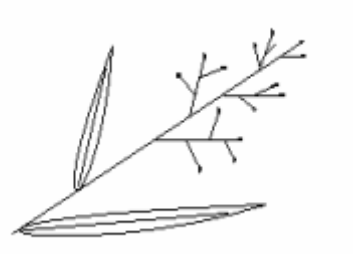
BOTANICAL SURVEY
OF

EAST BRADFORD TOWNSHIP

INCLUDING IDENTIFICATION OF
EXCEPTIONAL NATURAL AREAS
AND
RARE PLANT SPECIES SITES

FIELDWORK CONDUCTED 2009

REPORT PREPARED JUNE, 2010



Survey conducted by Janet Ebert and Jack Holt
With the assistance of
The East Bradford Township Environmental Advisory Council

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EAST BRADFORD TOWNSHIP
BOTANICAL SURVEY

EXECUTIVE SUMMARY

A botanical survey of East Bradford Township was conducted in 2009 by Janet Ebert and Jack Holt under the aegis of the Environmental Advisory Council. The Township was divided into twenty-four sections to facilitate the survey and to ascertain species abundance and distribution. The survey was performed by recording all plant species observed (with habitat notes for higher-quality areas) while walking roadsides, public lands, and private property of willing landowners. Special attention was given to rare plants, Exceptional Natural Areas (areas of relatively intact species-rich and native plant dominated communities), and invasive aliens.

The survey found that the Township still possesses considerable botanical richness, with at least 609 species of native plants, including 16 listed by the state as rare, threatened, or endangered. Many species once recorded as common are now apparently rare. A number of Exceptional Natural Areas were found, including two serpentine barrens, several dry upland woods, barrens, and scrublands, a number of rich tulip poplar forests, and extensive floodplain wetlands. However, this richness is threatened by habitat loss, habitat fragmentation, and encroachment from land development (mostly housing but some commercial), and habitat degradation mostly due to an overabundance of deer and numerous aggressive invasive alien plant species.

In order to retain the Township's remaining botanical diversity the following steps are recommended:

Habitat Loss Some Exceptional Natural Areas are already protected from development by conservation easements. The Township should give priority toward protecting all of the remaining mapped ENAs together with buffers and/or connectors between ENAs. The Township should also make it a priority to protect any forests present in 1937 (the first aerial photographic survey of Chester County) as even fragmented remnants of these older woodlands generally retain a fair amount of native diversity compared to those grown up since that date.

Deer The Township should coordinate (at a minimum) a township-wide management program to reduce the deer population, encouraging all landowners to participate. Efforts should also be made to coordinate this program with those of neighboring townships to make herd reduction regional.

Invasive aliens The Township should try to educate residents about the identification and control of invasive aliens and to manage natural areas to favor native species. Control of invasives could involve research programs by local universities and community volunteer efforts.

Education Uses of this information can include linking it to educational internet sites, inclusion of the data in an environmental information database for evaluating development and land management proposals, and to use as base documentation for monitoring ecological impacts of Township practices. However, care should be taken to ensure that sensitive information, i.e. locations of rare and endangered species or showy species vulnerable to destruction or theft, be made available only to trustworthy partners.

EAST BRADFORD TOWNSHIP
BOTANICAL SURVEY

PURPOSE

This survey was authorized by the East Bradford Township Board of Supervisors with the recommendation and oversight of the Environmental Advisory Council. The purpose was to inventory the plant species and communities of the Township, paying special attention to the location and quality of native plant communities, the distribution of alien invasives, and the presence of state listed species of special concern. The information gathered in the inventory can be used to help establish conservation priorities including locating, determining, and evaluating specimen vegetation or Exceptional Natural Areas (ENAs) in the township. It can also be useful to guide restoration efforts, in attempts to control alien invasive species, and as a baseline to monitor the botanical and broader ecological health of the township. Specific objectives for conducting a botanical survey in East Bradford Township include:

- Assisting with prioritization of individual land parcels for acquisition of interests in open space.
- Enhancing the competitive position of the Township for potential receipt of State and/or County land preservation funding.
- Achieving a maximum amount of environmental protection with a minimum amount of land.
- Recognizing that natural systems operate in larger patterns and at larger scales than the scale typically represented by individual properties.
- Creating a blueprint for the protection and restoration of contiguous networks of wildlife habitat.
- Providing context and environmental considerations for new subdivision and land development projects, as well as for PENNDOT and Township road projects.
- Offering a focus for East Bradford landowner education and outreach, and for the consideration of Township-provided incentives for landowner participation in land stewardship efforts.

METHODS

For the purposes of the survey the township was divided into twenty-four sections of more or less equal size (See Map 1 – *Botanