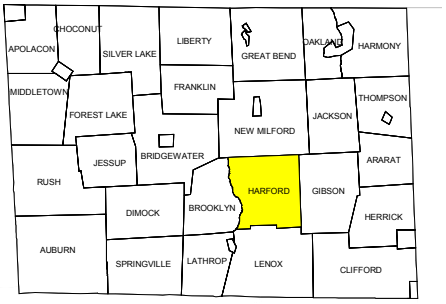
Eastern elliptio (*Elliptio complanata*)

Yellow lamp mussel

HARFORD TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	State	State Status	Last Seen	Quality**
None						

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: Tyler Lake Headwaters

Managed Lands:None

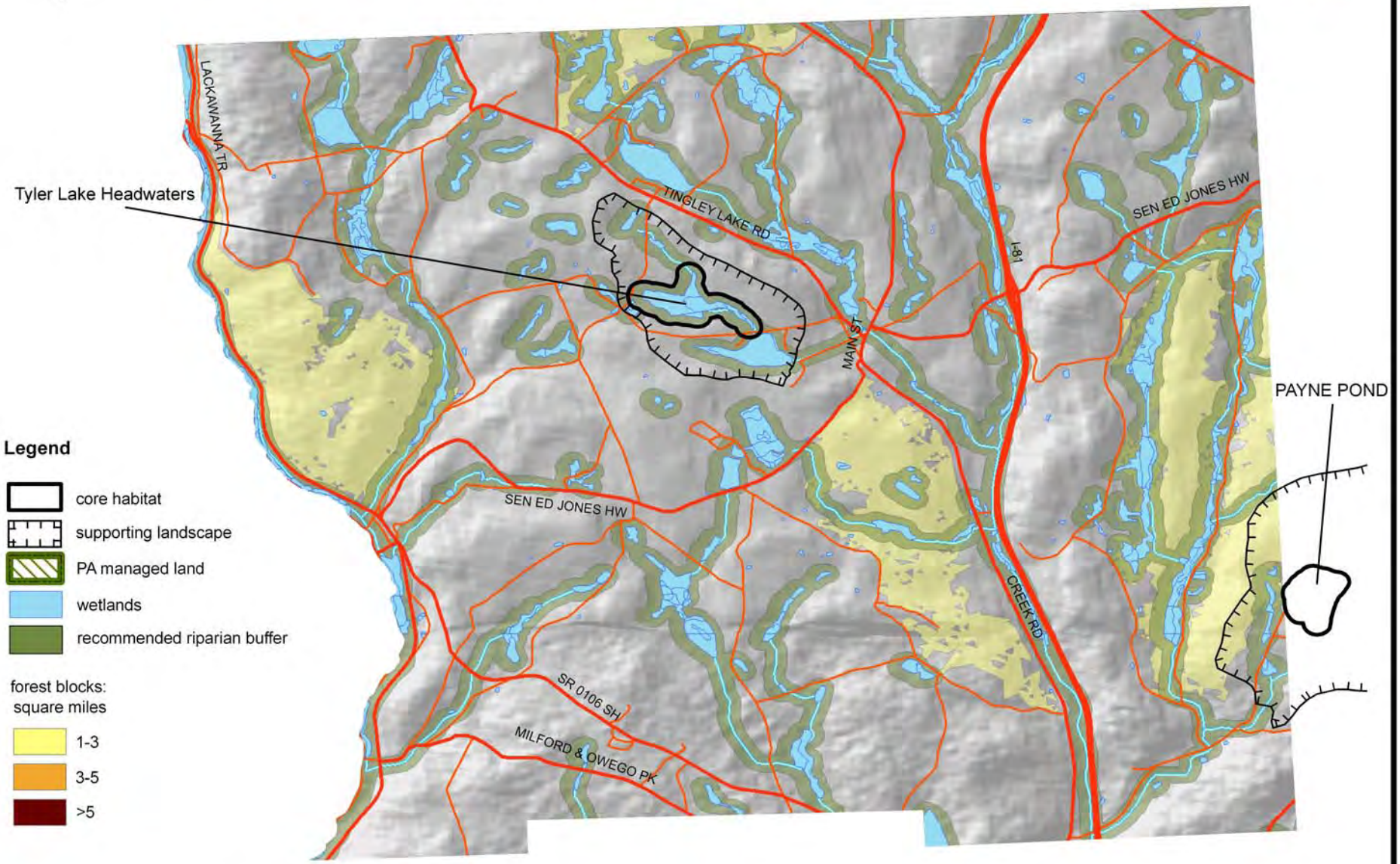
Aquatic Classification Project Results:
Fish: Warm Water Community 1—Martins Creek, Tunkhannock Creek, Nine Partners Creek
Fish: Cool Water Community 1—Butler Creek

Harford Township is characterized by numerous water resources, including wetlands, lakes, and streams, set in a landscape mosaic of agriculture and forestland. The township is drained by Martins Creek along the western boundary, Partners Creek, and Butler Creek in the east and includes headwater tributary streams and several lakes such as Tingley Lake and Tyler Lake. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. Maintenance and restoration of riparian buffers along the creeks are important to the water quality and flow of these watersheds. One of the largest intact forest blocks follows the banks of Butler Creek and its tributaries, forming a critical starting point for riparian conservation here. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Other forest blocks include many of the township's isolated wetlands and should be preserved as important buffers to these wetlands. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads.

HARFORD TOWNSHIP MAP

Harford Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Locally Significant Site:

Tyler Lake Headwaters – (Harford Township)
The large wetland on the north end of Tyler Lake appears to have been subject to repeated beaver influence. A diversity of habitats has been created by the cyclic ebb and flow of the water level at this site. An open water area near its confluence with Tyler Lake gives way to a sedge, grass and cat-tail dominated marsh which in turn progresses into a shrub swamp. Upstream, the wetland culminates in a small hemlock dominated swamp forest. This diversity of wetland habitats provides habitat for a wide variety of plant and animal species.

- Threats and Disturbances:

The cyclic high and low water levels created by beaver activity will likely maintain a diversity of wetland habitats at this site. Permanent flooding from man-made dams would drown the wetland habitat.

- Conservation Recommendations:

Maintain the current wetland hydrology by avoiding construction of permanent dams. Preserve the forested buffer surrounding the wetland by avoiding the construction of roads, development or utility rights-of-way. Additional biological surveys of this area are encouraged.

Above: Tyler Lake Headwaters
Below: Wild calla lily and tufted loosestrife are common species found in Tyler Lake Headwaters and many other of Susquehanna County's numerous wetlands.

HARMONY TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
BRANT SLOPES (5)	Plant: Canadian Milkvetch (*Astragalus canadensis*)	G5	S2	N	2005-7-07	BC
CHURCHILL LAKE (3)	Natural Community: Leatherleaf-sedge wetland	GNR	S3	N	2005-7-13	E
	Plant: Bog-rosemary (*Andromeda polifolia*)	G5	S3	PR	1993-8-18	D
	Plant: Slender sedge (Carex lasiocarpa)	G5	S3	PR	2005-7-13	E
	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-7-13	E
HEMLOCK CREEK WETLAND (4)	Plant: Soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-8-25	E
	Plant: Red currant (*Ribes triste*)	G5	S2	PT	2005-8-25	E
LITTLE ROARING BROOK WETLANDS (5)	Animal: Green-striped Darner Dragonfly (*Aeshna verticalis*)	G5	S3S4	N	2005-9-08	E
	Plant: Soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-9-08	E
NORTH BRANCH HEMLOCK CREEK SLOPES (4)	Plant: Kidney-leaved white violet (*Viola renifolia*)	G5	S1	N	2005-8-24	A
	Plant: Great-spurred violet (*Viola selkirkii*)	G5?	S1	N	2005-8-24	E
ROARING RUN HEADWATERS (5)	Plant: Mountain starwort (*Stellaria borealis*)	G5	S1S2	N	2005-7-07	E
	Plant: Soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-7-07	BC

HARMONY TOWNSHIP MAP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
ROUND HILL WETLANDS (5)	Plant: Bog rosemary (*Andromeda polifolia*)	G5	S3	PR	2005-7-06	C
SUSQUEHANNA RIVER (3)	Animal: Yellow Lampmussel (*Lampsilis cariosa*)	G3G4	S3S4	N	2004-8-11	A
	Animal: Eastern Lampmussel (*Lampsilis radiata*)	G5	S1	N	2004-8-11	D
	Animal: Elktoe mussel (*Alasmidonta marginata*)	G4	S4	N	2004-8-11	BC
	Animal: Treangle Floater mussel (Alasmidonta undulate)	G4	S3S4	N	2004-8-11	CD
	Animal: Black-banded Bandwing Dragonfly (*Calopteryx aequabilis*)	G5	S2	N	1986-6-11	B
	Animal: Midget Snaketail Dragonfly (*Ophiogomphus howei*)	G3	S1	N	1988-6-13	C
	Animal: Abbreviated Clubtail Dragonfly (*Gomphus abbreviatus*)	G3G4	S2	N	1986-6-19	B
	Animal: Harris' Checkerspot Butterfly (*Chosyne harrisii*)	G4	S3	N	1988-6-13	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
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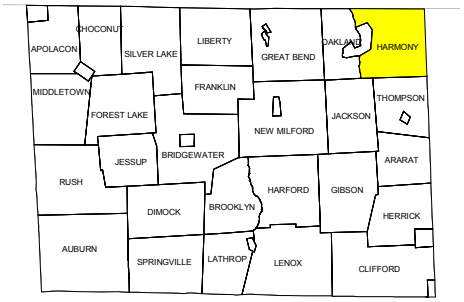


Locally Significant: None

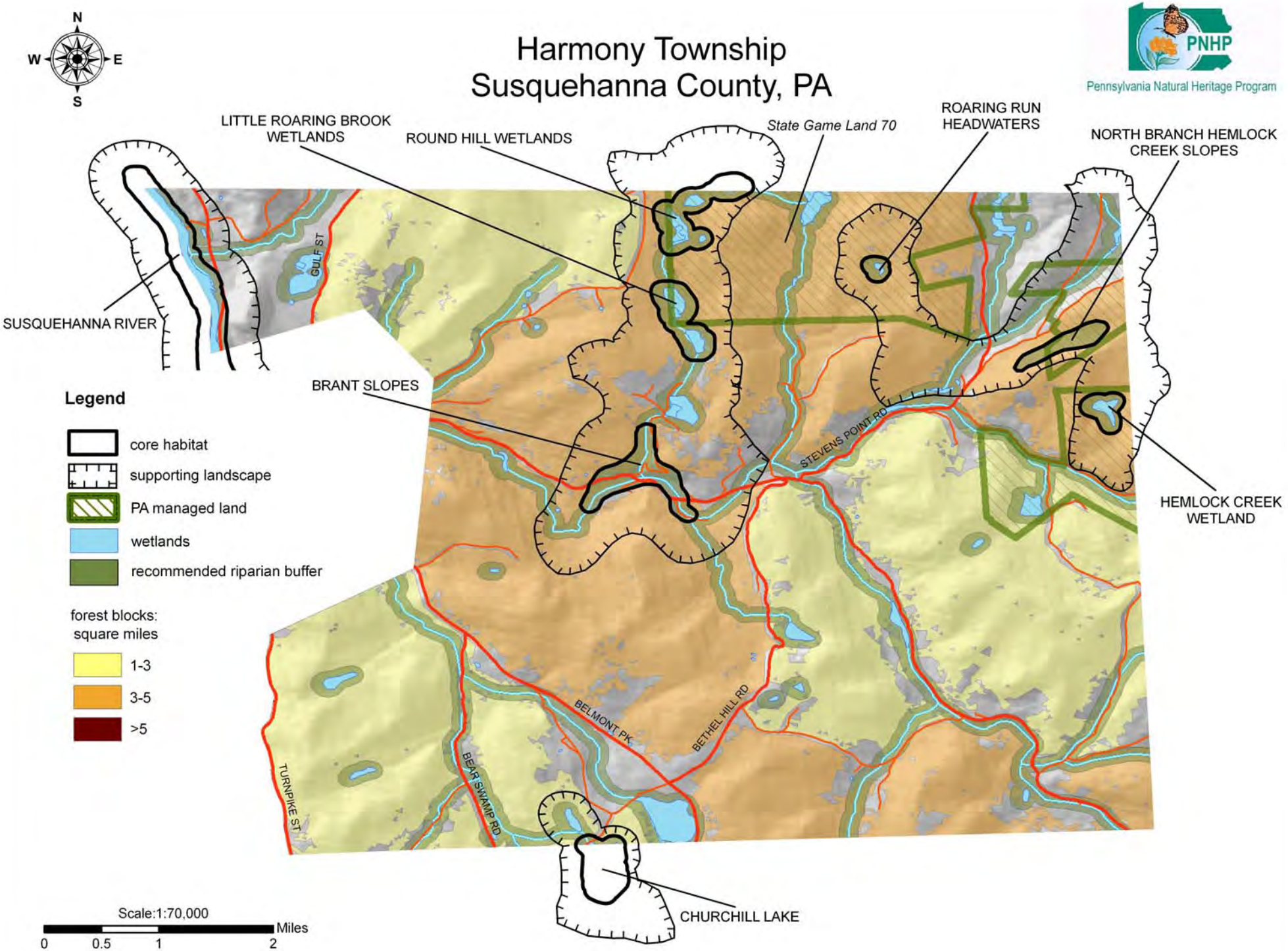
Managed Lands: State Game Lands #70

Aquatic Classification Project Results:
Fish: River and Impoundment Community: Susquehanna River, Denton Creek
Fish: Warm Water Community 1—Starucca Creek
Invertebrate: Rolledwinged stonefly / Small minnow mayfly —Susquehanna River-Denton Creek

HARMONY TOWNSHIP MAP

Harmony Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Located in the extreme northeastern corner of the county, Harmony Township is bordered by a portion of the Susquehanna River as it dips into northern Pennsylvania. Starucca Creek and its tributaries provide most of the drainage area for the township. The township is almost entirely forested, with the most significantly-sized forest block containing most of the large State Game Lands #70. Conservation efforts to buffer the edges of the Game Lands from development and disturbance are important to the long-term quality of the wildlife and land resources within the Game Lands. Much of the Susquehanna River bank in this area is characterized by extreme slopes that have prevented cultivation or development and preserved a forested floodplain. Maintaining an intact forested floodplain along the river and Starucca Creek can preserve much of the township's important biodiversity. Forested buffers should be maintained, widened and created where absent along the length of the river with logging operations minimizing cutting within 100 meters of the river edge. The large blocks of forested uplands should be preserved intact by avoiding unnecessary fragmentation of the landscape with additional roads or building developments. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

Harris' Checkerspot Butterfly (*Chosyne harrisii*)


Nodding ladies'-tresses (*Spiranthes cernua)* is an interesting, though not rare species, that was found in Little Roaring Brook Wetland Photo:PNHP

BRANT SLOPES – (Harmony Township)

This steep, south facing slope above Starrucca Creek has an abandoned railroad grade along the slope. The slope is dominated by thin young trees and the undergrowth is somewhat weedy. The G5, S2 Canadian milkvetch (*Astragalus canadensis*) occurs along the abandoned railroad bed where vehicle traffic has not worn away all vegetation.

- Threats and Disturbances:

Starrucca Creek has areas with discarded appliances, tires and other trash. The water appears clean and is used by fishermen. The Canadian milkvetch has colonized the disturbed area of the abandoned railbed. Increased vehicle traffic could reduce the size of this population.

- Conservation Recommendations:

This species can grow in certain types of disturbed conditions and should persist at this location where vehicle traffic does not trample it completely. Additional surveys for this species in more natural conditions as along Starrucca Creek are encouraged. The flood scour conditions of the creek likely provide the natural habitat for this species.

Canadian Milkvetch (*Astragalus canadensis*

CHURCHILL LAKE (Harmony and Thompson Townships)

Churchill Lake is a glacially formed wetland with a large area of open water containing a significant portion that is composed of a characteristic floating bog mat. The northern portion of the wetland is covered with low shrubs and stunted trees, but despite appearing as solid ground, this shrubland floats on centuries-long accumulations of partially decomposed sphagnum moss and other plant material, giving the shrubland a quaking aspect. Most of the 12 acre shrubland is dominated by leatherleaf (*Chamaedaphne calyculata*), a characteristic shrub of acidic peatlands, which in this case form a **Leatherleaf-sedge Wetland Natural Community.**

As the vegetation progresses away from the edge of the open water, scattered stunted white pine and red maple trees and a few American larches are underlain by an increasingly thick tangle of highbush blueberry, winterberry holly, smooth alder, spiraea, bog laurel, **bog rosemary (*Andromeda polifolia*), a G5, S3 PA-rare plant species of concern** and other shrubs. Within the branches of the shrubs are growing herbaceous species such as various sedges and rushes, marsh fern, hooded skullcap, swamp loosestrife and **marsh bedstraw (*Galium trifidum*), a G5, S2 PA plant species of concern**. Other plants include the characteristic acid peatland species cotton grass and the insectivorous pitcher plant. All these plants are rooted in a saturated substrate of deep sphagnum peat. The open water edge of the bog mat has a sedge species characteristic of early stage bog formation, **slender sedge (*Carex lasiocarpa*), a G5, S3 PA-rare species of concern**. Along the edge of the bog mat and in the shallows of the lake margins are a good variety of aquatic plant species with many dragonfly and damselfly species present as well. There was evidence of beaver activity in portions of the lake.

- Threats & Disturbances:

The lake is almost entirely surrounded by a wide forested buffer, which helps protect the water quality from non-point sources of pollution. A small gravel lane traverses the northern edge of the lake at its outflow. One or two residences occur along the shoreline of the wetland. One has a dock extending into the open water. Removal or modification of the forested buffer at these locations has occurred.

- Conservation Recommendations:

The lake is currently in a relatively undisturbed natural condition. A 100-meter undisturbed forested buffer surrounding the lake should be preserved to maintain the high water quality of this natural community (core habitat). Removal or modification of the forested buffer by the construction of

additional residences should be discouraged. Construction of elevated dams would drown a significant portion of the bog vegetation. Beaver dams should be removed as they occur to avoid negative impacts on the wetland. Activities within the upstream watershed should be scrutinized for their impact on this wetland habitat.

Little Roaring Brook Wetlands

HEMLOCK CREEK WETLAND – (Harmony Township)

This site is a pristine cool swamp nestled between two hills. This wetland complex includes a spring-fed herbaceous marsh with saturated to mucky soils surrounded by shrub and forested wetlands exhibiting a mound and pool microhabitat. The herbaceous layer within the wetland is thick and diverse, taking advantage of both drier habitats on the elevated hummocks and extremely wet conditions between the hummocks. The wetland complex is bordered by an upland hemlock-white pine forest. Two plant species of concern were documented within this forested wetland habitat. A population of the **G5, S2 PA-threatened red currant (*Ribes triste*)** occurs in scattered patches on both the elevated hummocks and the hollows between the hummocks. The **G5, S3 soft-leaved sedge (*Carex disperma*)** was documented growing on the elevated hummocks and downed logs.

- Threats and Disturbances:

No disturbances were observed in this apparently pristine habitat.

- Conservation Recommendations:

Preserve the forested buffer surrounding this wetland complex. Maintain the current hydrology by monitoring for beaver. It may be necessary to remove beavers to prevent flooding of this habitat.

LITTLE ROARING BROOK WETLANDS – (Harmony Township)

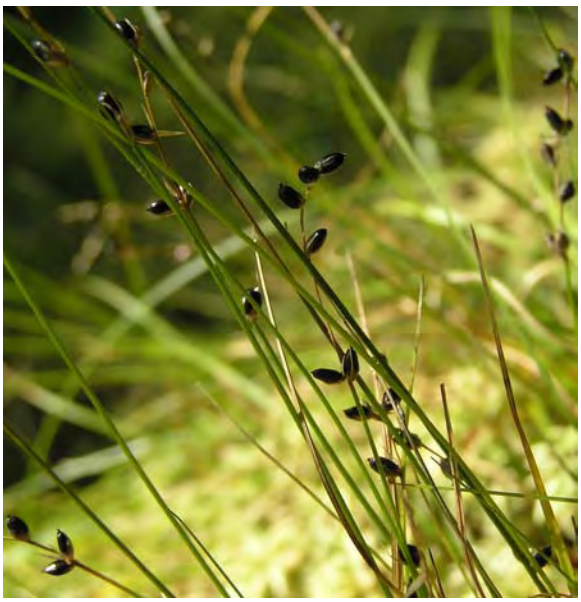
These two large, open wetlands have been influenced by periodic beaver activity. The wetlands are currently open sedge and shrub meadows that are recovering from past beaver impoundment. The **G5, S3 soft-leaved sedge (*Carex disperma*)** grows along the wet, shaded, hemlock forested margins of the wetland openings. An **animal species of concern** also was documented using the wetland opening as its primary habitat.

- Threats and Disturbances:

The area is actively farmed. Cattle are not fenced from the wetland, and graze through the adjacent forest. Logging of the hemlock forest adjacent to the wetland could eliminate the habitat of the soft-leaved sedge.

- Conservation Recommendations:

Fence the wetland and adjacent forest in a 100 meter buffer around the wetland from livestock grazing. Funding for this may be available through CREP or related programs. Avoid fragmentation of the forested buffer around the wetland. Maintain the natural wetland hydrology by avoiding dam building or draining for these wetland habitats.



Soft-leaved sedge (*Carex disperma*)
Phot:PNHP

NORTH BRANCH HEMLOCK CREEK SLOPES – (Harmony Township)

This north facing steep slope has a sugar maple dominated forested canopy over moist soils and a flora characteristic of more northerly habitats. The slope is rock and boulder-strewn, but most of the rocks are covered with soil or leaf litter. A population of the **G5?, S1 great-spurred violet (*Viola selkirkii*)** and the **G5, S1 kidney-leaved white violet (*Viola renifolia*)** were documented in this habitat. Prior to this survey, the kidney-leaved white violet was considered extirpated in PA, with no recently documented occurrences in the state. With this find, the state rank of the species will be changed from SH (state historical) to S1 (state critically imperiled).

- Threats and Disturbances:

There are old mining pits, quarries and roads on the eastern end of this forested slope. The western end remains fairly undisturbed.

- Conservation recommendations:

The forested slopes should be protected from logging and road construction activities. This site is partially on State game Lands #70. Additional surveys for these and other species of concern in this area are recommended.

ROARING RUN HEADWATERS – (Harmony Township)

This isolated headwater wetland is a hemlock-mixed hardwood palustrine forest fed by uphill seeps. There is standing water in places, but is mostly characterized by elevated hummocks of moss and decomposing fallen trees. The saturated soils contribute to trees falling down and the formation of hummocks by root 'tip-ups' and decomposing logs. The elevated hummocks provide slightly drier soils than the saturated muck in the depressions between them and support a dense herbaceous layer including a plant species of concern, the **G5, S3 PA-rare soft-leaved sedge (*Carex disperma*).** In adjacent open wetland areas small populations of the **G5, S1S2 mountain starwort (*Stellaria borealis*)** were documented.

- Threats and Disturbances:

No disturbances at this location were apparent. Logging or changes in the hydrology by the construction of dams could destroy the habitat for these species. Beaver dams could drown the wetland habitat.

- Conservation Recommendations:

Preserve a 100-meter undisturbed forested buffer around the wetland and tributaries leading into this wetland complex. Maintain the current wetland hydrology by removing beaver dams as they appear. Beaver removal may become necessary if they persist.

ROUND HILL WETLANDS – (Harmony Township)

There are several wetlands combined within this site, each with different characteristics. The largest are open, beaver influenced sedge and shrub meadows. The smallest of the wetlands is a small bog-like habitat with saturated soils covered with sphagnum moss and thick tangle of the short shrubs leatherleaf and bog laurel. The site also includes a small population of the **G5, S3 bog rosemary (*Andromeda polifolia*).** The wetland is surrounded by a dense tall shrub and red maple thicket underlain by sphagnum moss. The shrub thicket gives way to a pine woodland with a leatherleaf dominated shrub layer.

- Threats and Disturbances:

This habitat is not currently threatened by any nearby activities. Succession, over time, may lead to a more forested environment. Logging could reduce the quality of this wetland.

- Conservation Recommendations:

The wetland habitat was likely subject to natural wildfires in the past, which helped keep the undergrowth from completely closing the wetland opening. A carefully executed prescribed burn could potentially return the shrubland to more open conditions. Avoid fragmenting the adjacent habitat with roads or utility rights-of-way.

SUSQUEHANNA RIVER (Great Bend, Harmony and Oakland Townships)

Eight invertebrate animal species of concern were documented at various locations in the Susquehanna River. These animal species included four freshwater mussel species of concern: **the G3G4, S3S4 Yellow Lampmussel (*Lampsilis cariosa*); the G5, S1 Eastern Lampmussel (*Lampsilis radiata*): the G4,S4 Elktoe mussel (*Alasmidonta marginata*) and the G4, S3S4 Treangle Floater mussel (*Alasmidonta undulata*).**

Also documented form this location were **the G5, S2 Black-banded Bandwing Dragonfly (*Calopteryx aequabilis*), the G3, S1 Midget Snaketail Dragonfly (*Ophiogomphus howei*), the G3G4, S2 Abbreviated Clubtail Dragonfly (*Gomphus abbreviatus*) and the G4, S3 Harris' Checkerspot Butterfly (*Chosyne harrisii*).**

The entire length of the Susquehanna River should be considered suitable habitat for most of these species. Additional surveys are recommended to better estimate populations of these animals of concern in the river. The river also provides a valuable migration corridor for many bird species, especially aquatic-dependent birds, but also many neo-tropical passerine migratory species.

The Susquehanna River is subject to frequent flooding and seasonal low water levels. Scouring of the banks and islands by ice and flooding has created pockets of specialized habitats along the river floodplain. Several islands have distinctive "Big bluestem - Indian grass River Grasslands," which are natural tall grassland communities created as the result of these natural disturbances. The two plant species the community type is named for dominate these habitats and also include switch grass and Indian hemp. The habitat tends to grade into a "Water willow – Smartweed Riverbed Community" on the lowest island elevations, and into a "Black willow Scrub/shrub Wetland," and "River birch – Sycamore Floodplain Scrub" as the elevation increases and the habitat becomes drier. These natural communities are part of the "Riverbed – Bank – Floodplain Community Complex" (Fike 1999), a broadly defined mosaic of community types that typify the natural vegetation along the Susquehanna River in Susquehanna County.

- Threats and Disturbances:

There are numerous examples of disturbance along the Susquehanna River. These animal species of concern are affected by non-point sources of pollution including sedimentation from cultivated and developed land along the river, runoff from roadways, pesticide runoff from agricultural fields, discharge of chemical pollutants and thermal pollution. The main threat to these animals is reduction of water quality. The banks, floodplains and islands of the river have the invasive introduced plant species Japanese knotweed and purple loosestrife. Control of established populations of these species is very difficult. Eradication of pioneer populations is the best way to control the spread of these species of plants.

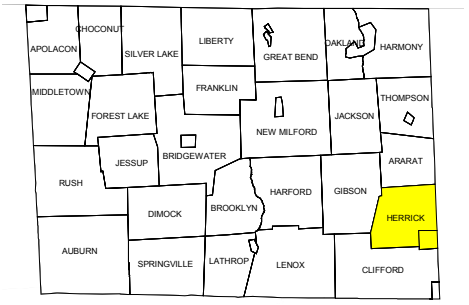
- Conservation Recommendations:

Any of the above types of disturbances should be minimized where possible. Also, monitoring of these populations should continue into the future. Loss of individuals and reductions in population sizes should lead to an investigation into possible causes. Water quality should be monitored and pollution sources should be identified where possible. Forested buffers should be maintained and created where absent along the length of the river, with logging operations refraining from cutting within 100 meters of the river edge. River bank forests help buffer the watershed from the effects of non-point sources of pollution including runoff from agricultural, residential and roadway settings. In addition, the river floodplain and corridor is usually an area of significantly higher biodiversity than the adjoining uplands. Much of the area's important biodiversity can be preserved by maintaining an intact, forested floodplain along the river. The effectiveness of the forested riverbanks as a habitat corridor would be diminished by fragmentation of the forest continuity by the construction of houses, businesses and additional roadways along the river. Local planning should discourage construction of new structures and roadways along the river, adjacent slopes and floodplain.

HERRICK TOWNSHIP and Union Dale Borough

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
BURNWOOD POND (4)	Plant: Lesser panicled sedge (*Carex diandra*)	G5	S2	PT	1991-6-25	B
FIDDLE LAKE CREEK WETLANDS (3)	Plant: Sweet-gale (*Myrica gale*)	G5	S2	PT	2004-8-03	A
	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2004-8-03	E
LEWIS LAKE (4)	Plant: Sweet-gale (*Myrica gale*)	G5	S2	PT	2002-08-14	B
LOWE LAKE (4)	Plant: Torrey's Bulrush (*Schoenoplectus torreyi*)	G5?	S1	PE	1988-7-05	B
	Plant: Flat-leaved Bladderwort (*Utricularia intermedia*)	G5	S2	PT	1988-7-05	B
	Plant: Bog-rosemary (*Andromeda polifolia*)	G5	S3	PR	1988-7-05	C
	Plant: Slender sedge (*Carex lasiocarpa*)	G5	S3	PR	1988-7-05	E
	Plant: Horned bladderwort (*Utricularia cornuta*)	G5	S2	N	1988-7-05	E
SGL #236 WETLANDS (3)	Animal: Gray Petaltail Dragonfly (*Tachopteryx thoreyi*)	G4	S3	N	2005	E
	Plant: Slender sedge (*Carex lasiocarpa*)	G5	S3	PR	2004-7-21	E
WEST BRANCH LACKAWANNA RIVER HEADWATERS (5)	Animal: Harpoon Clubtail Dragonfly (*Gomphus descriptus*)	G4	S1S2	N	2005-6-14	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

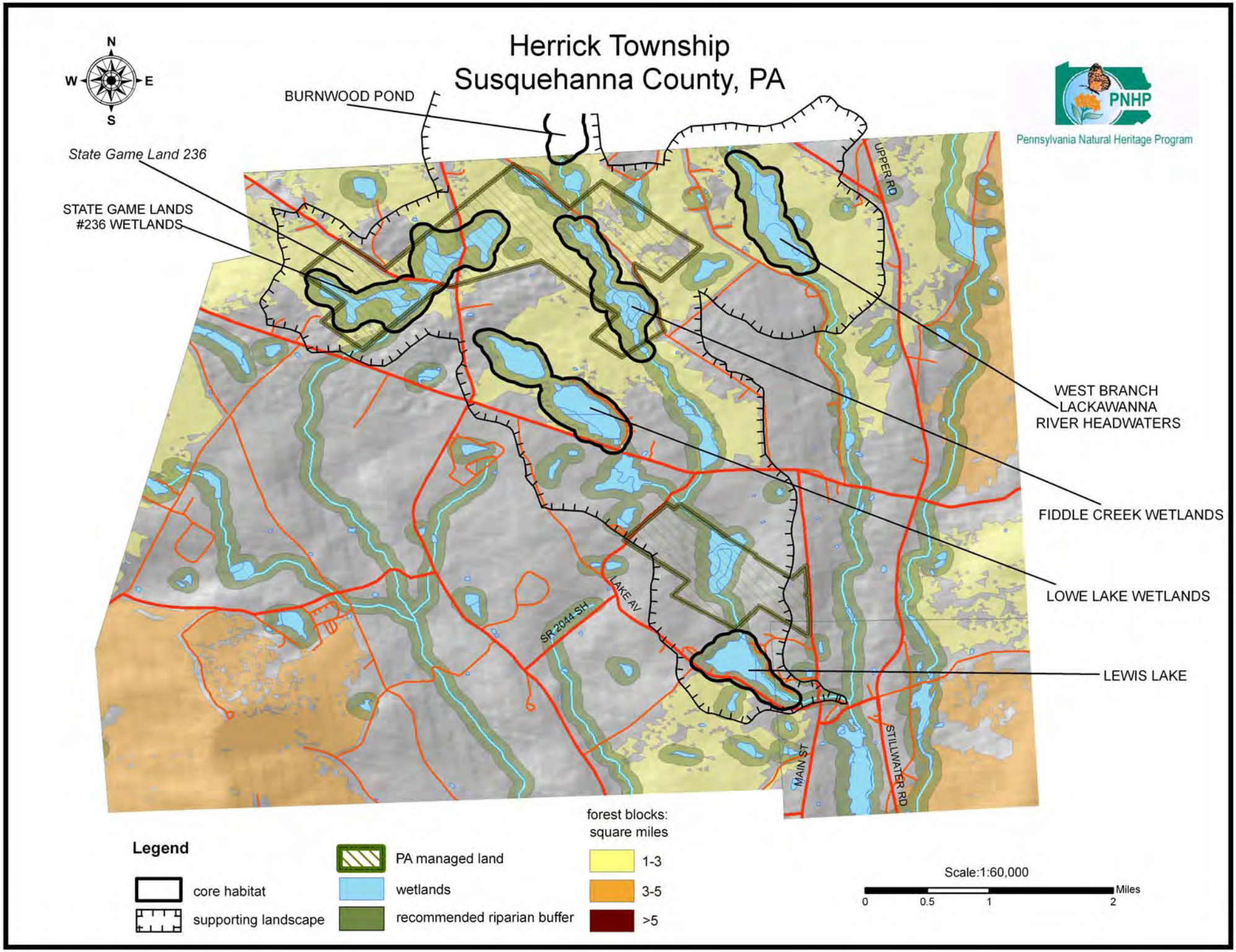


Locally Significant: None

Managed Lands: State Game Lands #236

Other: High Quality Cold Water Fishery: East Branch Lackawanna River

HERRICK TOWNSHIP MAP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STATE GAME LANDS
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RIVER HEADWATERS
FIDDLE CREEK WETLANDS
LOWE LAKE WETLANDS
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core habitat
supporting landscape
PA managed land
wetlands
recommended riparian buffer
forest blocks:
square miles
1-3
3-5
>5
Scale:1:60,000
0
0.5
1
2
Miles

Aquatic Classification Project Results:

Fish: Cold Water Community—East Branch Tunkhannock Creek-Dundaff
Fish: Cool Water Community 2—East and West Branch Lackawanna River
Invertebrate: Brushlegged mayfly / fingernet caddisfly —West Branch Lackawanna River

Herrick Township is characterized by numerous water resources, including wetlands, lakes, and streams, set in a landscape mosaic of agriculture and forestland. The forest blocks in the township are fragmented by scattered agricultural lands, roads, and other developments, but a few significantly sized blocks remain. One is concentrated around the State Game Lands #236. Conservation efforts to buffer the edges of the Game Lands from development and disturbance are important to the long-term quality of the wildlife and land resources within the Game Lands. Several forested blocks provide natural riparian buffers for the streams in the township, including the drainage area for the High Quality East Branch Lackawanna River and the West Branch Lackawanna River. In the western half of the township, the headwaters of the East Branch Tunkhannock Creek include several wetland resources. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands and headwater streams, and avoiding fragmentation of the largest forest blocks with additional roads. The abundance of water resources in this township put maintenance of water quality high in importance to the natural resources of the township and downstream neighbors. Restoration efforts should focus on riparian plantings along creeks and providing buffers to natural wetlands. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Protection of connectivity of the large forest block at Elk Hill to neighboring townships is important to the movement of wildlife in a natural corridor.

Fiddle Lake Creek Wetlands

Fiddle Lake Creek Wetlands on State Game Land #236

BURNWOOD POND – (Ararat and Herrick Townships)

The wetland on this site is partially within State Game Lands #236. A marsh occurs at the northern end of the shallow water pond adjacent to the open water lake. Several small channels wind through the grass and sedge dominated marsh before reaching the pond. A good quality population of the **G5, S2 PA-threatened lesser panicled sedge (*Carex diandra*)** was documented within this wetland. The wetland is currently well buffered from external sources of disturbance by a wide forested buffer.

- Threats and Disturbances:

Changes in the wetland hydrology, such as permanent flooding or draining would reduce the quality of the habitat for this species at this site. Residential development upstream could effect water quality of this wetland.

- Conservation Recommendations:

Preserve the wide undisturbed forested buffer surrounding the wetland. Maintain the current wetland hydrology. The temporary periodic flooding and draining due to beaver activity will likely keep these wetlands in various states of succession. Permanent flooding or draining would likely destroy this natural community.

FIDDLE LAKE CREEK WETLANDS – (Herrick Township)

As Fiddle Creek passes through State Game Lands #236 it opens into a large open wetland complex. The creek has likely seen cyclic, temporary inundation by the ebb and flow of beaver activity. The upland forest matrix leads to the shrub-dominated edge of the wetland. A wide wet sedge meadow acts as a water–filled moat as one approaches the creek. Nearer the creek edge are a series of mounds that provide drier habitat for a different group of small trees and shrubs. Sedges border the creek edge while the creek itself has numerous floating and emergent aquatic plants. Two plant species of concern were documented within these wetlands. A very good population of the **G5, S2 PA-threatened sweet gale (*Myrica gale*)** was documented on the perimeter and throughout the wetland along with other more common peatland shrubs including bog laurel, leatherleaf and marsh cinquefoil. The **G5, S2 marsh bedstraw (*Galium trifidum*)**, was also documented throughout the wetland.

- Threats and Disturbances:

This wetland is primarily within State Game Lands #236, so development pressure will likely not affect the immediate wetland habitat. Potential development upstream from the wetlands can have a significant impact on water quality within the wetland. Flooding to create an open water pond would also significantly decrease the quality of this interesting wetland habitat.

- Conservation Recommendations:

Maintain the current wetland hydrology by avoiding permanent flooding or draining. Preserve the wide forested buffer surrounding the wetland by avoiding further fragmentation by additional roads or utility rights of way.

Sweet gale (*Myrica gale*)
Photo: Bud Sechelr-PNHP

Lesser panicled sedge (*Carex diandra*)
Photo: John Kunsman-PNHP

LEWIS LAKE – (Herrick Township)

Lewis Lake is a 50-acre lake that has been dammed at the southern end. Summer cottages and year-round residences ring the lakeshore. Despite the disturbed nature of the lakeshore, a good-quality population of the **G5, S2 PA PA-threatened sweet-gale (*Myrica gale*)** persists along the boggy margins of the water's edge. This easily identified, fragrant, shrub species is characteristic of northern bogs & lakeshores and in Pennsylvania occurs exclusively in the glaciated northeast portion of the state.

- Threats and Disturbances:

Lakeshore development has likely much reduced the occurrence of sweet-gale at this location. Uninformed residents could unknowingly eliminate the uncommon shrub species that occurs at this site.

- Conservation Recommendations:

Inform property owners on how to identify this shrub species and its importance as a Pennsylvania rarity. Avoid the use of herbicides in and near the lake.

LOWE LAKE – (Herrick Township)

This glacially formed natural lake has a floating mat of bog vegetation occurring on its western edge. The eastern shore of the lake is developed with closely placed cottages and homes the length of the shorefront. The relatively undisturbed western shore supports five plant species of concern. The **G5, S2 PA-threatened flat-leaved bladderwort (*Utricularia intermedia*)** occurs as a floating plant in the lake. The **G5, S1 PA-endangered Torrey's bulrush (*Schoenoplectus torreyi*)** occurs in shallow water along the shoreline, while the **G5, S3 PA-rare slender sedge (*Carex lasiocarpa*)** grows along the lake shore, but in slightly drier areas than the Torrey's bulrush. The **G5, S3 PA-rare bog rosemary (*Andromeda polifolia*)** is a characteristic evergreen bog shrub that grows on the floating bog mat vegetation along with the **G5, S2 horned bladderwort (*Utricularia cornuta*)**.

- Threats and Disturbances:

Attempts to clear the lake of floating vegetation for recreational boating could impact the species of concern. Herbicide use on floating lake and bog vegetation could devastate the habitat of these plants. Beaver activity on the vegetation mats can fragment the mat into smaller pieces. Residential development of the undisturbed portions of the lake could severely reduce the populations of species of concern.

- Conservation Recommendations:

Advise lake residents on importance of uncommon plant species and their habitat. Avoid the use of herbicides in or near the lake. Avoid destruction of the bog mat vegetation on the western edge of the wetland by fragmentation of the lakeshore with additional development. Monitor septic systems of the cottage community to avoid nutrient enrichment of this naturally low-nutrient environment. Consider conservation easement on the western edge of the lake for future protection of this interesting habitat.

Lowe Lake

STATE GAME LANDS #236 WETLANDS – (Herrick Township)

This area supports a hemlock swamp with trees that are somewhat stunted and growing on moss covered mounds. These mounds also support a variety of shade and high moisture tolerant plants such as cinnamon fern, bog fern, gold thread and wood sorrel. The lower ground between the hummocks has carpets of sphagnum mosses, herbs or deep muck. Two species of concern were documented at this site. The **G5, S3 PA-rare slender sedge (*Carex lasiocarpa*)** was located in an open sedge meadow with a small stream meandering through. This species is characteristic of peat accumulating wetlands such as bogs and fens. The creek flowing through this wetland brings nutrients and minerals, which is more distinctive of a fen habitat. The Gray Petaltail Dragonfly (*Tachopteryx thoreyi*), a G4, S3 **animal species of concern** was also documented at this location.

- Threats and Disturbances:

No disturbances or threats were apparent to the species of concern or their habitats at this location.

- Conservation Recommendations:

Avoid flooding or draining of this habitat. Recent beaver activity has drowned many similar hemlock swamp forests in Susquehanna County. Dam removal and beaver trapping may be necessary to preserve the quality of this forested wetland habitat. Avoid fragmenting this habitat with additional roads, utility rights-of-way or game management food plots. Preserve water quality entering this wetland habitat by avoiding upstream and uphill development.

WEST BRANCH LACKAWANNA RIVER HEADWATERS - (Herrick Township)

This large wetland contains a wide-open bluejoint-reed canary grass marsh, which is likely the result of cyclic impoundment due to beaver activity. The marsh grasses form extremely dense stands on either side of a narrow, but deep stream channel, which cuts through the wetland opening. Plant diversity is fairly low in the central portion of this marsh habitat, but the small stream and occasional pools provide habitat for the **Harpoon Clubtail Dragonfly (*Gomphus descriptus*), a G5, S1S2 animal species of concern.**

- Threats and Disturbances:

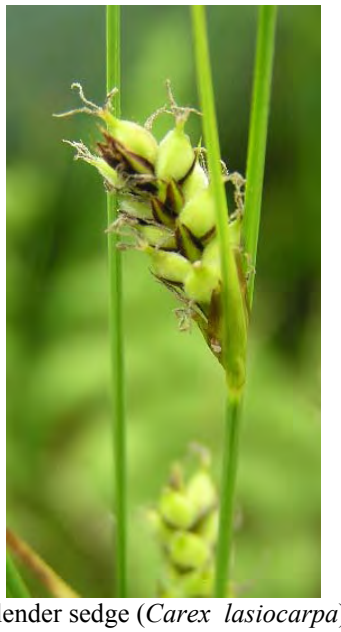
This wetland has been subjected to repeated short term flooding and draining due to the activities of beavers. This cyclic beaver impoundment will likely help keep this wetland in various stated of succession.

- Conservation Recommendations:

Preserve an undisturbed forested buffer around this wetland. Avoid construction of permanent dams. Avoid fragmenting the habitat with additional roads and utility rights-of-way.

West Branch Lackawanna River Headwaters

West Branch Lackawanna Headwaters

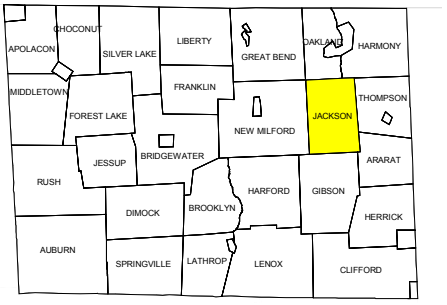


Slender sedge (*Carex lasiocarpa*)
Photo: PNHP

JACKSON TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
BRUSHVILLE LAKE (5)	Plant: Soft-leaved sedge (Carex disperma)	G5	S3	N	2005-07-19	E
	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-07-19	E
EAST LAKE WETLANDS (5)	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-07-19	E
	Animal: Halloween Pennant Dragonfly (*Celithemis eponina*)	G5	S2S3	N	2005-07-19	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: Butler Lake,
Little Butler Lake

Managed Lands: None

Other: High Quality Cold Water Fishery: Headwaters to Salt Lick Creek

Aquatic Classification Project Results:
Fish: River and Impoundment Community: Susquehanna River-Denton Creek;
Fish: Warm Water Community 1—Tunkhannock Creek-Nine Partners Creek, Salt Lick Creek;
Fish: Cool Water Community 1—Butler Creek;
Invertebrate: Rolledwinged stonefly / Small minnow mayfly —Susquehanna River-Denton Creek

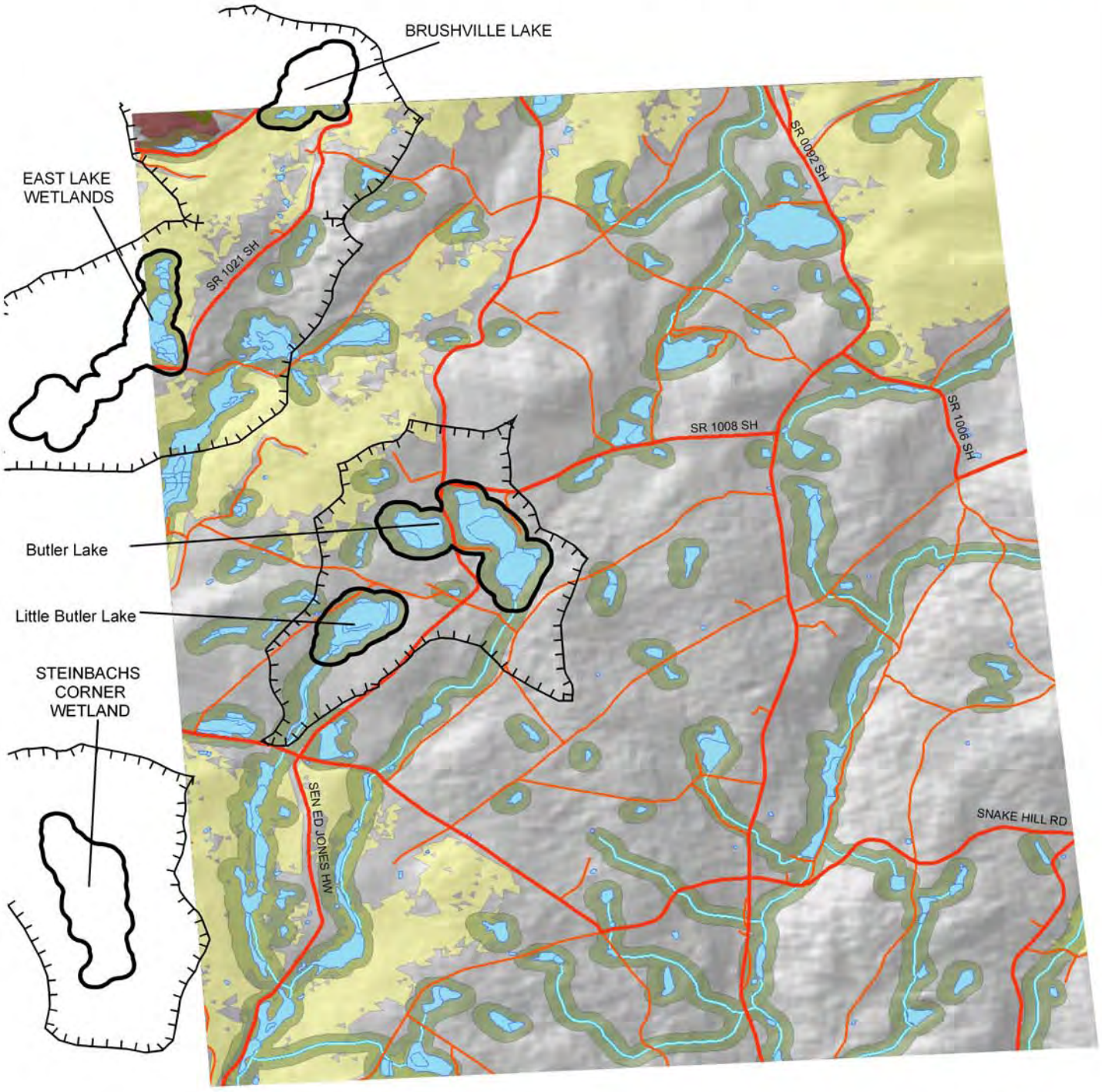
Jackson Township is characterized by abundant water resources, including streams, lakes, and numerous wetlands. The headwaters of Salt Lick Creek, Butler Creek, Tunkhannock Creek, and Drinker Creek all originate in this township. Much of the biodiversity of the township can be maintained by focusing conservation on these aquatic systems: avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin.

The habitat for the cool water community 1 in Butler Creek represents an important transition between cold headwater streams and warm, larger streams; the habitat is distinct among other habitat types and should be protected and restored. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

JACKSON TOWNSHIP MAP

Jackson Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

Scale:1:60,000

0 0.5 1 2 Miles

BRUSHVILLE LAKE – (Jackson and Oakland Townships)

This wetland had been dammed in the past to create an open water pond. The dam has recently been breached, exposing large areas of very shallow water and pond bottom muck. The shallow water still supports yellow water lily, while the exposed muck soils are being colonized by early successional wetland plant species such as soft rush, rice cut grass and wool-grass. A population of the **G5, S3 marsh bedstraw (*Galium trifidum*)** was documented growing along an old beaver dam adjacent to a hemlock swamp forest. The wet hemlock area supports the **G5, S2 PA-rare soft-leaved sedge (*Carex disperma*)**, which is growing at the base of several hemlock and white pine trees in the swamp forest. Since the water level of this wetland has recently been lowered the habitat has been altered dramatically. This freshly exposed pond bottom provides a good opportunity to document plant succession.

- Threats and Disturbances:

The marsh bedstraw will likely persist in its current habitat. An old beaver dam occurs where the stream enters the larger wetland from the hemlock swamp forest. A beaver dam at this location would likely drown the hemlock forest and destroy the habitat for the soft-leaved sedge. Logging of the wet hemlock forest could also severely degrade the habitat for this plant and many other shade and moisture tolerant species.

- Conservation recommendations:

Avoid flooding or logging of the hemlock swamp forest. Additional biological surveys in the hemlock swamp forest and the newly exposed pond bottom are encouraged.

Left: Marsh bedstraw is best identified by its arching fruit stems.

EAST LAKE WETLANDS – (Jackson and New Milford Townships)

This site is divided into two main areas: an eastern hemlock dominated forest, and an open wet meadow dominated by woolgrass, sedges, and cat-tails. The hemlock forest is characteristic of most hemlock areas in Susquehanna County and contains plant species such as northern wood sorrel, Canada mayflower and bluebead lily. The second main area is also a fairly widespread wetland type in Susquehanna County. This area provides excellent habitat for wetland birds such as Common Yellowthroat, Swamp Sparrow, and Willow Flycatcher. A good population of the **G5, S2 PA-rare small bedstraw (*Galium trifidum*)** was found in the open wet meadow and will continue to persist there if similar ecological conditions continue to persist. Other abundant plants found there include woolgrass, various sedges, meadowsweet and soft rush. In addition, the **Halloween Pennant Dragonfly (*Celithemis eponina*), a G5, S2S3 animal species of concern** was also documented at this location. Overall, the site is very diverse and has significant value to both plant life and animal life.

- Threats and Disturbances:

The wetland is well protected on its eastern edge by a wide forested buffer. A road, residences and agricultural fields occur on the western side.

- Conservation Recommendations:

The wetlands can be best protected from external disturbances by preserving the forested buffer on its eastern edge and by reforesting the western edge, which is currently in agricultural fields right up to the edge of the wetland. An adequate forested buffer would span the distance from the nearby road to the wetland edge. This forested buffer would help reduce non-point sources of pollution. Care should be taken to use only native species for reforestation projects. Seed or plant stock for replanting efforts should also come from local sources whenever possible.

Locally Significant Sites:

Butler Lake – (Jackson Township)

This site was not ground surveyed during the period of this inventory. Information on this site was derived from aerial photo interpretation. This apparent bog habitat has seen some recent conversion of its shoreline by residential development. Older photographs of the area show a classic kettlehole bog habitat characterized by a central deep water area surrounded by floating shrubby vegetation. Recent photos show some houses, some clearing of the shoreline and boat docks cut through the bog vegetation to the open water center. An extensive floating bog mat continues to exist on the western and southern portions of the wetland. In all likelihood, characteristic species of plants restricted to bog habitats are present on this fragile floating environment.

- Threats and Disturbances:

There are multiple boat docks fragmenting the bog vegetation. A few houses fragment the forest surrounding the bog. A road passes near the northwestern edge of the bog. The bog is in danger of conversion to a recreational open water habitat.

- Conservation Recommendations:

This bog is threatened by recreational development pressure. The current water level should be maintained. Flooding by dam construction or draining should not be permitted. A single boat launch should be established on the northeastern edge of the wetland where there is the narrowest band of bog vegetation. The other boat docks should be removed. The bog vegetation should be treated as the fragile and valuable habitat that it is. Good examples of bog vegetation are near their southern limit in northeastern Pennsylvania and should be treasured where they occur. Ground surveys of this potentially ecologically important habitat should be a priority for future biological surveys in the Township.

Little Butler Lake – (Jackson Township)

Little Butler Lake is a former kettle hole bog that was converted to a lake several decades ago by the construction of a dam. The dam, though well intentioned, flooded the bog, drowning much of the native and interesting bog vegetation. Some of the bog vegetation still remains as floating islands buoyed by centuries old accumulations of partially decomposed plant material called peat. The islands float on top of the water but are substantial enough to support shrubs and trees, some of which are over twenty feet tall. The islands also continue to support characteristic bog species such as the shrub leatherleaf and the insectivorous pitcher plant. The lake is still largely forested on its eastern side.

- Threats and Disturbances:

The worst damage has already occurred to this bog by the construction of the dam. Some cleared agricultural fields occur on a portion of the surrounding land. Introduced species of aquatic plants are present in the lake.

- Conservation recommendations:

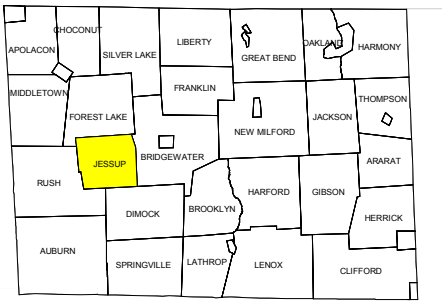
Despite the past disturbances, some of the former bog vegetation remains as fragmented floating islands. This open water lake may return to its former bog habitat in several hundred years, but this process could be accelerated by the removal of the dam and a return to the previous water level. Reforesting the western edge of the lake would help protect the water quality from degradation due to non-point sources of pollution such as runoff from roads, residences and agricultural fields.

The southern portion of Butler Lake has a floating vegetation mat that likely contains characteristic bog species of plants and animals. A biological survey of this wetland is recommended

JESSUP TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	State	State Status	Last Seen	Quality**
ELK LAKE WETLANDS (5)	Animal: Halloween Pennant Dragonfly (*Celithemis eponina*)	G5	S2	N	2005-6-21	E
	Plant: Dodder (*Cuscuta campestris*)	G5T5	S2	N	2002-7-28	E
DOC LUTZ WOODS (5)	Animal species of concern	G5	S3S4B,S4N	N	2002	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

Managed Lands: None

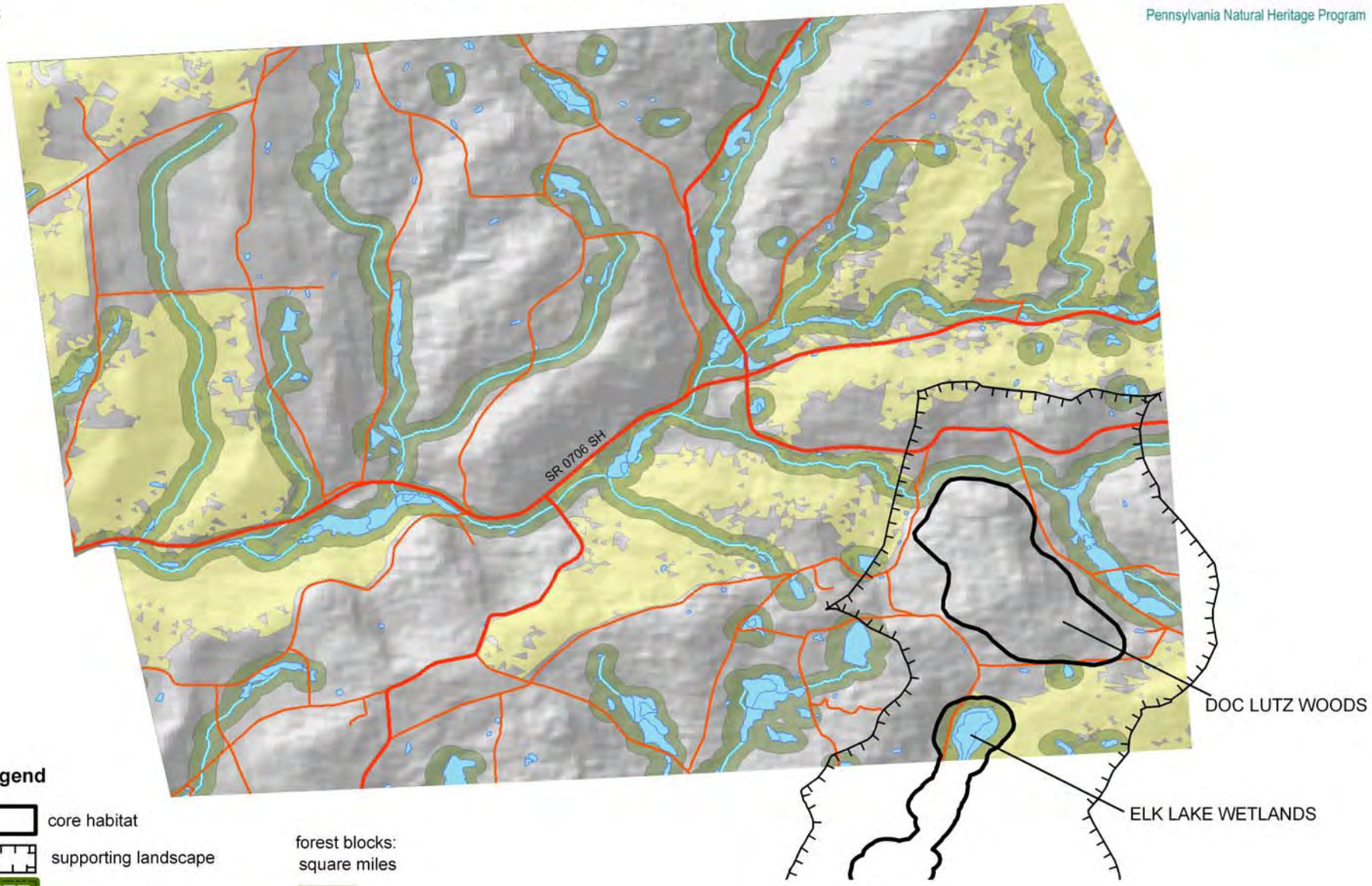
Aquatic Classification Project Results:
Fish: Warm Water Community 1—East Branch Wyalusing Creek

The East and South Branches of Wyalusing Creek meet in the center of Jessup Township. The largest forest blocks are clustered along portions of these streams. The landscape consists of a patchwork mosaic of agricultural and forested lands. Conservation efforts within the township could concentrate on replanting riparian buffers along the branches of Wyalusing Creek that lack adequate vegetation to protect from non-point sources of pollution such as agricultural, residential, and roadway runoff. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor.

JESSUP TOWNSHIP MAP

Jessup Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

Scale:1:55,000

0 0.5 1 2 Miles

ELK LAKE WETLANDS – (Dimock and Jessup Townships)

A series of open water lakes, forested wetlands, shrub swamps and sedge meadows occur within this area. Big Elk Lake is an open water glacial lake that has many residences around its perimeter. Little Elk Lake is more natural with fewer houses and the eastern portion of the lake remaining a natural shrub swamp. The main tributary to Big Elk Lake has several large wetland openings that have seen past and ongoing beaver activity. One of these wetlands is currently a sedge meadow, a stage reached when beavers have been absent for a decade or more. This habitat is dominated by grasses, sedges, rushes and cat-tails. A narrow but deep water channel cuts through the wetland opening. Dragonflies, damselflies and butterflies are abundant, especially where the creek forms small pools. Numerous large tree stumps occur in the wetland, suggesting that this habitat had once been a forested wetland. Further downstream, another wetland occurs that has a forest of standing dead trees in open water, suggesting recent flooding by beaver activity. The **G5, S2 plant species of concern dodder (*Cuscuta campestris*)** was documented along the stream that enters Big Elk Lake. An **aquatic animal species of concern** was documented in the northernmost large wetland opening and likely utilizes portions of the other wetland habitats as well.

- Threats and Disturbances:

The upper wetland openings have seen periodic flooding and draining due to cyclic beaver activity. They are mostly surrounded by a good forested buffer with portions of the area between them in agricultural production. Numerous residences surround Big Elk Lake. A small local road passes by the western of the wetland chain. Scattered residences occur throughout the area. Permanent flooding or draining of these wetlands could detrimentally affect the quality of the habitat for many species present at these wetlands.

- Conservation Recommendations:

Avoid dam construction on wetlands. Periodic flooding and draining due to beaver activity will not largely interfere with the ecosystem processes at work on the wetlands along this creek, but permanent flooding or draining could severely disturb these habitats. Preserve and repair forested buffer surrounding wetlands. Create forested buffer along creek between two upper wetlands. Trees will shade the creek, cooling water, which will hold more oxygen for aquatic animals. A forested buffer will also help protect the water quality from runoff pollution and sedimentation from roads, residences and agricultural fields.

DOC LUTZ WOODS – (Jessup Township)

This site contains an animal species of concern. This area is a large forested slope along the South Branch Wyalusing Creek primarily composed of northern hardwoods, but also with patches of hemlock-white pine and a few conifer plantations.

- Threats and Disturbances:

Conversion of the site from its present forested use to commercial and residential development would likely result in the abandonment of this nesting site.

- Conservation Recommendations:

Any logging activities should take place in the fall and early winter to avoid the most active spring and summer season.

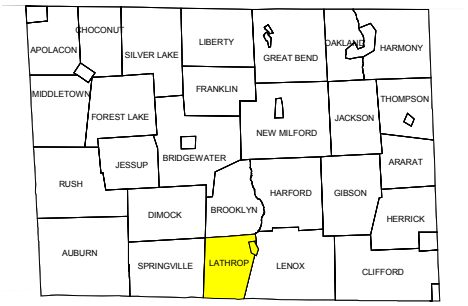
A portion of Elk Lake Wetlands

LATHROP TOWNSHIP and Hop Bottom Borough

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
HILLSDALE BOG (1)	Plant: Mud sedge (*Carex limosa*)	G5	S2	TU	2005-9-04	E
	Plant: Slender sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-9-04	E
	Plant: Soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-7-14	E
	Plant: Bog rosemary (*Andromeda polifolia*)	G5	S3	PR	2005-7-14	E
	Natural Community: Hemlock Palustrine Forest	GNR	S3	N	2005-7-14	E
	Natural Community: Leatherleaf-bog rosemary Peatland	GNR	S2S3	N	2005-7-14	E

- Ple
- ase refer to Appendix IV for an explanation of PNHP Ranks and State Status.

**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: Union Church Bog

Managed Lands: None

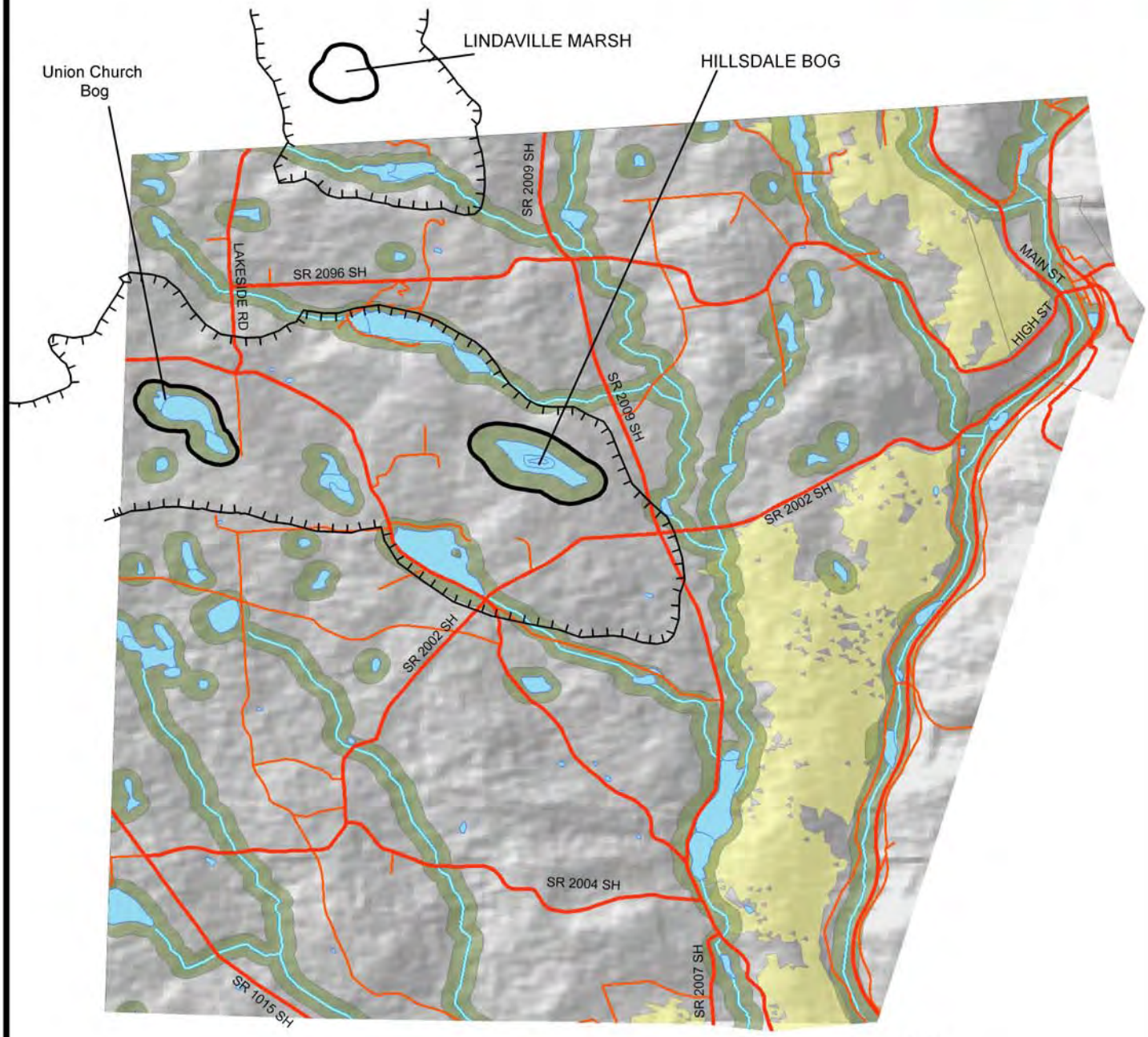
Aquatic Classification Project Results:

Fish: Warm Water Community 1—Horton Creek, Martins Creek, Tunkhannock Creek
Invertebrate: Rolledwinged stonefly / Small minnow mayfly—Tunkhannock Creek
Mussel: Yellow Lampmussel Community—Tunkhannock Creek

LATHROP TOWNSHIP MAP

Lathrop Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

Scale:1:55,000

0 0.5 1 2 Miles

LATHROP TOWNSHIP

Lathrop Township's natural areas are concentrated along the eastern border in the corridor created by Martins Creek. The township is dominated by cleared land, agriculture, roads, and pipelines, which have fragmented most of the forest and wetland areas. Several forested blocks provide natural riparian buffers for Martins Creek, forming a critical starting point for riparian conservation here. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands and avoiding fragmentation of the largest forest blocks with additional roads. Restoration efforts should focus on riparian plantings along creeks and providing buffers to natural wetlands. The abundance of water resources in this township put maintenance of water quality high in importance to the natural resources of the township and downstream neighbors. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor.

Hillsdale Bog

Hillsdale Bog is a small peat-forming wetland in a good landscape context. The wetland itself appears to have avoided many of the disturbances that have occurred in otjer bog-like wetlands in the county. This natural community should be considered one of the highest priority areas for conservation in the county.

Union Church Bog

HILLSDALE BOG – (Lathrop Township)
This wetland is relatively small for the county, but it represents one of the few unmodified bogs in the county. This bog has neither been flooded nor drained, and has a wide undisturbed forested buffer surrounding the bog habitat. The bog itself is composed of several distinct natural communities. The dry upland forest grades into a **Hemlock Palustrine Forest Natural Community** characterized by the dominance of its hemlock canopy and the saturated mineral soils that are typically covered in sphagnum and other mosses. The hemlock forest opens up into a tall shrub wetland as the soils become more saturated. The shrubs become shorter as the edge of the open water is approached. This shrub zone is primarily composed of leather leaf and bog rosemary, which combine to form a **Leatherleaf-bog rosemary Peatland Natural Community**. This zone typically occurs on a sphagnum moss substrate on vegetation mats that float on top of the water of the bog. At the edge of the bog vegetation mat where it meets the water, the mat thins to where it currently supports less vegetation due to increasing substrate saturation. This sphagnum moss lawn supports sedges and other herbaceous vegetation. The four plant species of concern documented at this location include the **G5, S2 mud sedge (*Carex limosa*)**, the **G5, S3 slender sedge (*Carex lasiocarpa*)**, the **G5, S3 soft-leaved sedge (*Carex disperma*)** and the **G5, S3 bog rosemary (*Andromeda polifolia*).**

- Threats and Disturbances:

This bog wetland is currently well buffered from external disturbances by a wide undisturbed forest. Potential detrimental threats include conversion of the bog wetland to an open water pond by construction of an artificial dam and removal or modification of the surrounding forest buffer through logging or residential development. Beaver activity could also severely impact the quality of this bog habitat.

- Conservation Recommendations:

Preserve the current wetland hydrology of this bog habitat by avoiding dam construction. Preserve the wide, undisturbed forested buffer surrounding the wetland. Avoid fragmenting this important habitat with additional roads or utility rights-of-way. Monitor the wetland for beaver activity and remove beaver dams as they appear. It may be necessary to trap beavers to prevent flooding of this bog habitat. As fewer and fewer good examples of unmodified classic bog habitats remain in Pennsylvania, those that are left should be cherished for the unique and fragile environmental gems that they are. Property owners adjacent to this wetland should consider applying for tax-reducing conservation easements for the future protection of this unique natural habitat.

Locally Significant Site:

Union Church Bog – (Lathrop Township)
This site was not ground surveyed during the period of this project. The description is derived from aerial photo interpretation. The wetland at this location appears to be a partially open water pond with a floating bog mat at the northern end. The bog mat likely support characteristic acidic wetland plant species such as leather leaf and pitcher plant, but may also provide suitable habitat for rare plant species.

- Threats and Disturbances:

Agricultural fields abut the wetland in a few locations, removing the protective forested buffer. The supporting landscape lacks large forest blocks, with most of the area fragmented by roads, agricultural fields and utility rights-of-way.

- Conservation Recommendations:

Biological surveys of the wetland and adjacent forested swamp are recommended to determine the plant and animal composition. Maintain the current wetland hydrology by avoiding permanent flooding or draining. Preserve and expand the existing forested buffer around the wetland by replanting with native species of trees and shrubs from local seedling sources.

LENOX TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
HARTLEY POND (5)	Animal: Slaty Skimmer Dragonfly (*Libellula incesta*)	G5	S3	N	2005-6-15	E
ROBINSON LAKE (1)	Animal: Bog Copper Butterfly (*Lycaena epixanthe*)	G4G5	S2	N	2005-6-21	E
	Plant: Bog rosemary (*Andromeda polifolia*)	G5	S3	PR	2005-6-21	BC
	Plant: Mud sedge (*Carex limosa*)	G5	S2	TU	2005-6-21	BC
	Plant: Slender sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-6-21	BC
	Plant: White-fringed orchid (*Platanthera blephariglottis*)	G4G5	S2S3	N	2005-6-21	BC
	Plant: Soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-6-21	BC
	Natural Community: Black spruce – tamarack palustrine wetland	GNA	S2	N	2005-6-21	E
TEA POND (5)	Plant: Bog-rosemary (*Andromeda polifolia*)	G5	S3	PR	1986-12-9	D
	Natural Community: Oligotrophic glacial kettlehole bog	GNR	S3	N	1986-12-9	D
TUNKHANNOCK CREEK WOODLAND (5)	Animal species of concern	G5	S2	N	2002	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: None

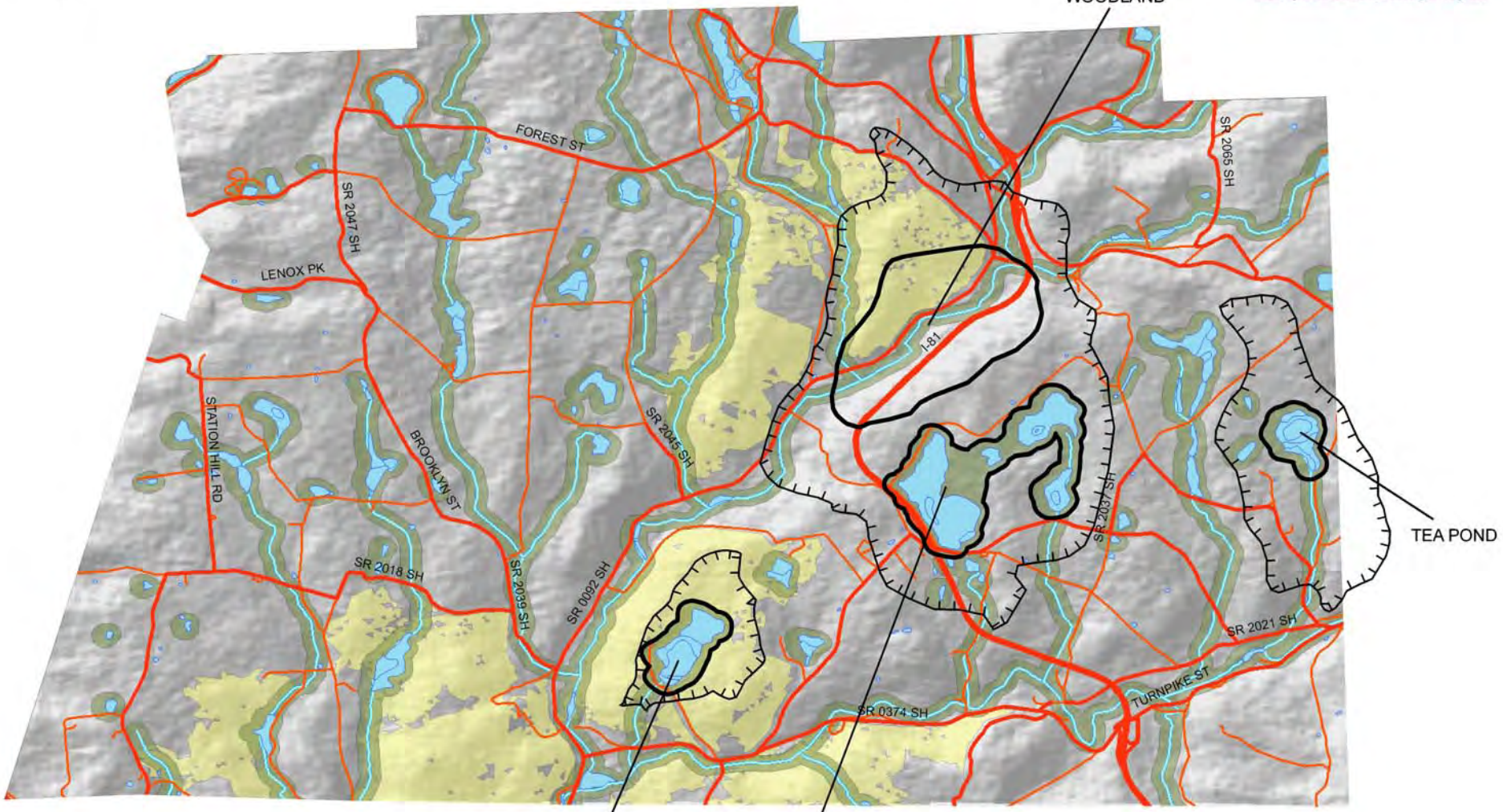
Managed Lands: None

Aquatic Classification Project Results:
Fish: Warm Water Community 1—East Branch Tunkhannock Creek; Tunkhannock Creek; Martins Creek

LENOX TOWNSHIP MAP

Lenox Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

Scale:1:75,000

0 0.5 1 2 Miles

LENOX TOWNSHIP

Lenox Township lies entirely within the watershed of Tunkhannock Creek, with several major tributaries and the main stem weaving through the landscape. The forest blocks in the township are fragmented by agricultural lands, roads, and other developments, but a few significantly-sized blocks remain. Important forest blocks follow the paths of Partners Creek, Tower Branch, Utley Brook, and the mainstem of Tunkhannock Creek and should be maintained to preserve the riparian buffer and connectivity of the stream. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands and headwater streams, and avoiding fragmentation of the largest forest blocks with additional roads. The abundance of water resources in this township put maintenance of water quality high in importance to the natural resources of the township and downstream neighbors. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. Restoration efforts should focus on riparian plantings along creeks and providing buffers to natural wetlands. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor.

Bog Copper Butterfly (*Lycaena epixanthe*)
Photo: John Kunsman-PNHP

Robinson Lake, a high-quality peat-forming wetland

White-fringed orchid
(*Platanthera blephariglottis*)
Photo: John Kunsman-PNHP

HARTLEY POND – (Lenox Township)

This wetland is primarily and open water pond with some acidic wetland plant species occurring along the perimeter. Fragrant water lily covers the shallower portions of the lake near the shore, while the center is free from vegetation, suggesting a deep water center. Remnants of a ring of floating vegetation islands occur adjacent to the open water center or the pond, further suggesting that this was once a bog habitat. The former bog habitat may have been flooded by the construction of an access road across the pond's outlet. The northern portion of the wetland grades from open water to a sedge and shrub meadow with characteristic bog plant species such as leatherleaf, cranberry, and the insectivorous pitcher plant and sundew. Beyond the shrub swamp, the wetland grades into a hemlock–white pine forested swamp. A **G5, S3 aquatic animal species of concern** was documented at this location.

- Threats and Disturbances:

The current elevated water levels in the lake may have drowned previous bog vegetation. The entire lake is currently well buffered from external disturbances by a wide forested buffer. An access road and a utility right-of-way cut through the forest to the south of the wetland. Several conifer tree plantations interrupt an otherwise natural setting for this wetland.

- Conservation Recommendations:

Preserve the wide forested buffer surrounding the wetland. Avoid fragmenting this large forested block with additional roads and utility rights-of-way. The water level could be reduced slightly and gradually to accelerate the return of the former bog vegetation. Additional surveys for species of concern at this location are encouraged.

ROBINSON LAKE – (Lenox Township)

This site includes Robinson Lake, Tamarack Swamp and Harding Pond, which are all bogs of glacial origin. Robinson Lake is the highest quality of the three, having received less human modification. Although it's just yards from Interstate-81, Robinson Lake exhibits a remarkably unspoiled habitat. A small open water pond is ringed by a narrow quaking shrub and small tree swamp with characteristic bog species such as leatherleaf, bog laurel, cotton grass, and the orchids grass pink and rose pogonia. The bog habitat also supports five plant and one animal species of concern and is itself an uncommon type of **natural community, a Black spruce –tamarack Palustrine Wetland.** Other characteristic bog species documented at this site include the **G5, S2S3 white-fringed orchid (*Platanthera blephariglottis)***, the **G5, S3 PA-rare bog rosemary (*Andromeda polifolia*),** an evergreen shrub that resembles, but is not related to the herb rosemary, and three sedges of concern: the **G5, S2 mud sedge (*Carex limosa*),** the **G5, S3 slender sedge (*Carex lasiocarpa*)** and the **G5, S3 soft-leaved sedge (*Carex disperma*).** In addition, the **G5G4, S2 bog copper butterfly (*Lycaena epixanthe*),** which feeds exclusively on cranberry plants during its larval stage, was also observed at this location.

Tamarack Swamp and Harding Pond, adjacent to Robinson Lake, are mere remnants of their former bog habitat. Both have been flooded in the recent past, perhaps by beaver activity. Bog vegetation appears to persist as fragments of floating vegetation mats within both of these wetlands.

- Threats and Disturbances:

Robinaon Lake likely receives runoff from Interstate-81, which pass just yards from its edge. Other local roads skirt along the edges of this wetland. Nutrient enrichment of a portion of the wetland was evident. Invasive species of plants are beginning to colonize the perimeter of the wetland. Beaver impoundment could flood the bog and destroy the habitat for the species of concern. Tamarack Swamp and Harding Pond have a few more houses in the area, and much less forest cover, with agricultural fields up to the edges of the wetland in several areas.

- Conservation Recommendations:

Channel drainage from I-81 away from the Robinson Lake wetland. Monitor for beaver activity. Beaver dams should be removed as they appear. It may be necessary to trap and remove beavers if they persist in damming these wetlands. Preserve the remaining forested buffers around these wetlands and replant with native species of trees and shrubs where forested buffers are lacking. Additional biological surveys of these wetlands are encouraged. Property owners may want to consider tax-reducing conservation easements on parcels surrounding these wetlands.

TEA POND – (Lenox Township)

Tea Pond was not ground surveyed during this project. Information regarding this area is based on aerial photo interpretation and previous surveys. Tea Pond is a small **kettlehole bog natural community** surrounded by a red maple-blueberry swamp forest. The bog appears to a have a well developed ring of floating bog vegetation. The **G5, S3 PA-rare bog rosemary (*Andromeda polifolia*)** was documented at the site during surveys in 1986.

- Threats and Disturbances:

The bog lacks a forested buffer, with agricultural fields cut to the edge of the bog in some areas. This lack of buffer has resulted in nutrient enrichment of a naturally nutrient poor environment.

- Conservation Recommendations:

Repair the forested buffer around the bog. Use native species from local sources for replanting efforts. Maintain the current water level of the bog. Avoid flooding or draining of this habitat. This bog is a good candidate for recovery if the forest buffer is reestablished.

TUNKHANNOCK CREEK WOODLAND – (Lenox Township)

This site contains an animal species of concern. This large forested slope along the floodplain of Tunkhannock Creek is a mixture of conifers and hardwoods. Interstate-81 runs along the Tunkhannock and right through this area.

- Threats and Disturbances:

Conversion of the site from its present forested use to commercial and residential development would also likely result in the abandonment of this nesting site.

- Conservation Recommendations:

Any logging activities should take place in the fall and early winter to avoid the most active spring and summer nesting season.

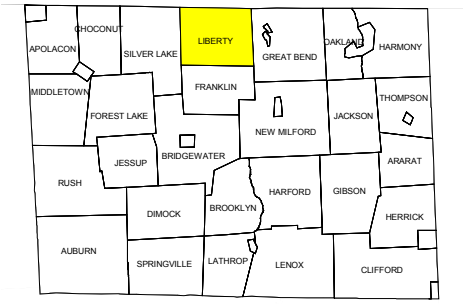
Tea Pond, a good candidate for restoration.

Tamarack Swamp, part of the Robinson Lake Wetland complex.

LIBERTY TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
LITTLE RHINEY CREEK (5)	Animal: Harpoon Clubtail Dragonfly (*Gomphus descriptus*)	G4	S1S2	N	2005-6-23	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

Managed Lands: None

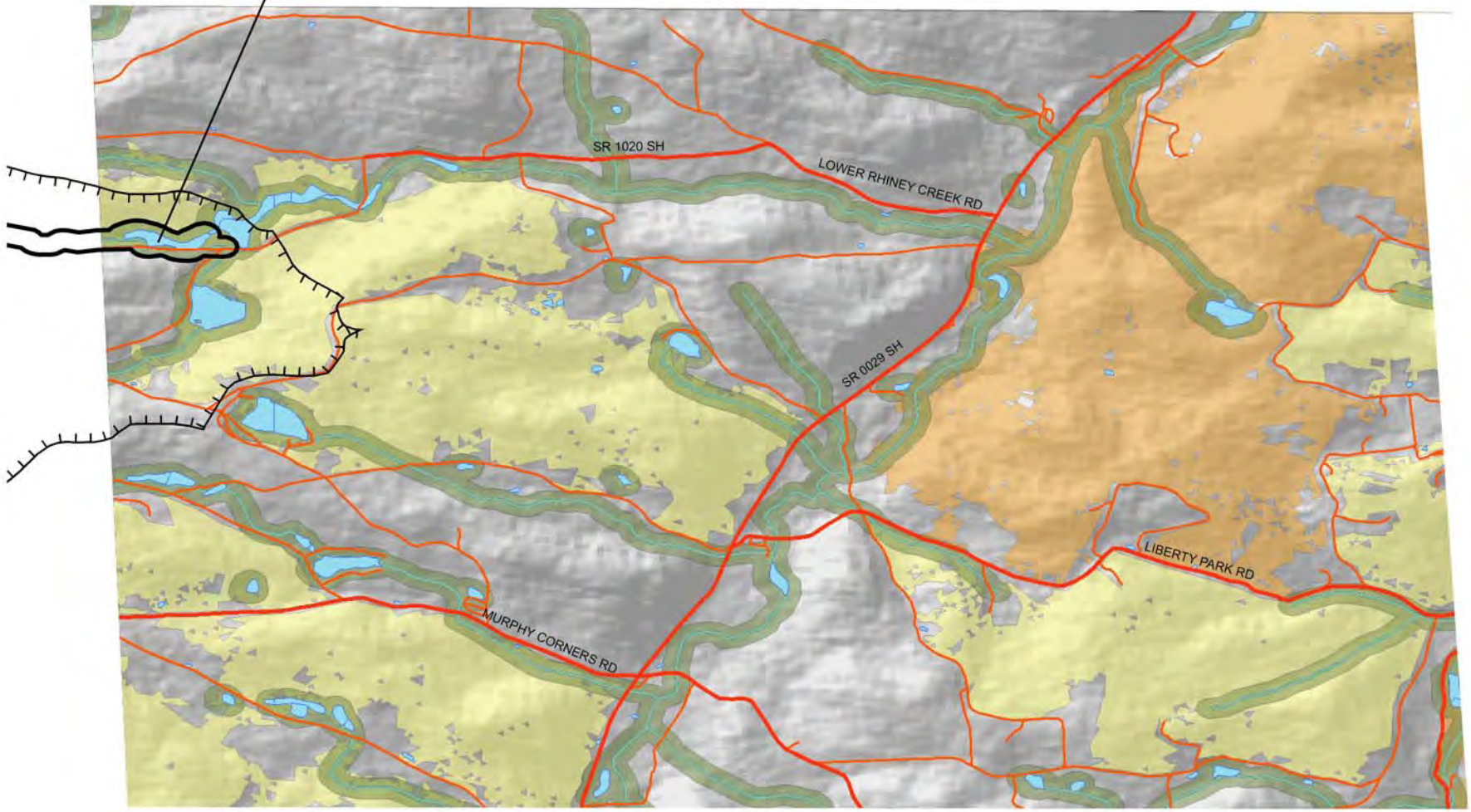
Aquatic Classification Project Results:
Fish: Warm Water Community 1—Snake Creek, Susquehanna River
Fish: Cool Water Community 1—Silver Creek
Invertebrate: Rolledwinged stonefly / Small minnow mayfly —Susquehanna River
Invertebrate: Brushlegged mayfly / fingernet caddisfly —Snake Creek

Liberty Township is extremely rural and primarily forested, with some scattered agriculture and many non-coal quarries. The Snake Creek floodplain parallels Route 29 through the township and features much of the non-forested portion of the area. Rhiney Creek provides another agricultural corridor through the northern portion. Conservation efforts within the township could concentrate on replanting riparian buffers along Snake and Rhiney Creeks that lack adequate vegetation to protect from non-point sources of pollution such as agricultural, residential, and roadway runoff. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. The eastern portion of the township in the vicinity of Mingo Lake is host to several significantly sized contiguous forest blocks that provide connectivity to the forested bend of the Susquehanna River in northern Susquehanna County. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

LIBERTY TOWNSHIP MAP

Liberty Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Scale:1:60,000

0 0.5 1 2 Miles

Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

LITTLE RHINEY CREEK – (Liberty and Silver Lake Townships)

Running east to west across the township, Little Rhiney Creek has several beaver influenced wetland openings of various size and composition. Hemlock and white pine border the creek with beech, sugar maple, red maple, black cherry, yellow birch and basswood dominating the upland slopes. Several maturing conifer plantations occur near the creek as well. Active beaver dams and lodges were observed at several locations along the creek. The **Harpoon Clubtail Dragonfly (*Gomphus descriptus*), a G5, S1S2 animal species of concern,** was documented using the wetland openings along the creek.

- Threats and Disturbances:

The proper habitat conditions for this species are provided by the variety of environments created by various stages of beaver activity. Removal of the forested canopy on the shores of the creek could result in diminished water quality and a decrease in the quality of habitat for this species.

- Conservation Recommendations:

Maintain a wide undisturbed forested buffer along this and all streams, creeks and rivers in the county for the preservation of water quality.

Little Rhiney Creek flows past Quakerr Lake

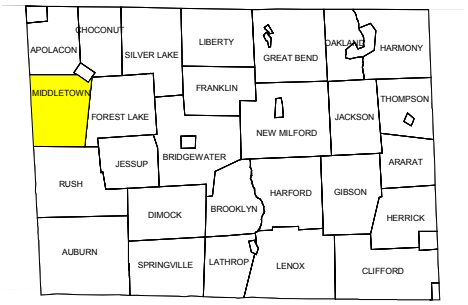
Dominant and charactieristic plants of Little Rhiney Creek

Scientific Name	Common Name	Scientific Name	Common Name
		Trees	
Acer pensylvanicum	striped maple	*Fraxinus americana*	white ash
Acer rubrum	red maple	*Pinus strobus*	eastern white pine
Acer saccharum	sugar maple	*Prunus serotina*	black cherry
Betula alleghaniensis	yellow birch	*Rubus hispidus*	bristly dewberry
Fagus grandifolia	American beech	*Tsuga canadensis*	eastern hemlock
		Shrubs	
Alnus incana	speckled alder	*Rosa multiflora*	multiflora rose
Carpinus caroliniana	hornbeam	*Spiraea latifolia*	northern meadow-sweet
Hamamelis virginiana	witch-hazel	*Viburnum lentago*	nannyberry
		Herbs	
Arisaema triphyllum	jack-in-the-pulpit	*Galium aparine*	catchweed bedstraw
Asclepias incarnata	swamp milkweed	*Glyceria melicaria*	slender manna grass
Aster divaricatus	serpentine aster	*Juncus effusus*	soft rush
Athyrium filix-femina	subarctic lady-fern	*Ludwigia palustris*	marsh seedbox
Brachyelytrum erectum	bearded short-husk	*Lycopodium dendroideum*	treelike clubmoss
Carex debilis	white-edge sedge	*Maianthemum canadense*	wild lily-of-the-valley
Carex folliculata	long sedge	*Myosotis scorpioides*	true forget-me-not
Carex gynandra	sedge	*Onoclea sensibilis*	sensitive fern
Carex lacustris	lake-bank sedge	*Osmunda cinnamomea*	cinnamon fern
Carex leptalea	bristly-stalk sedge	*Ostrya virginiana*	hophornbeam
Carex lurida	shallow sedge	*Phalaris arundinacea*	reed canary grass
Carex projecta	necklace sedge	*Poa trivialis*	scribner bluegrass
Carex scabrata	rough sedge	*Polygonum arifolium*	halberd-leaf tearthumb
Carex stipata	stalk-grain sedge	*Polygonum sagittatum*	arrow-leaved tearthumb
Carex vulpinoidea	fox sedge	*Polystichum acrostichoides*	Christmas fern
Coptis trifolia	goldthread	*Scutellaria galericulata*	hooded skullcap
Dactylis glomerata	orchard grass	*Thelypteris noveboracensis*	New York fern
Dryopteris carthusiana	spinulose shield fern	*Tiarella cordifolia*	heart-leaved foam-flow
Dryopteris intermedia	evergreen woodfern	*Verbena urticifolia*	white vervain
Dulichium arundinaceum	three-way sedge		

MIDDLETOWN TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
None						

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

Managed Lands: State Game Lands #140

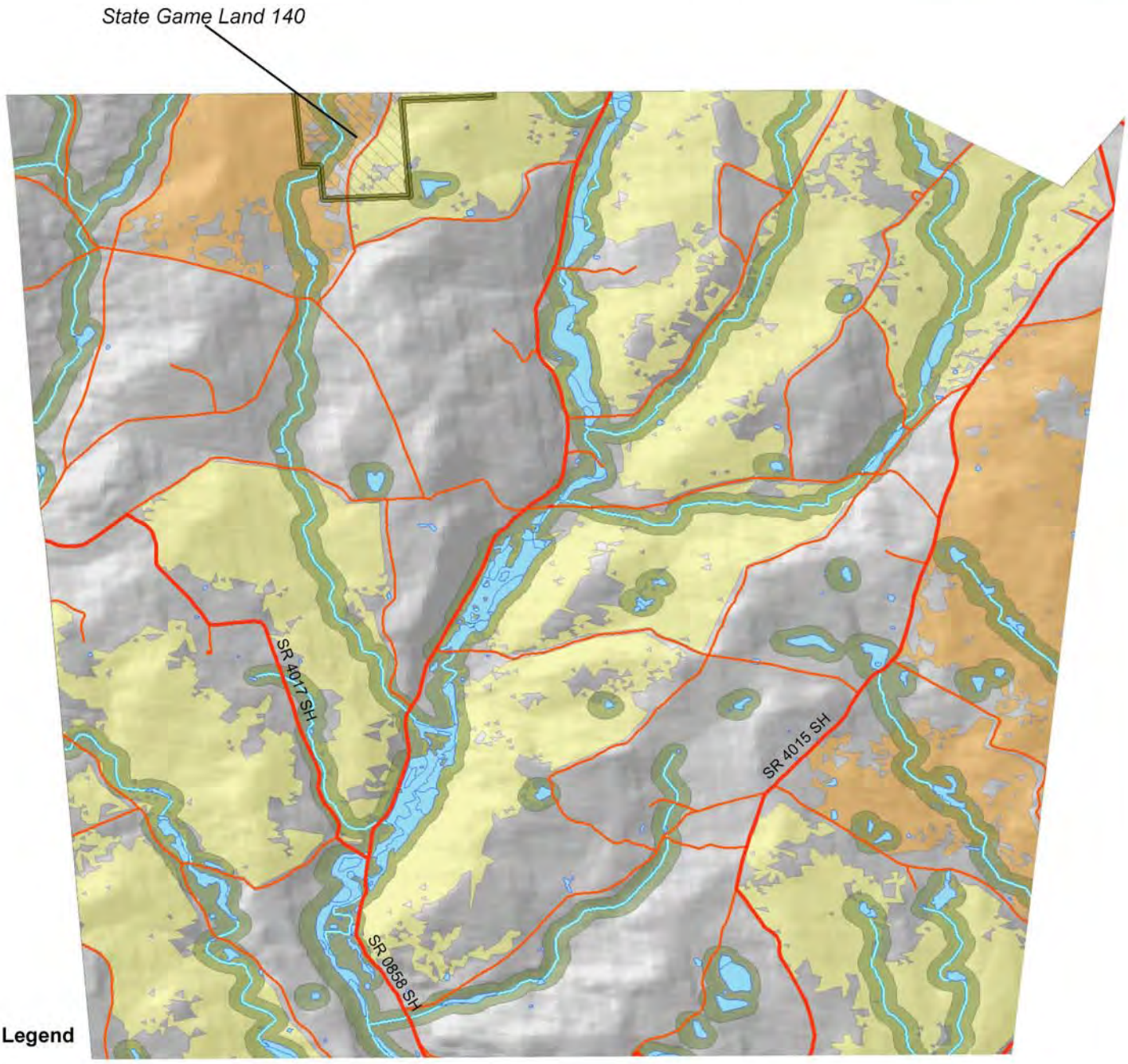
Aquatic Classification Project Results:
Fish: Warm Water Community 1—North Branch Wyalusing Creek, Middle Branch Wyalusing Creek
Fish: Warm Water Community 2—Gaylord Creek

The North Branch Wyalusing Creek runs north to south through the agricultural fields and forested hills of Middletown Township. Several tributaries the the North Branch make up the rest of the water resources in the township. Conservation efforts within the township could concentrate on replanting riparian buffers along the North Branch and its tributaries that lack adequate vegetation to protect from non-point sources of pollution such as agricultural, residential, and roadway runoff. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

MIDDLETOWN TOWNSHIP MAP

Middletown Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

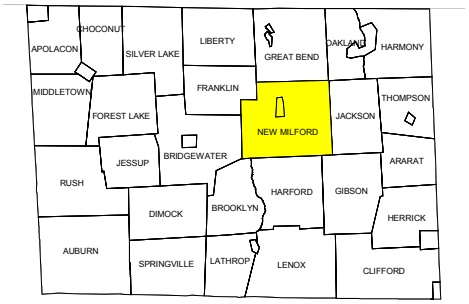
Scale:1:60,000

0 0.5 1 2 Miles

NEW MILFORD TOWNSHIP and New Milford Borough

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
EAST LAKE WETLANDS (5)	Animal: Halloween Pennant Dragonfly (*Celithemis eponina*)	G5	S2S3	N	2005-7-19	E
	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-7-19	E
GILLESPIES POND (5)	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-07-13	E
STEINBACHS CORNERS WETLAND (5)	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-7-19	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

Managed Lands: State Game Lands #175
State Game Lands #35

High Quality Cold Water Fishery: Salt Lick Creek

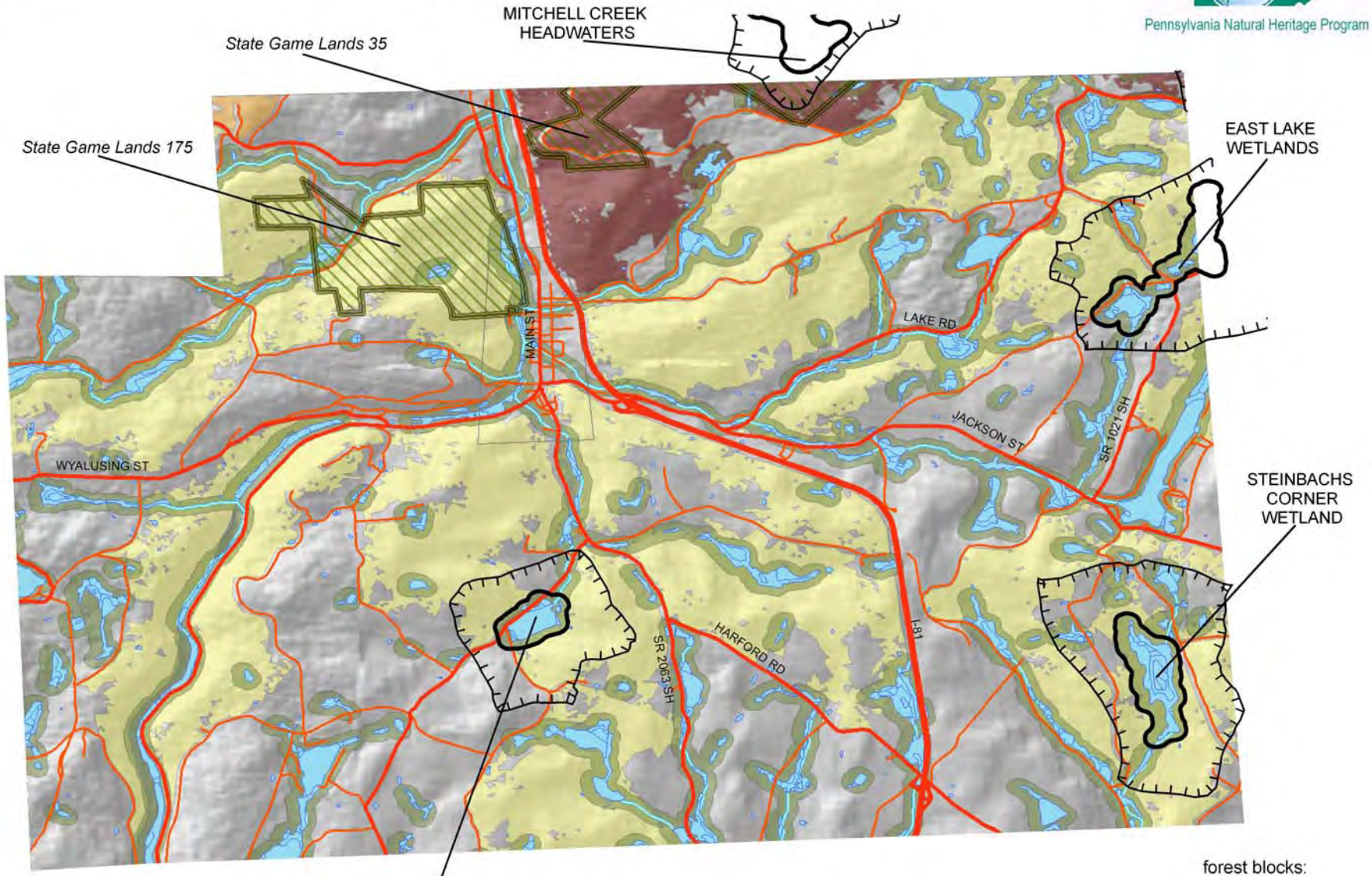
Aquatic Classification Project Results:
Fish: Warm Water Community 1—Nine Partners Creek, Salt Lick Creek, Martins Creek
Fish: Cool Water Community 1—Butler Creek
Invertebrate: Rolledwinged stonefly / Small minnow mayfly —Susquehanna River-Denton Creek

New Milford Township is characterized by abundant water resources, including streams, lakes, and numerous wetlands. The headwaters of Salt Lick Creek, East Branch Martins Creek, and Nine Partners Creek originate in this township. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

NEW MILFORD TOWNSHIP MAP

New Milford Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Scale:1:80,000

0 0.5 1 2 Miles

Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

EAST LAKE WETLANDS – (Jackson and New Milford Townships)

This site is divided into two main areas: an eastern hemlock dominated forest, and an open wet meadow dominated by woolgrass, sedges, and cat-tails. The hemlock forest is characteristic of most hemlock areas in Susquehanna County and contains plant species such as northern wood sorrel, Canada mayflower and bluebead lily. The second main area is also a fairly widespread wetland type in Susquehanna County. This area provides excellent habitat for wetland birds such as Common Yellowthroat, Swamp Sparrow, and Willow Flycatcher. A good population of the **G5, S2 marsh bedstraw (*Galium trifidum*)** was found in the open wet meadow and will continue to persist there if similar ecological conditions continue to persist. Other abundant plants found there include woolgrass, various sedges, meadowsweet and soft rush. In addition, an **aquatic animal species of concern** was also documented at this location. Overall, the site is very diverse and has significant value to both plant life and animal life.

- Threats and Disturbances:

The wetland is well protected on its eastern edge by a wide forested buffer. A road, residences and agricultural fields occur on the western side.

- Conservation Recommendations:

The wetlands can be best protected from external disturbances by preserving the forested buffer on its eastern edge and by reforesting the western edge, which is currently in agricultural fields right up to the edge of the wetland. An adequate forested buffer would span the distance from the nearby road to the wetland edge. This forested buffer would help reduce non-point sources of pollution. Care should be taken to use only native species for reforestation projects. Seed or plant stock for replanting efforts should also come from local sources whenever possible.

Halloween Pennant Dragonfly (*Celithemis eponina*)


East Lake Wetlands

GILLESPIE'S POND – (New Milford Township)
This artificially dammed, open water lake was used in the past as a mill pond. Around most of the lake is a very narrow strip of wetland vegetation. A few floating leaved aquatic plants as well as filamentous algae occur in the lake water. The small stream entering the lake fans out into a delta as it enters the lake forming a small shallow water area that supports some wetland plants including the **G5, S2 marsh bedstraw (*Galium trifidum*)**.

- Threats and Disturbances:

Scattered residences and a local road occur along portions of the lake shore. The presence of filamentous algae in the lake suggests nutrient enrichment, perhaps from nearby residences, roadway or agricultural runoff. Lakeshore development or the removal of the remaining forested upland buffer would likely lead to a further reduction of water quality.

- Conservation Recommendations:

Uphill activities should be scrutinized for their effect on water quality. Septic systems of nearby residences as well as upslope mining activities should be monitored for the effect of their outflow on the aquatic habitat.

STEINBACHS CORNERS WETLAND – (New Milford Township)
This wetland habitat is ecologically rich and provides important habitat for a variety of wildlife and plant species. The area consists of an open wet meadow with a stream running through it. The habitat is excellent for dragonflies and damselflies and wetland plants and birds. A population of the **G5, S2marsh bedstraw, (*Galium trifidum*)** was documented in this wetland habitat. The surrounding woods were dominated by white pine and eastern hemlock, and contained a number of plants of more northern affinity species such as bunchberry. In general, this area is very diverse and provides excellent habitat for an assortment of plant and animal species.

- Threats and Disturbances:

The wetland is currently well protected from external disturbances by a wide forested buffer. No disturbances were observed. Logging or development of the forested buffer represents a potential threat to the wetland. Draining or flooding of the wetland would also be destructive to the wetland habitat.

- Conservation Recommendations:

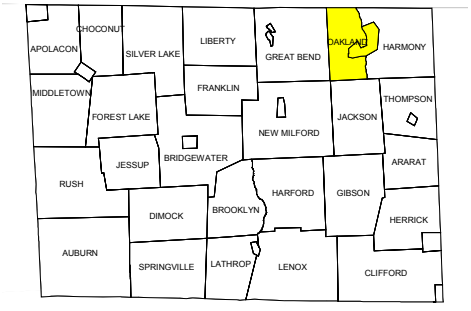
Preservation of a 100-meter forested buffer surrounding the wetland will best help protect this important habitat from negative external disturbances. Logging or development of the wetland perimeter should be avoided. The current wetland hydrology should be maintained by avoiding draining or flooding of this habita

Steinbachs Corners Wetland

OAKLAND TOWNSHIP and Oakland Borough

Site Name (County rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
BRUSHVILLE LAKE (5)	Plant: Soft-leaved sedge (Carex disperma)	G5	S3	N	2005-7-19	E
	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	PR	2005-7-19	E
SUSQUEHANNA RIVER (3)	Animal: Yellow Lampmussel (*Lampsilis cariosa*)	G3G4	S3S4	N	2004-8-11	A
	Animal: Eastern Lampmussel (*Lampsilis radiata*)	G5	S1	N	2004-8-11	D
	Animal: Elktoe mussel (*Alasmidonta marginata*)	G4	S4	N	2004-8-11	BC
	Animal: Treangle Floater mussel (Alasmidonta undulate)	G4	S3S4	N	2004-8-11	CD
	Animal: Black-banded Bandwing Dragonfly (*Calopteryx aequabilis*)	G5	S2	N	1986-6-11	B
	Animal: Midget Snaketail Dragonfly (*Ophiogomphus howei*)	G3	S1	N	1988-6-13	C
	Animal: Abbreviated Clubtail Dragonfly (*Gomphus abbreviatus*)	G3G4	S2	N	1986-6-19	B
	Animal: Harris' Checkerspot Butterfly (*Chosyne harrisii*)	G4	S3	N	1988-6-13	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



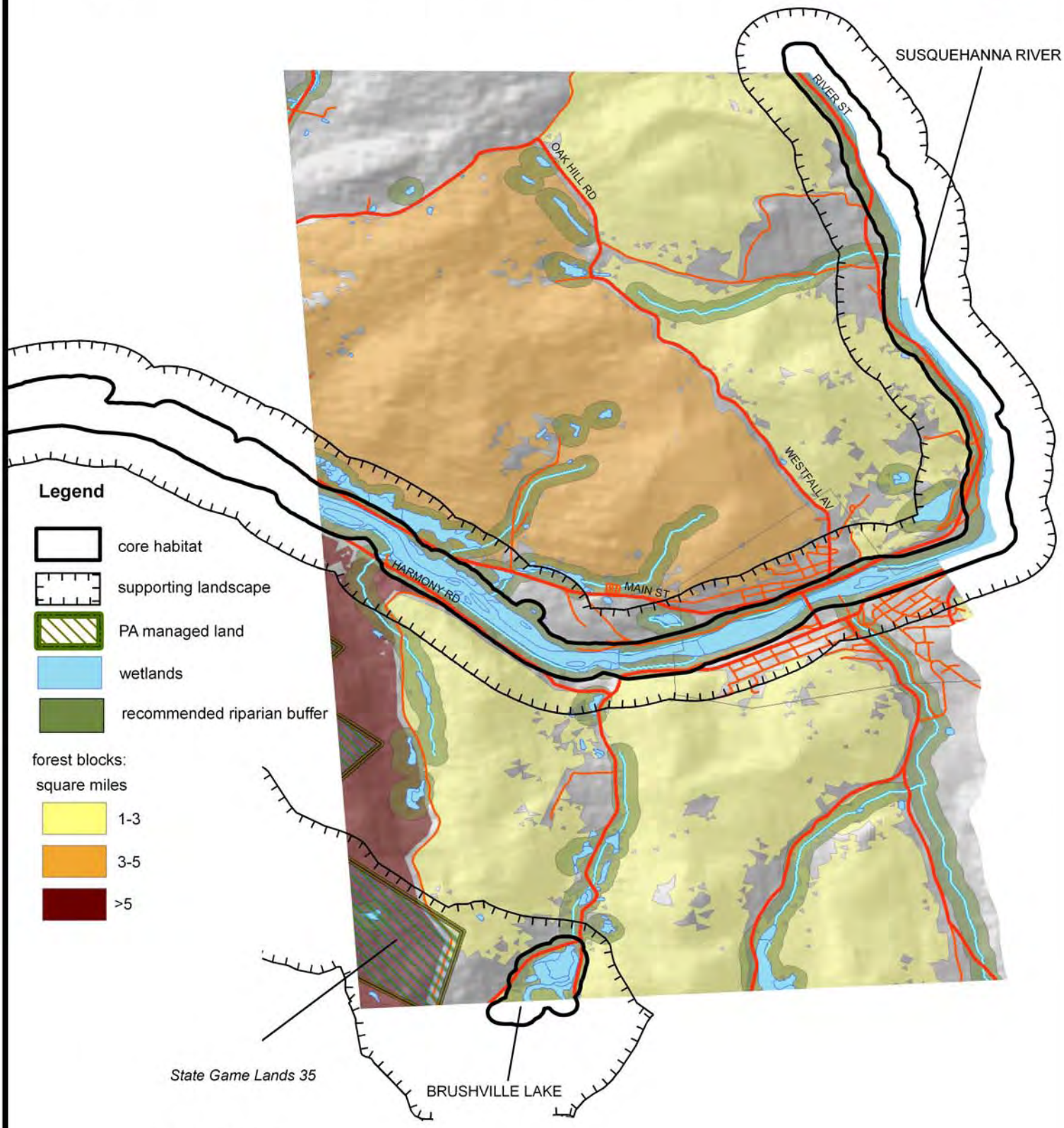
Locally Significant: None

Managed Lands: State Game Lands #35

Aquatic Classification Project Results:
Fish: River and Impoundment Community: Susquehanna River, Denton Creek;
Invertebrate: Rolledwinged stonefly / Small minnow mayfly —Susquehanna River-Denton Creek

Oakland Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



OAKLAND TOWNSHIP

Oakland Township is host to the so-called Great Bend of the Susquehanna River as it dips into northern Pennsylvania. The township is almost entirely forested, with a portion of the most significantly sized forest block contained by the large State Game Lands #35, shared with Great Bend Township. Conservation efforts to buffer the edges of the Game Lands from development and disturbance are important to the long-term quality of the wildlife and land resources within the Game Lands. Much of the river bank in this area is characterized by extreme slopes that have prevented cultivation or development and preserved a forested floodplain. Maintaining an intact forested floodplain along the river can preserve much of the township's important biodiversity. Forested buffers should be maintained, widened and created where absent along the length of the river with logging operations minimizing cutting within 100 meters of the river edge. The large blocks of forested uplands should be preserved intact by avoiding unnecessary fragmentation of the landscape with additional roads or building developments. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Protection of connectivity of the large forest blocks to neighboring townships is important to the movement of wildlife in a natural corridor.

BRUSHVILLE LAKE – (Jackson and Oakland Townships)

This wetland had been dammed in the past to create an open water pond. The dam has recently been breached, exposing large areas of very shallow water and pond bottom muck. The shallow water still supports yellow water lily, while the exposed muck soils are being colonized by early successional wetland plant species such as soft rush, rice cut grass and wool-grass. A population of the **G5, S2 marsh bedstraw (*Galium trifidum*)** was documented growing along an old beaver dam adjacent to a hemlock swamp forest. The wet hemlock area supports the **G5, S3 PA-rare soft-leaved sedge (*Carex disperma*)**, which is growing at the base of several hemlock and white pine trees in the swamp forest. Since the water level of this wetland has recently been lowered the habitat has been altered dramatically. This freshly exposed pond bottom provides a good opportunity to document plant succession.

- Threats and Disturbances:

The marsh bedstraw will likely persist in its current habitat. An old beaver dam occurs where the stream enters the larger wetland from the hemlock swamp forest. A beaver dam at this location would likely drown the hemlock forest and destroy the habitat for the soft-leaved sedge. Logging of the wet hemlock forest could also severely degrade the habitat for this plant and many other shade and moisture tolerant species.

- Conservation recommendations:

Avoid flooding or logging of the hemlock swamp forest. Additional biological surveys in the hemlock swamp forest and the newly exposed pond bottom are encouraged.

SUSQUEHANNA RIVER - (Great Bend, Harmony and Oakland Townships)

Eight invertebrate animal species of concern were documented at various locations in the Susquehanna River. These animal species included four freshwater mussel species of concern: **the G3G4, S3S4 Yellow Lampmussel (*Lampsilis cariosa*); the G5, S1 Eastern Lampmussel (*Lampsilis radiata*): the G4,S4 Elktoe mussel (*Alasmidonta marginata*) and the G4, S3S4 Treangle Floater mussel (*Alasmidonta undulata*).**

Also documented form this location were **the G5, S2 Black-banded Bandwing Dragonfly (*Calopteryx aequabilis*), the G3, S1 Midget Snaketail Dragonfly (*Ophiogomphus howei*), the G3G4, S2 Abbreviated Clubtail Dragonfly (*Gomphus abbreviatus*) and the G4, S3 Harris' Checkerspot Butterfly (*Chosyne harrisii*).**

The entire length of the Susquehanna River should be considered suitable habitat for most of these species. Additional surveys are recommended to better estimate populations of these animals of concern in the river. The river also provides a valuable migration corridor for many bird species, especially aquatic-dependent birds, but also many neo-tropical passerine migratory species.

The Susquehanna River is subject to frequent flooding and seasonal low water levels. Scouring of the banks and islands by ice and flooding has created pockets of specialized habitats along the river floodplain. Several islands have distinctive "Big bluestem - Indian grass River Grasslands," which are natural tall grassland communities created as the result of these natural disturbances. The two plant

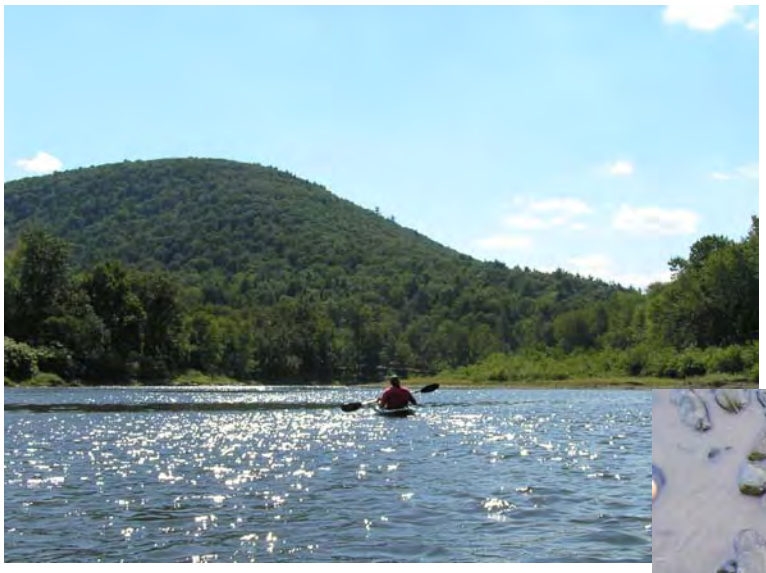
species the community type is named for dominate these habitats and also include switch grass and Indian hemp. The habitat tends to grade into a "Water willow – Smartweed Riverbed Community" on the lowest island elevations, and into a "Black willow Scrub/shrub Wetland," and "River birch – Sycamore Floodplain Scrub" as the elevation increases and the habitat becomes drier. These natural communities are part of the "Riverbed – Bank – Floodplain Community Complex" (Fike 1999), a broadly defined mosaic of community types that typify the natural vegetation along the Susquehanna River in Susquehanna County.

- Threats and Disturbances:

There are numerous examples of disturbance along the Susquehanna River. These animal species of concern are affected by non-point sources of pollution including sedimentation from cultivated and developed land along the river, runoff from roadways, pesticide runoff from agricultural fields, discharge of chemical pollutants and thermal pollution. The main threat to these animals is reduction of water quality. The banks, floodplains and islands of the river have the invasive introduced plant species Japanese knotweed and purple loosestrife. Control of established populations of these species is very difficult. Eradication of pioneer populations is the best way to control the spread of these species of plants.

- Conservation Recommendations:

Any of the above types of disturbances should be minimized where possible. Also, monitoring of these populations should continue into the future. Loss of individuals and reductions in population sizes should lead to an investigation into possible causes. Water quality should be monitored and pollution sources should be identified where possible. Forested buffers should be maintained and created where absent along the length of the river, with logging operations refraining from cutting within 100 meters of the river edge. River bank forests help buffer the watershed from the effects of non-point sources of pollution including runoff from agricultural, residential and roadway settings. In addition, the river floodplain and corridor is usually an area of significantly higher biodiversity than the adjoining uplands. Much of the area's important biodiversity can be preserved by maintaining an intact, forested floodplain along the river. The effectiveness of the forested riverbanks as a habitat corridor would be diminished by fragmentation of the forest continuity by the construction of houses, businesses and additional roadways along the river. Local planning should discourage construction of new structures and roadways along the river, adjacent slopes and floodplain.

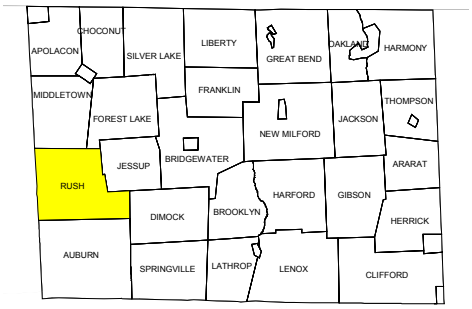


The Susquehanna River loops through northern Susquehanna County. The river is rich with aquatic life such as a variety of freshwater mussels (right). The river also acts as an important wildlife corridor, attracting migrating water fowl and other animals to its water, islands and shoreline.

RUSH TOWNSHIP

Site Name	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
None						

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: Tuscarora Lake

Managed Lands:None

Aquatic Classification Project Results:
Fish: Warm Water Community 1—East Branch Wyalusing Creek, Middle Branch Wyalusing Creek, Wyalusing Creek-Bennet Creek & Tuscarora Creek
Fish: Warm Water Community 2—Gaylord Creek

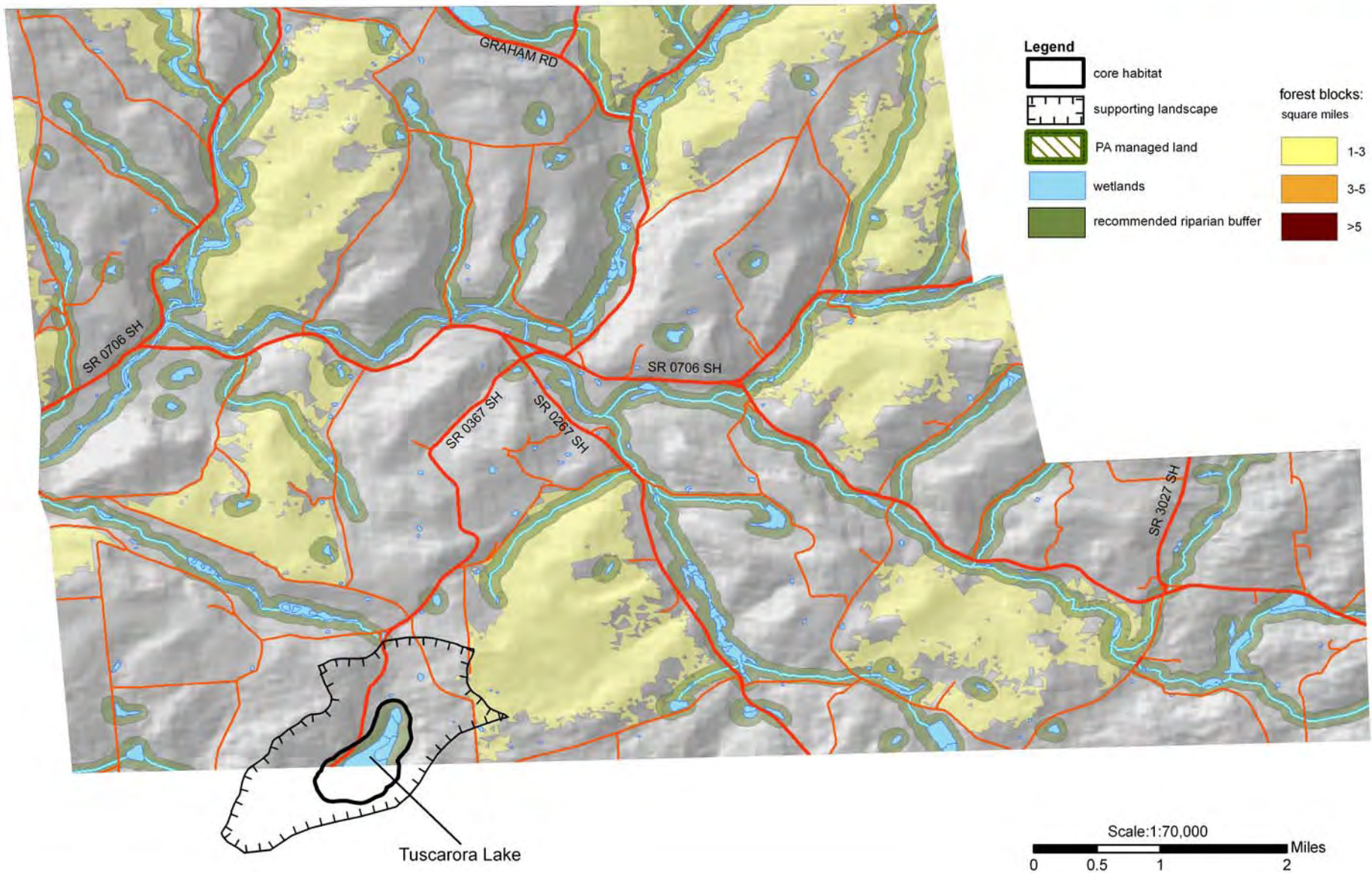
Rush Township is the meeting point of four branches of the Wyalusing Creek. It is characterized by a mosaic of agriculture and forest with several large forest blocks remaining between floodplain areas. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. Conservation efforts within the township could concentrate on replanting riparian buffers along the branches of Wyalusing Creek that lack adequate vegetation to protect from non-point sources of pollution such as agricultural, residential, and roadway runoff. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands, and avoiding fragmentation of the largest forest blocks with additional roads.

Locally Significant Site:

Tuscarora Lake – (Auburn and Rush Townships)
Tuscarora Lake was not ground surveyed during the period of this project, but information regarding this wetland was interpreted from aerial photos of the area. This wetland appears to be a former bog habitat that has been flooded in the past by a man-made dam to create an open water lake. Remnants of the former bog vegetation in the form of floating islands appear to persist within the lake. Species of plants restricted to bog habitats may still occur on these floating islands, and will likely persist in this fragmented condition. A slight reduction of the water level to pre-dam conditions could help this former bog recover from its presently flooded condition. Future biological surveys of this habitat are encouraged.

Rush Township
Susquehanna County, PA

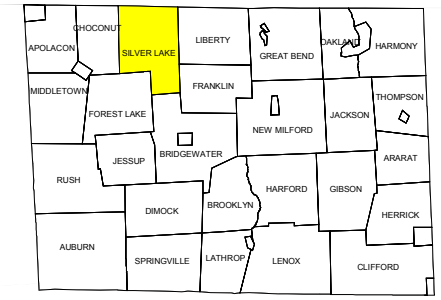
Pennsylvania Natural Heritage Program



SILVER LAKE TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
LITTLE RHINEY CREEK (5)	Animal: Harpoon Clubtail Dragonfly (*Gomphus descriptus*)	G4	S1S2	N	2005-6-23	E
SALT SPRINGS (3)	Animal: Grey Comma Butterfly (*Polygonia progne*)	G5	SU	N	2001-8-26	E
	Animal : Ocellated Darner Dragonfly (*Boyeria grafiana*)	G5	S3	N	2003	E
	Animal: Halloween Pennant Dragonfly (*Celithemis eponina*)	G5	S2S3	N	2003	E
	Animal: Lilypad Clubtail Dragonfly (*Arigomphus furcifer*)	G5	S2	N	2003	E
	Animal: Band-winged Meadowhawk Dragonfly (*Sympetrum semicinctum*)	G5	S3S4	N	2003	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: Cranberry Lake
Silver Lake
St. Joseph Ravine

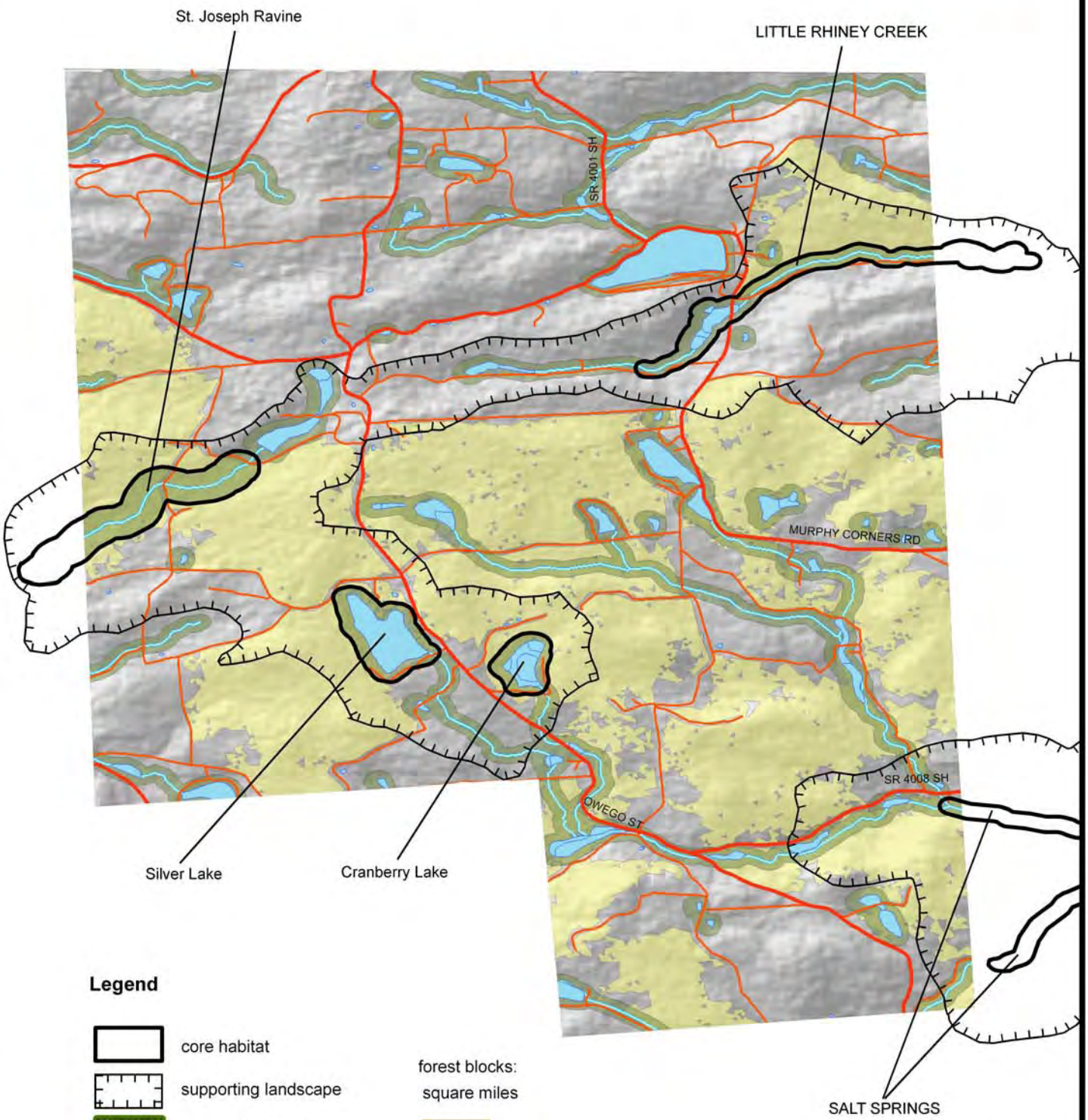
Managed Lands: Silver Lake (E.L. Rose Conservancy)

Aquatic Classification Project Results:
Fish: Warm Water Community 1 - Snake Creek
Fish: Cool Water Community 1 - Silver Creek
Invertebrate: Rolledwinged stonefly / Small minnow mayfly -Choconut Creek & Little Snake Creek
Invertebrate: Brushlegged mayfly / fingernet caddisfly - Snake Creek

SILVER LAKE TOWNSHIP MAP

Silver Lake Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

- 1-3
- 3-5
- >5

Scale:1:70,000

0 0.5 1 2 Miles

SILVER LAKE TOWNSHIP

Silver Lake Township is known for its lakes, including Quaker Lake, Laurel Lake, Meeker Lake, Silver Lake, and Cranberry Lake. The township remains largely forested and undeveloped, though most of the forest blocks are fragmented by the topography and layout of roads. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands and headwater streams, and avoiding fragmentation of the largest forest blocks with additional roads. The abundance of water resources in this township put maintenance of water quality high in importance to the natural resources of the township and downstream neighbors. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. The habitat for the cool water community 1 represents an important transition between cold headwater streams and warm, larger streams; the habitat is distinct among other habitat types and should be protected and restored. Restoration of stream temperature, habitat, and water quality to natural conditions is recommended. Management of storm water runoff and riparian vegetation restoration are critical to improvement of aquatic community conditions.

Band-winged Meadowhawk Dragonfly
(*Sympetrum semicinctum*)

Large tall-grass and sedge wetland adjacent to Quaker Lake

Silver Lake

The large continuously forested block on the western edge of Silver Lake helps protect the water quality of the lake and provides excellent habitat for a good diversity of native plant and animal species. The E.L. Rose Conservancy preserves much of this forest block. Avoid building new roads and developments through this and similar large forest blocks in the county. Large forest blocks left intact will provide necessary habitat for native species of plants and animals that are dependent on interior forest conditions such as many species of neotropical migrating birds.

LITTLE RHINEY CREEK – (Liberty and Silver Lake Townships)

Running east to west across the township, Little Rhiney Creek has several beaver influenced wetland openings of various size and composition. Hemlock and white pine border the creek with beech, sugar maple, red maple, black cherry, yellow birch and basswood dominating the upland slopes. Several maturing conifer plantations occur near the creek as well. Active beaver dams and lodges were observed at several locations along the creek. A **G5, S1S2 aquatic animal species of concern** was documented using the wetland openings along the creek.

- Threats and Disturbances:

The proper habitat conditions for this species are provided by the variety of environments created by various stages of beaver activity. Removal of the forested canopy on the shores of the creek could result in diminished water quality and a decrease in the quality of habitat for this species.

- Conservation Recommendations:

Maintain a wide undisturbed forested buffer along this and all streams, creeks and rivers in the county for the preservation of water quality.

Dominant and charactieristic plants of Little Rhiney Creek

Scientific Name	Common Name	Scientific Name	Common Name
		Trees	
Acer pensylvanicum	striped maple	*Fraxinus americana*	white ash
Acer rubrum	red maple	*Pinus strobus*	eastern white pine
Acer saccharum	sugar maple	*Prunus serotina*	black cherry
Betula alleghaniensis	yellow birch	*Tsuga canadensis*	eastern hemlock
Fagus grandifolia	American beech		
		Shrubs	
Alnus incana	speckled alder	*Rubus hispidus*	bristly dewberry
Carpinus caroliniana	hornbeam	*Spiraea latifolia*	northern meadow-sweet
Hamamelis virginiana	witch-hazel	*Viburnum lentago*	nannyberry
Rosa multiflora	multiflora rose		
		Herbs	
Arisaema triphyllum	jack-in-the-pulpit	*Galium aparine*	catchweed bedstraw
Asclepias incarnata	swamp milkweed	*Glyceria melicaria*	slender manna grass
Aster divaricatus	serpentine aster	*Juncus effusus*	soft rush
Athyrium filix-femina	subarctic lady-fern	*Ludwigia palustris*	marsh seedbox
Brachyelytrum erectum	bearded short-husk	*Lycopodium dendroideum*	treelike clubmoss
Carex debilis	white-edge sedge	*Maianthemum canadense*	wild lily-of-the-valley
Carex folliculata	long sedge	*Myosotis scorpioides*	true forget-me-not
Carex gynandra	sedge	*Onoclea sensibilis*	sensitive fern
Carex lacustris	lake-bank sedge	*Osmunda cinnamomea*	cinnamon fern
Carex leptalea	bristly-stalk sedge	*Ostrya virginiana*	hophornbeam
Carex lurida	shallow sedge	*Phalaris arundinacea*	reed canary grass
Carex projecta	necklace sedge	*Poa trivialis*	scribner bluegrass
Carex scabrata	rough sedge	*Polygonum arifolium*	halberd-leaf tearthumb
Carex stipata	stalk-grain sedge	*Polygonum sagittatum*	arrow-leaved tearthumb
Carex vulpinoidea	fox sedge	*Polystichum acrostichoides*	Christmas fern
Coptis trifolia	goldthread		
Dactylis glomerata	orchard grass	*Scutellaria galericulata*	hooded skullcap
Dryopteris carthusiana	spinulose shield fern	*Thelypteris noveboracensis*	New York fern
Dryopteris intermedia	evergreen woodfern	*Tiarella cordifolia*	heart-leaved foam-flower
Dulichium arundinaceum	three-way sedge	*Verbena urticifolia*	white vervain

SALT SPRINGS – (Franklin and Silver Lake Townships)

Fall Brook tumbles through a narrow ravine in Salt Springs State Park forming several waterfalls along its stony descent. The ravine is flanked by mature old growth hemlock, which casts heavy shade on the stream and adjacent forest floor. Much of the park is in a hemlock-white pine forest cover, but the park also includes numerous acres in northern hardwood forest, shrub swamps, old pastures, fields and orchards. The herbaceous layer underneath the hemlocks is generally sparse and reflects a more northerly distribution. The **Gray Comma (*Polygonia progne*), a butterfly of special concern,** was documented within the park. This species is more commonly found north of Pennsylvania, but it can be found in cool, rich, deciduous woodlands in Pennsylvania. The larvae of this butterfly feed on currant and gooseberry shrubs (*Ribes* species). **Four aquatic animal species of concern** were also documented as occurring along Fall Brook in the park, both the heavily shaded hemlock portions and the more open shrubby areas of the creek. A small mammal survey of the park documented a good diversity of animals, but also revealed that the old fields and pastures adjacent to the ravine strongly influence the animal composition of the ravine. While woodland species of small mammals such as the rock vole would have been expected in the deep shade of the ravine, the high number of meadow voles (a species usually associated with grasslands and old agricultural fields), documented in the ravine suggest an undue influence of the fields on the ravine habitat.

- Threats and Disturbances:

The site is primarily within a state park and as such is not threatened from many type of disturbance. The prevalence of the agricultural habitats influences the more natural areas of the park. Many introduced and invasive species of plants can spread from these agricultural areas.

- Conservation Recommendations:

Much of the former agricultural lands should be allowed, through succession, to revert to early stage shrub forest, and eventually to a mature forest of native species, thereby reducing the amount of habitat available to grassland species surrounding the virgin hemlock areas. Invasive species of trees, shrubs and other plants found throughout the park should be removed or destroyed to allow a more native forest composition to thrive.

Locally Significant Sites:

Cranberry Lake (Silver Lake Township)

This site was described from aerial photo interpretation. There is a distinct ring of floating vegetation on portions of Cranberry Lake, suggesting that this is a flooded bog habitat.

- Threats and Disturbances:

There is a road going part way around the wetland with a few cottages/residences and boat docks on its perimeter. Much of the forested buffer surrounding the wetland remains intact. Raised water levels have partially drowned the bog vegetation.

- Conservation Recommendations:

Conserve and repair the remaining forested buffer. Gradually and slightly lower the water level to help return the lake to its former bog habitat. Monitor septic outflow of adjacent residences and upgrade systems as needed to preserve and improve water quality. A biological survey of the bog vegetation is encouraged.

Silver Lake – (Silver Lake Township)

This site was described from aerial photo interpretation. This open water wetland appears to be a natural glacially formed lake. These glacial lakes can have an interesting assemblage of aquatic plants. A good diversity of dragonflies and damselflies can also be strongly represented in these habitats. The western side of the lake is composed of a large unfragmented forest block of mixed hemlock, white pine and hardwoods.

- Threats and Disturbances:

Cottages and residences ring portions of the lake shoreline.

- Conservation Recommendations:

Preserve and repair the remaining forested buffer surrounding the lake. Future residential development should consider cluster housing in existing disturbed areas to conserve the remaining undeveloped lake shore. Monitor septic outflow of adjacent residences and upgrade systems as needed to preserve and improve water quality.

St. Joseph Ravine (Choconut & Silver Lake Townships)

St. Joseph Ravine is a hemlock/white pine/mixed northern hardwood forest with higher concentrations of hemlocks alongside the stream and mixed hardwoods and white pine dominating the upland areas. This scenic forested ravine with wet rock outcrops and waterfalls has a variety of wildflowers and plants of a more northern affinity. The site also contains an excellent diversity of neo–tropical migrant songbirds. The area appears especially important to hemlock-dependent songbirds such as Black-throated Green Warblers, Blackburnian Warbler, and Blue-headed Vireo. Overall, the forested ravien and slopes contribute greatly to local biodiversity, providing a contiguous forest with a high quality stream that is well-buffered. The low numbers of exotic invasive plants also increases the biodiversity of this area.

- Threats and Disturbances:

No disturbances were apparent at this forested ravine. Logging of the stream bottom or adjacent slopes would greatly decrease the quality of this natural habitat.

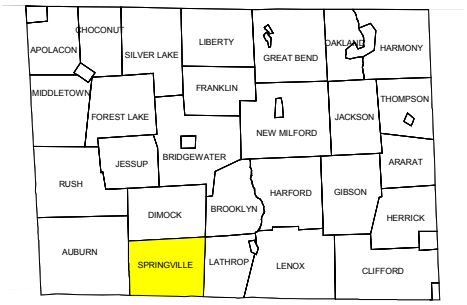
- Conservation Recommendations:

Preserve the forested continuity of this habitat. Avoid logging to within 100 meters of the creek edge and on adjacent steep slopes.

SPRINGVILLE TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen	Quality**
MONROE CREEK WETLANDS (5)	Plant: Soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-7-14	E
SCHOOLEY POND (4)	Plant: Torrey's Bulrush (*Schoenoplectus torreyi*)	G5?	S1	PE	2002-8-14	A

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: None

Managed Lands: None

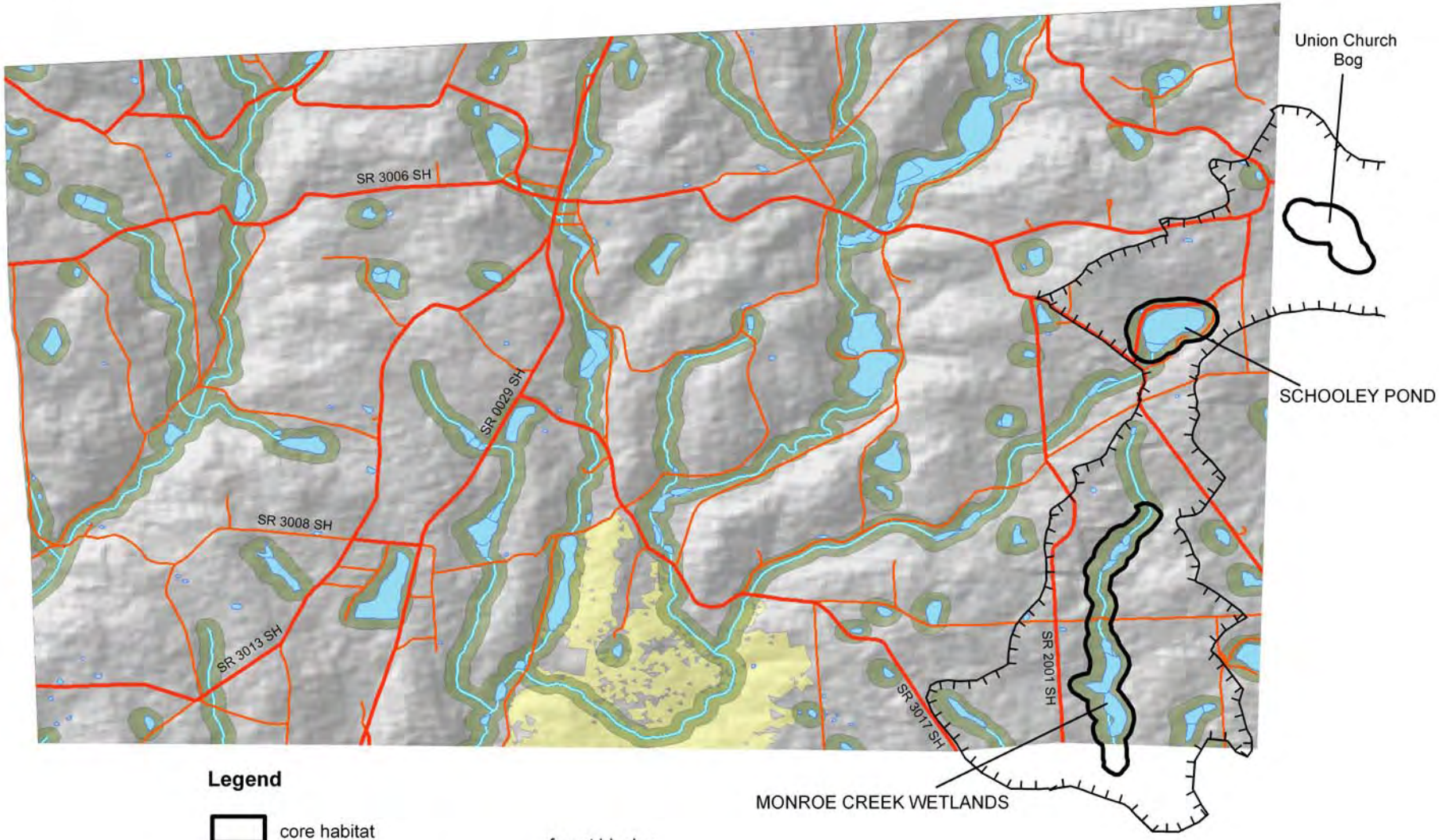
Aquatic Classification Project Results:

Fish: Warm Water Community 1—Tunkhannock Creek, Meshoppen Creek
Fish: River and Impoundment Community—West Branch Meshoppen Creek
Invertebrate: Rolledwinged stonefly / Small minnow mayfly —Tunkhannock Creek, Meshoppen Creek, West Branch Meshoppen Creek
Mussel: Yellow Lampmussel Community—Tunkhannock Creek

SPRINGVILLE TOWNSHIP MAP

Springville Township
Susquehanna County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- PA managed land
- wetlands
- recommended riparian buffer

forest blocks: square miles

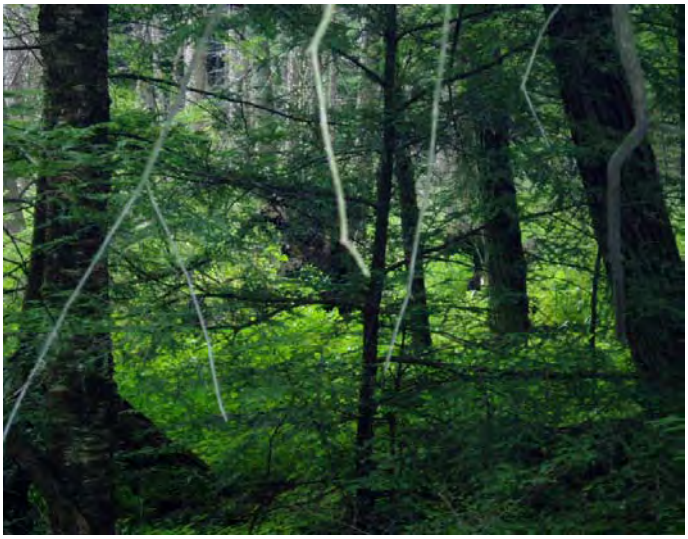
- 1-3
- 3-5
- >5

Scale:1:65,000

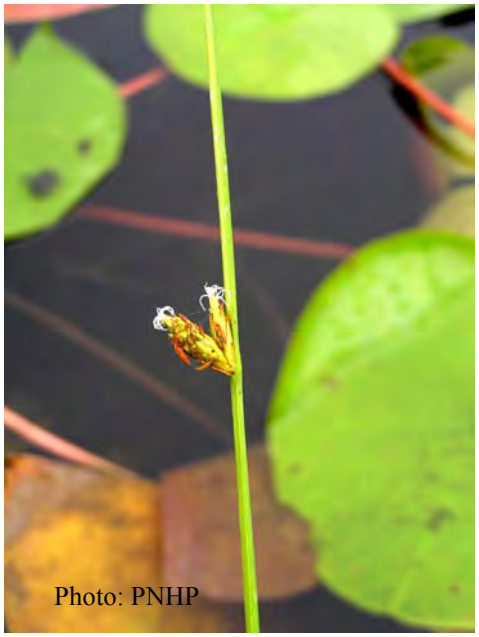
0 0.5 1 2 Miles

SPRINGVILLE TOWNSHIP

Springville Township is drained primarily by tributaries of Meshoppen Creek. The township is dominated by cleared land, agriculture, roads, and pipelines, which have fragmented most of the forest and wetland areas. A large forested block remains along the mainstem Meshoppen Creek, providing natural riparian buffers and forming a critical starting point for riparian conservation here. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands and avoiding fragmentation of the largest forest blocks with additional roads. The abundance of water resources in this township put maintenance of water quality high in importance to the natural resources of the township and downstream neighbors. Therefore, the focus of conservation in this township should be maintaining and providing buffers to streams and wetlands. Restoration efforts should focus on riparian plantings along creeks and providing buffers to natural wetlands. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor.



Hemlock-dominated forested wetland at Monroe Creek



Torrey's bulrush at Schooley pond

Large beds of native emergent aquatic plant species at Schooley Pond

MONROE CREEK WETLANDS – (Springville Township)

Monroe Creek in this area has experienced periodic beaver influence, creating a large, open grass, sedge and cat-tail dominated wetland. The area has a good diversity of plants and also contains good marsh-bird habitat. The wetland narrows into a small hemlock palustrine forest with moss-covered saturated soils under a heavy shade canopy. A small population of the **G5, S3 soft-leaved sedge (*Carex disperma*)** grows on the elevated moss mounds in this habitat.

- Threats and Disturbances:

Agricultural fields are adjacent to much of the creek with little forested buffer. The wetland has been subject to cyclic beaver activity resulting in periodic flooding and draining of the wetland. Permanent flooding or draining would degrade the quality of this habitat.

- Conservation Recommendations:

Restore a 100 meter forested buffer where it is lacking. Avoid construction of permanent dams.

SCHOOLEY POND – (Springville Township)

This naturally occurring lake has residences and cottages around most of its perimeter, many with boat docks. There are large beds of floating and emergent aquatic plants like yellow water lily, fragrant water lily, watershield and pickerel weed. The lake water itself has plentiful filamentous algae suggesting nutrient enrichment, possibly from the adjacent houses. The outlet of the lake has a large, dense shrub swamp thicket, likely the result of past and ongoing beaver activity. Despite the apparent disturbances to the lake habitat, there is an excellent quality population of the **G5, S1 PA-endangered Torrey's Bulrush (*Schoenoplectus torreyi*)** that occurs along the shallow water shoreline.

- Threats and Disturbances:

The lake has apparently been dammed in the past by man-made and beaver dams. Beavers were observed near the lake outlet. Much of the natural lakeshore vegetation has been removed and replaced with houses, lawns and landscape plants. In places, the water is thick with algae and introduced floating aquatic plants like Eurasian water-milfoil. The algae present in the lake water may be a symptom of nutrients leaching from home septic systems into the lake, but may also the result of runoff from adjacent agricultural fields.

- Conservation Recommendations:

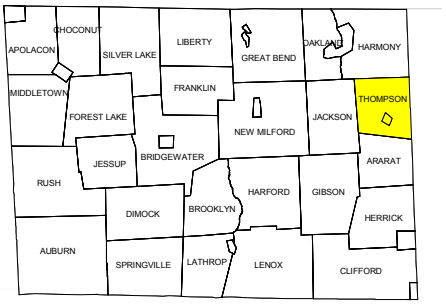
The high levels of aquatic plants and algae may prompt boat owners to attempt control methods. Mechanical or hand removal would be acceptable where non-native species are the targets for removal. Chemical controls, especially herbicides should not be used in or near the lake. Septic systems of surrounding homes and cottages should be monitored for the effect of their output on the lake ecosystem. Problem systems should be upgraded. The slopes surrounding the lake should be reforested for future protection of the water quality of this lake from runoff and non-point sources of pollution. The Torry's bulrush at this lake should persist as long as water level and quality do not change abruptly. Permanent flooding or draining should be avoided.

Open wetlands along a portion of Monroe Creek

THOMPSON TOWNSHIP and Thompson Borough

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
CHURCHILL LAKE (3)	Natural Community: Leatherleaf-sedge wetland	GNR	S3	N	2005-7-13	E
	Plant: Bog-rosemary (*Andromeda polifolia*)	G5	S3	PR	1993-8-18	D
	Plant: Slender sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-7-13	E
	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-7-13	E
RT-171 WETLANDS (5)	Animal: Brush-tipped Emerald Dragonfly (*Somatochlora walshii*)	G5	S2	N	2005-7-12	E
WEIR POND – SHELLY PRESERVE (4)	Natural Community: Graminoid Marsh	GNR	S3	N	1992-9-16	C
	Plant: Soft-leaved Sedge (*Carex disperma*)	G5	S3	PR	2004-7-21	E
	Plant: Slender Sedge (*Carex lasiocarpa*)	G5	S3	PR	2005-8-04	BC
	Plant: Marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-8-04	B
	Animal: Arctic Skipper Butterfly (*Carterocephalus palaemon mandan*)	G5T5	S2	N	2005-6-14	E
	Animal: Red-waisted Whiteface Dragonfly (*Lecorrhinia proxima*)	G5	S2	N	2005-6-14	E
	Animal: Petite Emerald Damselfly (*Dorocordulia lepida*)	G5	S2	N	2005-6-14	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



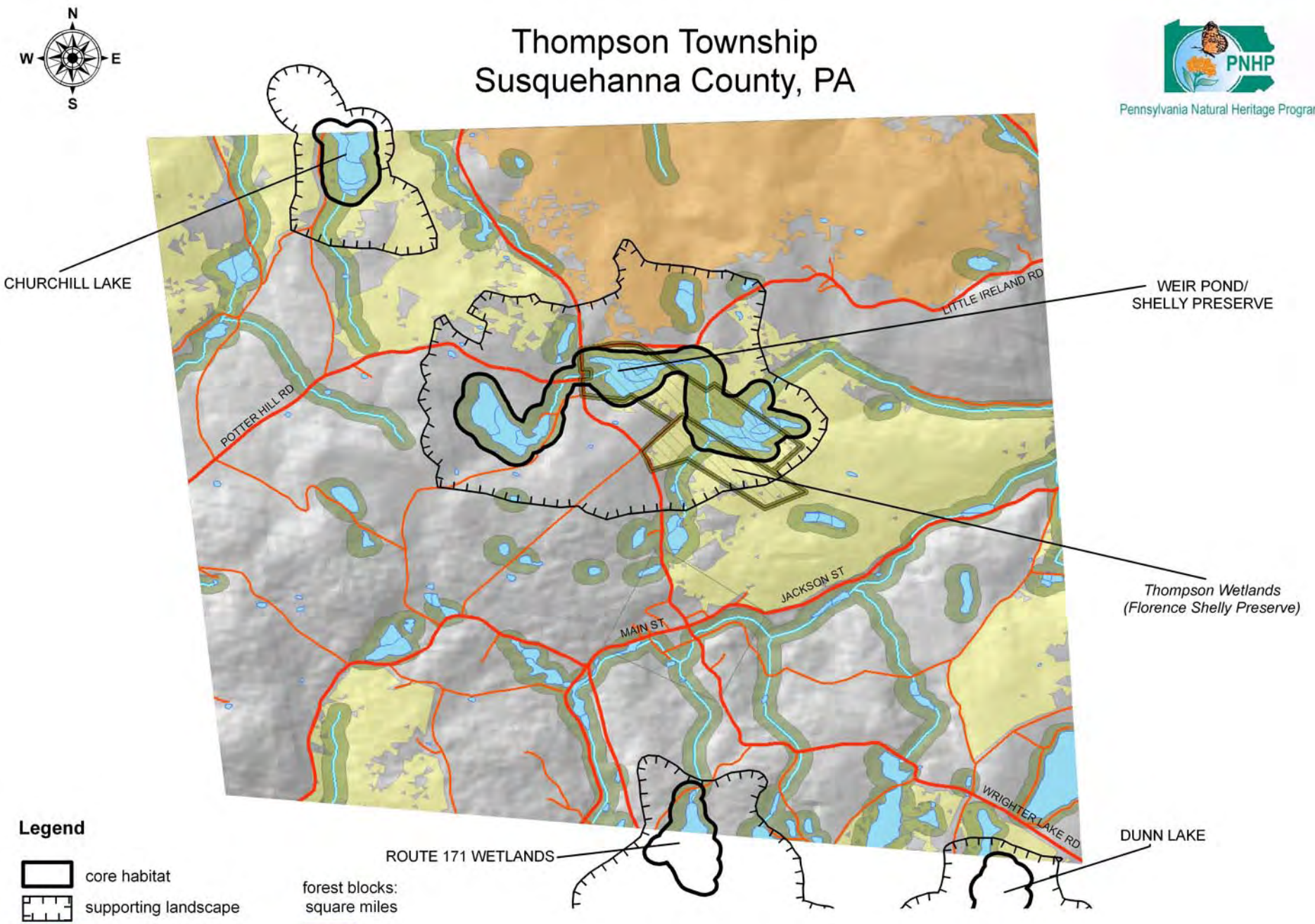
Locally Significant: None

Managed Lands: Thompson Wetlands/Florence Shelly Preserve (The Nature Conservancy)

Other: Exceptional Value Waters: Unnamed Tributary to Starucca Creek

THOMPSON TOWNSHIP MAP

Thompson Township
Susquehanna County, PA



PNHP
Pennsylvania Natural Heritage Program

THOMPSON TOWNSHIP

Aquatic Classification Project Results:

Fish: River and Impoundment Community - Susquehanna River & Denton Creek
Fish: Warm Water Community 1 - Starucca Creek, Tunkhannock Creek &Nine Partners Creek
Invertebrate: Rolledwinged stonefly / Small minnow mayfly - Susquehanna River & Denton Creek

Thompson Township is characterized by a mosaic of large forest blocks, agriculture, and non-coal mining. The headwaters of Starucca Creek, including one tributary designated Exceptional Value, originate in this township. Several of the township's headwater streams are surrounded by significant forest blocks. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers around wetlands and streams, and avoiding fragmentation of the largest forest blocks with additional roads. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Protection of connectivity of the large forest blocks to neighboring townships is important to the movement of wildlife in a natural corridor.

Churchill Lake

Weir Pond , Thompson Township

CHURCHILL LAKE (Harmony and Thompson Townships)

Churchill Lake is a glacially formed wetland with a large area of open water containing a significant portion that is composed of a characteristic floating bog mat. The northern portion of the wetland is covered with low shrubs and stunted trees, but despite appearing as solid ground, this shrubland floats on centuries-long accumulations of partially decomposed sphagnum moss and other plant material, giving the shrubland a quaking aspect. Most of the 12 acre shrubland is dominated by leatherleaf (*Chamaedaphne calyculata*), a characteristic shrub of acidic peatlands, which in this case form a **Leatherleaf-sedge Wetland Natural Community.**

As the vegetation progresses away from the edge of the open water, scattered stunted white pine and red maple trees and a few American larches are underlain by an increasingly thick tangle of highbush blueberry, winterberry holly, smooth alder, spiraea, bog laurel, **bog rosemary (*Andromeda polifolia*), a G5, S3 PA-rare plant species of concern** and other shrubs. Within the branches of the shrubs are growing herbaceous species such as various sedges and rushes, marsh fern, hooded skullcap, swamp loosestrife and **marsh bedstraw (*Galium trifidum*), a G5, S2 PA plant species of concern**. Other plants include the characteristic acid peatland species cotton grass and the insectivorous pitcher plant. All these plants are rooted in a saturated substrate of deep sphagnum peat. The open water edge of the bog mat has a sedge species characteristic of early stage bog formation, **slender sedge (*Carex lasiocarpa*), a G5, S3 PA-rare species of concern**. Along the edge of the bog mat and in the shallows of the lake margins are a good variety of aquatic plant species with many dragonfly and damselfly species present as well. There was evidence of beaver activity in portions of the lake.

The outflow of the lake (right) has a narrow passage of open water flanked by tall emergent stands of great bulrush. A good diversity of aquatic plants float in the water.

Dominant and characteristic plant species of Churchill Lake:

Scientific Name	Common Name
Trees:	
Acer rubrum	red maple
Larix laricina	American larch
Pinus strobus	eastern white pine
Quercus alba	white oak
Shrubs:	
Alnus incana	speckled alder
Cephalanthus occidentalis	buttonbush
Chamaedaphne calyculata	leatherleaf
Ilex verticillata	winterberry holly
Kalmia polifolia	bog laurel
Rosa palustris	swamp rose
Sambucus canadensis	american elderberry
Spiraea latifolia	northern meadow-sweet
Spiraea tomentosa	hardhack spiraea
Vaccinium corymbosum	highbush blueberry
Vaccinium macrocarpon	large cranberry
Herbs:	
Carex canescens	hoary sedge
Carex comosa	bristly sedge
Carex lacustris	lake-bank sedge
Cicuta bulbifera	bulb-bearing water-hemlock
Eriophorum virginicum	tawny cotton-grass
Iris versicolor	blueflag
Juncus effusus	soft rush
Lysimachia terrestris	swamp loosestrife
Nuphar lutea	yellow cowlily
Nymphaea odorata	American water lily
Phalaris arundinacea	reed canary grass
Pontederia cordata	pickerel weed
Sarracenia purpurea	northern pitcher-plant
Schoenoplectus tabernaemontani	soft stem bulrush
Scirpus cyperinus	wool-grass
Scutellaria galericulata	hooded skullcap
Thelypteris palustris	marsh fern
Triadenum virginicum	marsh St. John's wort
Typha latifolia	common cat tail

- T

<u>hreats & Disturbances:</u>

The lake is almost entirely surrounded by a wide forested buffer, which helps protect the water quality from non-point sources of pollution. A small gravel lane traverses the northern edge of the lake at its outflow. One or two residences occur along the shoreline of the wetland. One has a dock extending into the open water. Removal or modification of the forested buffer at these locations has occurred.

- <u>Conservation Recommendations:</u>

The lake is currently in a relatively undisturbed natural condition. A 100-meter undisturbed forested buffer surrounding the lake should be preserved to maintain the high water quality of this natural community (core habitat). Removal or modification of the forested buffer by the construction of additional residences should be discouraged. Construction of elevated dams would drown a significant portion of the bog vegetation. Beaver dams should be removed as they occur to avoid negative impacts on the wetland. Activities within the upstream watershed should be scrutinized for their impact on this wetland habitat.

THOMPSON TOWNSHIP

ROUTE 171 WETLANDS – (Thompson Township)

A wetland complex along Route 171 has a diversity of wetland habitats. A narrow hemlock swamp forest surrounds an often very thick shrub swamp. Within the shrub swamp are several smaller openings dominated by sedges and other herbaceous plants. This diversity of habitats provides suitable environments for a large array of species. The **Brush-tipped Emerald dragonfly (*Somatochlora walshii*), a G5, S2 animal species of concern,** was documented using shallow water pools within the herbaceous openings.

- Threats and Disturbances:

Route 171, a busy north-south roadway through the county, passes near the western edge of the wetland. The proximity to the road may lead to increased development pressure. A portion of this wetland south of Route 171 has in the past been dammed and converted to an open-water pond. Flooding or draining of the northern half of the wetland would destroy the current variety of wetland habitats. Much of the surrounding land is currently in agricultural use.

- Conservation Recommendations:

Maintain the current wetland hydrology. Avoid permanent flooding or draining of this complex wetland habitat. Preserve and increase the undisturbed forested buffer around the wetland. If the surrounding land use changes from agriculture to residential, a wide forested buffer should be provided to isolate the wetland from external sources of disturbance.

Dominant & characteristic species of Route 171 Wetlands

Scientific Name	Common Name	*Scientific Name*	Common Name
		Trees	
Acer rubrum	red maple	*Fraxinus americana*	white ash
Betula alleghaniensis	yellow birch	*Tsuga canadensis*	eastern hemlock
Fagus grandifolia	American beech		
		Shrubs	
Alnus incana	speckled alder	*Rhododendron maximum*	rosebay rhododendron
Amelanchier arborea	serviceberry	*Rosa multiflora*	multiflora rose
Aronia melanocarpa	black chokeberry	*Rubus hispidus*	bristly dewberry
Cephalanthus occidentalis	buttonbush	*Sambucus canadensis*	American elderberry
Hamamelis virginiana	witch-hazel	*Spiraea latifolia*	northern meadow-sweet
Ilex verticillata	winterberry holly	*Vaccinium corymbosum*	highbush blueberry
Lindera benzoin	spicebush	*Viburnum cassinoides*	witherod
Nemopanthus mucronatus	mountain holly	*Viburnum recognitum*	northern arrow-wood
		Herbs	
Aralia nudicaulis	wild sarsaparilla	*Lysimachia terrestris*	swamp loosestrife
Calla palustris	wild calla	*Maianthemum canadense*	wild lily-of-the-valley
Caltha palustris	marsh marigold	*Medeola virginiana*	indian cucumber-root
Carex comosa	bristly sedge	*Mitchella repens*	partridge-berry
Carex folliculata	long sedge	*Monotropa uniflora*	indian-pipe
Carex gynandra	sedge	*Onoclea sensibilis*	sensitive fern
Carex intumescens	bladder sedge	*Osmunda cinnamomea*	cinnamon fern
Carex lacustris	lake-bank sedge	*Osmunda regalis*	royal fern
Carex stipata	stalk-grain sedge	*Polygonum arifolium*	halberd-leaf tearthumb
Carex stricta	tussock sedge	*Polygonum sagittatum*	arrow-leaved tearthumb
Carex trisperma	three-seed sedge	*Saxifraga pensylvanica*	swamp saxifrage
Chelone glabra	white turtlehead	*Scirpus cyperinus*	cottongrass bulrush
Clintonia borealis	clinton lily	*Scutellaria galericulata*	hooded skullcap
Coptis trifolia	goldthread	*Sium suave*	hemlock water-parsnip
Cypripedium acaule	pink lady's-slipper	*Solanum dulcamara*	climbing nightshade
Dryopteris intermedia	evergreen woodfern	*Thelypteris noveboracensis*	New York fern
Dulichium arundinaceum	three-way sedge	*Thelypteris palustris*	marsh fern
Eupatorium perfoliatum	common boneset	*Triadenum virginicum*	marsh St. John's wort
Eupatorium purpureum	sweet joe-pye weed	*Trientalis borealis*	northern starflower
Glyceria melicaria	slender manna grass	*Trillium erectum*	ill-scent trillium
Iris versicolor	blueflag	*Uvularia grandiflora*	large-flowered bellwort
Juncus effusus	soft rush	*Veratrum viride*	American false-hellebore
Ludwigia palustris	marsh seedbox		

Route-171 Wetland photo: Charlie Eichelberger

Weir Pond – Shelly Preserve – (Thompson Township)

This wetland complex includes a pond with a well developed inlet and outlet. The shore is boggy with rather elevated hummocks that make walking difficult and have dense waist-high leatherleaf, red maple and other shrubs and small trees. This vegetation zone is rather narrow and quickly grades into a tall sedge and grass dominated boggy wetland. As one approaches the woods, the sedge and grass area has increasing numbers of highbush blueberry mixed in, with evidence of lots of bear traffic. Based on the species composition, the wetland doesn't appear very acidic. The pond vegetation has probably been affected by beaver activity over the years. The site contains three plant species of concern, three animal species of concern and also a **Graminoid Marsh Natural Community**. The three plant species of concern documented are the **G5, S3 slender sedge (*Carex lasiocarpa*)**, which was found in the open graminoid marsh; the **G5, S3 soft-leaved sedge (*Carex disperma*),** which was found in the hemlock dominated swamp forest; and the **G5, S2 marsh bedstraw (*Galium trifidum*),** which occurs scattered in the graminoid marsh and shrub swamp habitats. The **three animal species of concern** use the open wetlands as their primary habitat.

- Threats and Disturbances:

A busy road passes between two parts of this wetland complex. A secondary road runs near the northern edge of the wetlands. Agricultural fields and occasional residences occur adjacent to the wetlands. Invasive species of plants occur on the borders of the wetlands. The western wetland has received considerable flooding, apparent from many dead standing trees.

- Conservation recommendations:

Much of this site is protected as a nature preserve. Conserve and repair a 100 meter forested buffer around all wetlands and tributary streams. Use only native trees and shrubs, preferably from local sources, for replanting efforts. Deer hunting should be encouraged to decrease herbivory pressure on understory plants and tree seedlings. Beaver activity should be monitored, and may need to be trapped if water levels are raised significantly.

Dominant and characteristic plants of Weir Pond / Shelly Preserve

Scientific name	Common Name	*Scientific name*	Common Name
	Trees		
Acer rubrum	red maple	*Pinus strobus*	eastern white pine
Amelanchier arborea	serviceberry	*Populus tremuloides*	quaking aspen
Fagus grandifolia	american beech	*Tsuga canadensis*	eastern hemlock
	Shrubs		
Alnus incana	speckled alder	*Rubus hispidus*	bristly dewberry
Aronia melanocarpa	black chokeberry	*Sambucus canadensis*	american elderberry
Cephalanthus occidentalis	buttonbush	*Spiraea latifolia*	northern meadow-sweet
Chamaedaphne calyculata	leatherleaf	*Spiraea tomentosa*	hardhack spiraea
Decodon verticillatus	hairy swamp loosestrife	*Vaccinium corymbosum*	highbush blueberry
Ilex verticillata	winterberry holly	*Viburnum cassinoides*	with-rod
Rosa palustris	swamp rose	*Viburnum recognitum*	northern arrow-wood
	Herbs		
Arisaema triphyllum	jack-in-the-pulpit	*Glyceria melicaria*	slender manna grass
Calamagrostis canadensis	blue-joint reedgrass	*Hypericum boreale*	northern St. John's-wort
Calla palustris	wild calla	*Hypericum ellipticum*	pale St. John's-wort
Carex atlantica	prickly bog sedge	*Impatiens capensis*	spotted jewel-weed
Carex canescens	hoary sedge	*Iris versicolor*	blueflag
Carex comosa	bristly sedge	*Juncus canadensis*	Canada rush
Carex echinata	little prickly sedge	*Juncus effusus*	soft rush
Carex folliculata	long sedge	*Lysimachia terrestris*	swamp loosestrife
Carex lacustris	lake-bank sedge	*Lysimachia thyrsiflora*	water loosestrife
Carex leptalea	bristly-stalk sedge	*Maianthemum canadense*	wild lily-of-the-valley
Carex lurida	shallow sedge	*Onoclea sensibilis*	sensitive fern
Carex scabrata	rough sedge	*Osmunda cinnamomea*	cinnamon fern
Carex stipata	stalk-grain sedge	*Phalaris arundinacea*	reed canary grass
Carex stricta	tussock sedge	*Polygonum arifolium*	halberd-leaf tearthumb
Carex trisperma	three-seed sedge	*Pontederia cordata*	pickerel weed
Cicuta bulbifera	bulb-bearing water-hemlock	*Rumex orbiculatus*	water dock
Clintonia borealis	clinton lily	*Sagittaria latifolia*	broadleaf arrowhead
Coptis trifolia	goldthread	*Scirpus cyperinus*	cottongrass bulrush
Cyperus acuminatus	short-pointed flatsedge	*Scirpus polyphyllus*	leafy bulrush
Drosera rotundifolia	roundleaf sundew	*Scutellaria galericulata*	hooded skullcap
Dryopteris cristata	crested shield-fern	*Senecio aureus*	golden ragwort
Dulichium arundinaceum	three-way sedge	*Thelypteris noveboracensis*	New York fern
Epilobium leptophyllum	linear-leaved willow-herb	*Thelypteris palustris*	marsh fern
Equisetum sylvaticum	woodland horsetail	*Triadenum fraseri*	marsh St. John's-wort
Galium tinctorium	stiff marsh bedstraw	*Trientalis borealis*	northern starflower
Glyceria canadensis	Canada manna-grass	*Veratrum viride*	american false-hellebore

Appendices

Glossary

Acid Mine Drainage (AMD) – drainage flowing from or caused by surface mining, deep mining, or coal refuse piles that are typically highly acidic with elevated levels of dissolved metals (DEP).

Acidophilic – a plant that requires or prefers acidic soil conditions.

Alluvium – material such as sand, silt, or clay that is deposited on land by streams.

Anthracite- Dense, shiny coal that has a high carbon content and little volatile matter and burns with a clean flame. Also called *hard coal***.**

Anthropogenic – human caused.

ATV – all-terrain-vehicle.

Bedrock- The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Bt (*Bacillus thuringiensis*) – an insecticide, which is produced by the fermentation of a bacterium (Bt), used to control many caterpillar-type pests (e.g., gypsy moth).

Bog – a nutrient poor, acidic peatland that receives water primarily from direct rainfall with little or no input from groundwater or runoff; vegetation consists primarily of peat moss and ericaceous shrubs.

Calcareous- composed of, containing, or characteristic of calcium carbonate, calcium, or limestone; chalky.

Canopy – the layer formed by the tallest vegetation.

Circumneutral – pH between 5.5 and 7.

Co-dominant – where several species together comprise the dominant layer (see "dominant" below).

Community – an assemblage of plant or animal populations sharing a common environment and interacting with each other and the physical environment.

DBH – the diameter of a tree at breast height.

DCNR – Pennsylvania Department of Conservation and Natural Resources.

DEP – Pennsylvania Department of Environmental Protection.

Diabase – a dark gray igneous rock. The chemical composition of diabase may support unusual plant communities.

Dimilin – a commercially produced, restricted-use insecticide containing diflubenzuron as the active ingredient. Diflubenzuron, which has been used as a method to control gypsy moth, interferes with chitin production during the early stages of certain insects (DCNR, Division of Pest Management).

Dominant– the species (usually plant) exerting the greatest influence on a given community either by numerical dominance or influence on microclimate, soils and other species.

Ecosystem- an ecological community together with its environment, functioning as a unit.

Element – all-inclusive term for species of special concern and exemplary natural communities.

Ericaceous – members of the heath family including blueberries, huckleberries, rhododendrons, and azaleas; these plants are adapted to living in acidic soils.

Exceptional Value Waters (EV) – DEP designation for a stream or watershed which constitutes an outstanding national, state, regional or local resource, such as waters of national, state or county parks or forests; or waters which are used as a source of unfiltered potable water supply, or waters of wildlife refuges or State Game Lands, and other waters of substantial recreational or ecological significance. For more detailed information about EV stream designations, the reader is referred to the Special Protection Waters Implementation Handbook (Shertzer 1992).

Exotic – non-native; used to describe plant or animal species that were introduced by humans; examples include Japanese honeysuckle, purple loosestrife and grass carp; exotics present a problem because they may out-compete native species.

Extant – currently in existence.

Fen- open-canopy peatland that has developed under the influence of basic-rich waters

Floodplain – low-lying land generally along streams or rivers that receives periodic flooding.

Forb – non-grass herbaceous plant such as goldenrod.

Fragipan- a very dense soil layer that prevents water from draining quickly through the soil.

Graminoid – grass or grass-like plant such as a sedge or a rush.

Ground cover – low shrubs, herbs and mosses that are found at or close to the ground surface.

Hemic – an organic soil in which the plant remains show a good degree of decomposition (between 1/3 and 2/3 of the fibers are still visible after rubbing the material between the fingers).

Hibernacula – a location where animals hibernate.

Hibernation –the period of winter inactivity during which time normal physiological processes are reduced and a significant decrease in body temperature occurs. In Pennsylvania, true hibernation is shown by woodchucks, jumping mice, and bats.

High-Quality Coldwater Fisheries (HQ-CWF)– DEP designation (PA Code, Chapter 93) for a stream or watershed that has excellent quality waters and environmental or other features that require special water quality protection.

Hydrology – water system of an area including both surface water and ground water.

Igneous-formed by solidification from a molten state. Used of rocks.

Kame – a short ridge or mound of sand and gravel deposited during the melting of glacial ice.

Kettle – a depression left in a mass of glacial drift, apparently formed by the melting of an isolated block of glacial ice.

Lepidoptera – moths and butterflies.

Listed species – species that is monitored and considered to be of concern by PNHP.

Littoral – the area where water meets land, the shoreline.

Matrix – the form of land use or habitat that surrounds a focal patch of habitat.

Mesic – moist, not saturated.

Minerotrophic – groundwater fed; influenced by water that has been in contact with bedrock or soil, and is richer in mineral content than rainwater.

Native – describes species that occurred in Pennsylvania or in the area in which they are found prior to European settlement; not introduced by human activities.

Natural area – as used in this study, a site with either an exemplary natural community or species of special concern; not to be confused with the State Forest Natural Areas which are specific management units designated by DCNR Bureau of Forestry.

Neo-tropical- referring to the tropical locations in the new world; Mexico, Caribbean Islands, and Central and parts of Northern South America.

Non-point – refers to diffuse sources of pollution such as storm water runoff contaminated with oil or pesticides.

Obligate species- able to exist or survive only in a particular environment or by assuming a particular role

Oligotrophic – poor to extremely poor in nutrients; typically describes dilute waters with low base metal ion concentrations.

Palustrine- describes wetlands; areas intermediate between aquatic and terrestrial habitats, supporting predominately hydrophytic vegetation, where conditions are at least periodically wet enough during the growing season to produce anaerobic soil conditions and thereby influence plant growth.

Peat – partially decomposed remains of plant material in which at least some of the plant parts are still distinguishable.

POSCIP – Plant of Special Concern in Pennsylvania.

Potential Natural Area – used by The Nature Conservancy to denote an area that may have desirable environmental characteristics to support rare species or exemplary natural communities, but which needs a field survey to confirm; a preliminary category given to sites prior to field survey (see METHODS section).

Prescribed burning – burning under controlled conditions; needed to maintain communities such as limestone glades and pitch pine barrens.

Riparian – streamside.

Rookery- the breeding ground of certain birds or animals, such as herons, penguins and seals.

R-O-W – strip of land occupied or intended to be occupied by a street, crosswalk, railroad, electric transmission line, oil or gas pipeline, water main, sanitary or storm sewer line, or other special use.

Sapric – organic soils (muck) in which most of the plant material is decomposed and the original constituents cannot be recognized.

Sedge- grasslike herbaceous plant of the family *Cyperaceae*, especially members of the genus *Carex*.

Seeps – where water flows from the ground in a diffuse pattern and saturates the soil; lush herbaceous vegetation often grows in these wet areas.

Shrub - a perennial, woody plant that differs from a tree in its short stature (less than five meters in height) and typically multi-growth form.

Soil association – a group of soils that are geographically associated in a characteristic repeating pattern and defined and delineated as a single unit.

Soil series – groups of soils that have vertical profiles that are almost the same, that is, with horizons (layers) that are similar in composition, thickness, and arrangement.

Subcanopy - in a forest community, the tops and branches of the small trees and tall shrubs that form a distinct layer beneath the high tree canopy and above the shrub layer (if present).

Swamp - a wooded wetland, intermittently or permanently flooded

Succession – natural process of vegetation change through time; over time, the plant species of a site will change in composition and structure as light and soil conditions change (e.g., a field that is left alone may, over time, be taken over by shrubs, then small trees and eventually a woodland).

Talus – slope formed of loose rock and gravel that accumulates at the base of mountains or cliffs.

TNC – The Nature Conservancy

Understory – layer of shrubs and small trees between the herbaceous layer and the canopy.

Upland- sites with well-drained dry to mesic soils.

Wetlands- areas intermediate between aquatic and terrestrial habitats; characterized by a predominance of hydrophytes, where conditions are at least periodically wet enough, during the growing season, to produce anaerobic soil conditions and thereby influence plant growth.

Vernal – occurring in the spring.

Xeric – extremely dry or droughty.

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Appendix I: Natural Area Survey Form

Surveyor: Address & Phone:

Date of Observation_____Site Name:

Quadrangle Name_____ Exact Location of
Site (please be specific & include a map or sketch)

Owner:
Owners Attitude Toward Conservation:

Site Elevation:_____ Size of Site (acres):

Source of Lead:

Current Land Use:

Type of Area: __Old Growth Forest; __Marsh; __Shrub Swamp;
__Forested Swamp; __Bog; __Natural Pond.

Written Description: Try to convey a mental image of the site features (including vegetation, significant animals & plants, aquatic features, land forms, geologic substrata, scenic qualities, etc

Evidence of Disturbance:

Site Condition Compared to Your Last Visit:

Please attach any additional information, species list, etc.
Please send completed report forms to Pennsylvania Science Office
of The Nature Conservancy, 208 Airport Drive, Middletown, PA 17057
(717) 948-3962. Additional forms may be obtained from this
office. Thank you for your contribution.

Appendix II: Community Classification

CLASSIFICATION OF NATURAL COMMUNITIES IN PENNSYLVANIA (Fike 1999)

Community Name	State Rank
Terrestrial Forests	
CONIFEROUS TERRESTRIAL FORESTS:	
Hemlock (white pine) forest	S4
CONIFER – BROADLEAF TERRESTRIAL FORESTS	
Serpentine pitch pine - oak forest	S1
Serpentine Virginia pine - oak forest	S1
Pitch pine - mixed oak forest	S4
Virginia pine - mixed hardwood forest	S5
Dry white pine (hemlock) - oak forest	S4
Hemlock (white pine) -northern hardwood forest	S5
Hemlock (white pine) - red oak - mixed hardwood forest	S4
Hemlock - tuliptree - birch forest	S4
Rich hemlock - mesic hardwoods forest	S2S3
BROADLEAF TERRESTRIAL FORESTS	
Dry oak-heath forest	S4S5
Dry oak-mixed hardwood forest	S3
Red oak - mixed hardwood forest	S5
Northern hardwood forest	S4
Black cherry - northern hardwood forest	S4
Tuliptree- beech -maple forest	S4
Sugar maple - basswood	S4
Mixed mesophytic forest	S1S2
Sweet gum - oak coastal plain forest	S1
Red maple (terrestrial) forest	S5
Black-gum Ridgetop Forest	S3
Aspen/gray (paper) birch forest	S3 NOT TRACKED
Palustrine Forests	
CONIFEROUS PALUSTRINE FORESTS	
Black spruce - tamarack peatland forest	S3
Red spruce palustrine forest	S3
Hemlock palustrine forest	S3
CONIFER – BROADLEAF PALUSTRINE FORESTS	
Hemlock - mixed hardwood palustrine forest	S3S4
Red spruce - mixed hardwood palustrine forest	S3
BROADLEAF PALUSTRINE FORESTS	
Bottomland oak - hardwood palustrine forest	S2
Red maple - black-gum palustrine forest	S3S4
Red maple - black ash palustrine forest	S2S3
Red maple - magnolia Coastal Plain palustrine forest	S1
Great Lakes Region lakeplain palustrine forest	S1
Sycamore - (river birch) - box-elder floodplain forest	S3
Silver maple floodplain forest	S3
Red maple - elm - willow floodplain swamp	S2

Terrestrial Woodlands

CONIFEROUS WOODLANDS	
Pitch pine - heath woodland	S2
Pitch pine - scrub oak woodland	S2S3
Red spruce rocky summit	S1
Pitch pine - rhodora - scrub oak woodland	S1
CONIFER – BROADLEAF TERRESTRIAL WOODLANDS	
Pitch pine - mixed hardwood woodland	S2S3
Virginia pine - mixed hardwood shale woodland	S2
Red-cedar - mixed hardwood rich shale woodland	S1S2
BROADLEAF – TERRESTRIAL WOODLANDS	
Dry oak - heath woodland	S3
Birch (black-gum) rocky slope woodland	S2
Yellow oak - redbud woodland	S2
Great Lakes Region scarp woodland	S1S2
Great Lakes Region bayberry - cottonwood community	S1

Palustrine Woodlands

CONIFEROUS PALUSTRINE WOODLANDS	
Pitch pine - leatherleaf palustrine woodland	S1
Black spruce - tamarack palustrine woodland	S2
Red spruce palustrine woodland	S2S3
BROADLEAF PALUSTRINE WOODLANDS	
Red maple - highbush blueberry palustrine woodland	S4
Red maple - sedge palustrine woodland	S4
Red maple - mixed shrub palustrine woodland	S4

Terrestrial Shrublands

CONIFEROUS TERRESTRIAL SHRUBLANDS	
Red-cedar - prickly pear shale shrubland	S2
Red-cedar - pine serpentine shrubland	S1
CONIFER – BROADLEAF TERRESTRIAL SHRUBLANDS	
Red-cedar - redbud shrubland	S2
BROADLEAF TERRESTRIAL SHRUBLANDS	
Low heath shrubland	S1
Low heath - mountain ash shrubland	S2
Scrub oak shrubland	S3
Rhodora - mixed heath - scrub oak shrubland	S1

Palustrine Shrublands

BROADLEAF PALUSTRINE SHRUBLANDS	
Buttonbush wetland	S4
Alder - ninebark wetland	S3
Alder - sphagnum wetland	S4
Highbush blueberry - meadow-sweet wetland	S5
Highbush blueberry - sphagnum wetland	S5
Leatherleaf - sedge wetland	S3
Leatherleaf - bog rosemary peatland	S2
Leatherleaf -cranberry peatland	S2S3
Water-willow (Decodon verticillatus) shrub wetland	S3
River birch - sycamore floodplain scrub	S4
Black willow scrub/shrub wetland	S4
Poison sumac - red-cedar - bayberry fen	S1

Buckthorn - sedge (Carex interior) - golden ragwort fen	S1
Great Lakes Region scarp seep	S1
Great Lakes Region bayberry - mixed shrub palustrine shrubland	S1

Terrestrial Herbaceous Openings

Little bluestem - Pennsylvania sedge opening	S2
Side-oats gramma calcareous grassland	S1
Calcareous opening/cliff	S2
Serpentine grassland	S1
Serpentine gravel forb community	S1
Great Lakes Region dry sandplain	S1
Great Lakes Region sparsely vegetated beach	S1

Herbaceous Wetlands

PERSISTENT EMERGENT WETLANDS

Bluejoint - reed canary grass marsh	S5
Cattail marsh	S5
Tussock sedge marsh	S3
Mixed forb marsh	S3
Herbaceous vernal pond	S3S4
Wet meadow	S5 NOT TRACKED
Bulrush marsh	S3
Great Lakes Region palustrine sandplain	S1
Prairie sedge - spotted joe-pye-weed marsh	S1S2
Open sedge (Carex stricta, C. prairea, C. lacustris) fen	S1
Golden saxifrage - sedge rich seep	S2
Skunk cabbage - golden saxifrage forest seep	S4S5
Serpentine seepage wetland	S1
Golden saxifrage - Pennsylvania bitter-cress spring run	S3S4
Sphagnum - beaked rush peatland	S3
Many fruited sedge - bladderwort peatland	S2
Water-willow (Justicia americana)- smartweed riverbed community	S4
Riverside ice scour community	S1S2
Big bluestem - Indian grass river grassland	S3

NON-PERSISTENT EMERGENT WETLANDS

Pickerel-weed - arrow-arum - arrowhead wetland	S4
Spatterdock - water lily wetland	S4

Community Complexes

ACIDIC GLACIAL PEATLAND COMPLEX
GREAT LAKES REGION SCARP COMPLEX
ERIE LAKESHORE BEACH - DUNE - SANDPLAIN COMPLEX
MESIC TILL BARRENS COMPLEX
SERPENTINE BARRENS COMPLEX
RIDGETOP ACIDIC BARRENS COMPLEX
RIVER BED - BANK - FLOODPLAIN COMPLEX

* Not all natural communities have been assigned a global or state rank; disturbed or artificial communities are not assigned ranks.

Appendix III: Field Survey Form

PENNSYLVANIA NATURAL DIVERSITY INVENTORY EAST:
SPECIES OF SPECIAL CONCERN FIELD REPORT

SNAME: EOCODE:

SURVEYDATE:

SITENAME:

SOURCECODE

SURVEYSITE: SURVEYOR:

SPECIMEN REPOSITORY:

Locational Information QUADCODE DOTNUM TEN,TEN COUNTYCODE TOWNSHIP

LAT:

LONG:

DIRECTIONS:

Global PA EORANK:

EORANK COMMENTS:

DATA:

HABITAT DESCRIPTION:

MISCELLANEOUS:

DATA SENSITIVITY: OWNERCODE

REASON FOR DATA SENSITIVITY: OWNER

HABITAT SKETCH:

Appendix IV: Federal And State Status And The Pennsylvania Natural Heritage Program Ranks

FEDERAL STATUS

U.S. FISH AND WILDLIFE SERVICE CATEGORIES OF ENDANGERED AND THREATENED PLANTS AND ANIMALS

The following definitions are extracted from the September 27, 1985 U.S. Fish and Wildlife Service notice in the Federal Register:

LE - Listed Endangered - Taxa in danger of extinction throughout all or a significant portion of their ranges.

LT - Listed Threatened - Taxa that are likely to become endangered within the foreseeable future through all or a significant portion of their ranges.

PE - Proposed Endangered - Taxa proposed to be formally listed as endangered.

PT - Proposed Threatened - Taxa proposed to be formally listed as threatened.

C1 - Taxa for which the Service currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list them as endangered or threatened species.

C2 - Taxa for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threats are not currently known or on file to support the immediate preparation of rules.

C3 - Taxa that are no longer being considered for listing as threatened or endangered species. Such taxa are further coded to indicate three categories, depending on the reason(s) for removal from consideration.

3A--Taxa for which the Service has persuasive evidence of extinction.

3B--Names that, on the basis of current taxonomic understanding, usually as represented in published revisions and monographs, do not represent taxa meeting the Act's definition of "species".

3C--Taxa that have proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat.

N - Taxa not currently listed by the U.S. Fish and Wildlife Service

STATE STATUS-NATIVE PLANT SPECIES

Legislative Authority: Title 25, Chapter 82, Conservation of Native Wild Plants, amended June 18, 1993, Pennsylvania Department of Environmental Resources.

PE - Pennsylvania Endangered - Plant species which are in danger of extinction throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained or if the species is greatly exploited by man. This classification shall also include any populations of plant species that have been classified as Pennsylvania Extirpated, but which subsequently are found to exist in this Commonwealth.

PT - Pennsylvania Threatened - Plant species which may become endangered throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained to prevent further decline in this Commonwealth, or if the species is greatly exploited by man.

PR - Pennsylvania Rare - Plant species which are uncommon within this Commonwealth. All species of native wild plants classified as Disjunct, Endemic, Limit of Range and Restricted are included within the Pennsylvania Rare classification.

PX - Pennsylvania Extirpated - Plant species believed by the Department to be extinct within this Commonwealth. These plant species may or may not be in existence outside this Commonwealth. If plant species classified as Pennsylvania Extirpated are found to exist, the species automatically will be considered to be classified as Pennsylvania Endangered.

PV - Pennsylvania Vulnerable - Plant species which are in danger of population decline within Pennsylvania because of their beauty, economic value, use as a cultivar, or other factors which indicate that persons may seek to remove these species from their native habitats.

TU - Tentatively Undetermined - Plant species which are believed to be in danger of population decline, but which cannot presently be included within another classification due to taxonomic uncertainties, limited evidence within historical records, or insufficient data.

N - None - Plant species which are believed to be endangered, rare, or threatened, but which are being considered by the required regulatory review processes for future listing

STATE STATUS-ANIMALS

The following state statuses are used by the Pennsylvania Game Commission for (1990, Title 34, Chapter 133 pertaining to wild birds and mammals) and by the Pennsylvania Fish and Boat Commission (1991, Title 30, Chapter 75 pertaining to fish, amphibians, reptiles and aquatic organisms):

PE - Pennsylvania Endangered

Game Commission - Species in imminent danger of extinction or extirpation throughout their range in Pennsylvania if the deleterious factors affecting them continue to operate. These are: 1) species whose numbers have already been reduced to a critically low level or whose habitat has been so drastically reduced or degraded that immediate action is required to prevent their extirpation from the Commonwealth; or 2) species whose extreme rarity or peripherality places them in potential danger of precipitous declines or sudden extirpation throughout their range in Pennsylvania; or 3) species that have been classified as "Pennsylvania Extirpated", but which are subsequently found to exist in Pennsylvania as long as the above conditions 1 or 2 are met; or 4) species determined to be "Endangered" pursuant to the Endangered Species Act of 1973, Public law 93-205 (87 Stat. 884), as amended.

Fish and Boat Commission - Endangered Species are all species and subspecies: (1) declared by the Secretary of the United States Department of the Interior to be threatened with extinction and appear on the Endangered Species List or the Native Endangered Species list published in the Federal Register; or, (2) declared by the Executive Director (PaFC) to be threatened with extinction and appear on the Pennsylvania Endangered Species List published in the Pennsylvania Bulletin.

PT - Pennsylvania Threatened

Game Commission - Species that may become endangered within the foreseeable future throughout their range in Pennsylvania unless the causal factors affecting the organism are abated. These are: 1) species whose populations within the Commonwealth are decreasing or have been heavily depleted by adverse factors and while not actually endangered, are still in critical condition; or 2) species whose populations may be relatively abundant in the Commonwealth but are under severe threat from serious adverse factors that have been identified and documented; or 3) species whose populations are rare or peripheral and in possible danger of severe decline throughout their range in Pennsylvania; or 4) species determined to be "Threatened" pursuant to the Endangered Species Act of 1973, Public law 93-205 (87-Stat. 884), as amended, that are not listed as "Pennsylvania Endangered".

Fish and Boat Commission - Threatened Species are all species and subspecies: (1) declared by the Secretary of the United States Department of the Interior to be in such small numbers throughout their range that they may become endangered if their environment worsens and appear on a Threatened Species List published in the Federal Register; or, (2) have been declared by the Executive Director (PaFC) to be in such small numbers throughout their range that they may become endangered if their environment worsens and appear on the Pennsylvania Threatened Species List published in the Pennsylvania Bulletin.

APPENDIX IV (continued)

PNHP GLOBAL ELEMENT RANKS

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH = Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered (e.g., Bachman's Warbler).

GU = Possibly in peril range wide but status uncertain; need more information.

GX = Believed to be extinct throughout its range (e.g., Passenger Pigeon) with virtually no likelihood that it will be rediscovered.

PNHP STATE ELEMENT RANKS

S1 = Critically imperiled in state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2 = Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

S3 = Rare or uncommon in state (on the order of 21 to 100 occurrences).

S4 = Apparently secure in state, with many occurrences.

S5 = Demonstrably secure in state and essentially ineradicable under present conditions.

SA = Accidental in state, including species which only sporadically breed in the state.

SE = An exotic established in state; may be native elsewhere in North America (e.g., house finch).

SH = Of historical occurrence in the state with the expectation that it may be rediscovered.

SN = Regularly occurring, usually migratory and typically non-breeding species for which no significant or effective habitat conservation measures can be taken in the state.

SR = Reported from the state, but without persuasive documentation which would provide a basis for either accepting or rejecting (e.g., misidentified specimen) the report.

SRF = Reported falsely (in error) from the state but this error persisting in the literature.

SU = Possibly in peril in state but status uncertain; need more information.

SX = Apparently extirpated from the state.

Note: A "T" appearing in either the G Rank or S Rank indicates that the intraspecific taxa is being ranked differently than the species. A "Q" in the rank indicates that there is taxonomic uncertainty about a taxa being ranked (i.e., taxa is being accepted as a full species or natural community in this list but may be treated as a variety or form by others). A "?" after a "G" "S" indicates that the rank is uncertain at this time.

Appendix V: **Pennsylvania Element Occurrence Quality Ranks**

Quality Rank*	Explanation
A	Excellent occurrence: all A-rank occurrences of an element merit quick, strong protection. An A-rank community is nearly undisturbed by humans or has nearly recovered from early human disturbance; further distinguished by being an extensive, well-buffered occurrence. An A-rank population of a sensitive species is large in area and number of individuals, stable, if not growing, shows good reproduction, and exists in natural habitat.
B	Good occurrence: protection of the occurrence is important to the survival of the element in Pennsylvania, especially if very few or no A-rank occurrences exist. A B-rank community is still recovering from early disturbance or recent light disturbance, or is nearly undisturbed but is less than A-rank because of significantly smaller size, poorer buffer, etc. A B-rank population of a sensitive species is at least stable, in a minimally disturbed habitat, and of moderate size and number.
C	Fair occurrence: protection of the occurrence helps conserve the diversity of a region's or county's biota and is important to statewide conservation if no higher-ranked occurrences exist. A C-rank community is in an early stage of recovery from disturbance, or its structure and composition have been altered such that the original vegetation of the site will never rejuvenate, yet with management and time partial restoration of the community is possible. A C-rank population of a sensitive species is in a clearly disturbed habitat, small in size and/or number, and possibly declining.
D	small occurrence: protection of the occurrence may be worthwhile for historical reasons or only if no higher ranked occurrences exist. A D-rank community is severely disturbed, its structure and composition been greatly altered, and recovery to original conditions, despite management and time, essentially will not take place. A D-rank population of a sensitive species is very small with a high likelihood of dying out or being destroyed, and exists in a highly disturbed and vulnerable habitat.
E	Verified as extant, but has not been given a rank; additional information needed to evaluate quality.

- Intermediate ranks may also be assigned.

Appendix VI: Plants and Animals Of Special Concern In Susquehanna County

Susquehanna County Animals of Special Concern

Scientific Name	Common Name
Dragonflies & Damselflies	
Aeshna clepsydra	Mottled darner dragonfly
Aeshna constricta	Lance-tipped darner dragonfly
Aeshna verticalis	Green-striped darner dragonfly
Ariogomphus furcifer	Lilypad clubtail dragonfly
Boyeria grafiana	Ocellated darner dragonfly
Calopteryx aequabilis	River jewelwing damselfly
Celithemis eponina	Halloween pennant dragonfly
Dorocordulia lepida	Petite emerald dragonfly
Enallagma boreale	Boreal bluet damselfly
Gomphaeschna furcillata	Harlequin darner dragonfly
Gomphus abbreviatus	Spine-crowned clubtail dragonfly
Gomphus descriptus	Harpoon clubtail dragonfly
Ischnura kellicotti	Lilypad forktail damselfly
Leucorrhinia proxima	Red-waisted whiteface dragonfly
Libellula incesta	Slaty skimmer dragonfly
Ophiogomphus howei	Pygmy snaketail dragonfly
Somatochlora walshii	Brush-tipped emerald dragonfly
Tachopteryx thoreyi	Gray petaltail dragonfly
Butterflies	
Carterocephalus palaemon mandan	Arctic Skipper
Chosyne harrisii	Harris' Checkerspot
Lycaena epixanthe	Bog Copper
Polygonia progne	Gray Comma

Reptiles	
Thamnophis sauritus sauritus	Ribbon Snake
Birds	
Acipiter gentilis	Northern Goshawk
Ardea herodius	Great Blue Heron Rookery
Cistothorus palustris,	Marsh Wren
Rallus limicola	Virginia Rail
Freshwater mussels	
Alasmidonta marginata	Elktoe
Alasmidonta undulata	Triangle Floater
Lampsilis radiata	Eastern Lampmussel
Lampsilis cariosa	Yellow Lampmussel

Susquehanna County Plants of Special Concern

Scientific Name	State Common Name
Andromeda polifolia	Bog rosemary
Astragalus canadensis	Canadian Milkvetch
Carex diandra	Lesser panicled sedge
Carex disperma	Soft-leaved sedge
Carex lasiocarpa	Slender sedge
Carex limosa	Mud sedge
Carex pauciflora	Few-flowered Sedge
Cuscuta campestris	Dodder
Eleocharis robbinsii	Robbins' Spike-rush
Epilobium palustre	Marsh willow-herb
Eriophorum tenellum	Rough cotton grass
Galium trifidum	Marsh bedstraw
Juncus militaris	Bayonet Rush
Lobelia dortmanna	Water Lobelia

Myrica gale	Sweet gale
Nymphoides cordata	Floating-heart
Platanthera blephariglottis	White Fringed-orchid
Polemonium van-bruntiae	Jacob's-ladder
Potamogeton obtusifolius	Blunt-leaved pondweed
Ranunculus aquatilis var. diffusus	White water-crowfoot
Ribes triste	Red currant
Schoenoplectus subterminalis	Water bulrush
Schoenoplectus torreyi	Torrey's Bulrush
Stellaria borealis	Mountain starwort
Utricularia cornuta	Horned bladderwort
Utricularia intermedia	Flat-leaved Bladderwort
Viola renifola	Kidney-leaved white violet
Viola selkirkii	Great-spurred violet

Susquehanna County Natural Communities of Special Concern

Natural Community Name
Black Spruce-Tamarack Palustrine Wetland
Glacial Bog
Graminoid Marsh
Hemlock Palustrine Forest
Little bluestem - Pennsylvania Sedge Opening
Leatherleaf - Bog Rosemary Peatland
Leatherleaf - Sedge Wetland
Northern-Hardwood Conifer Forest
Oligotrophic Glacial Kettlehole Bog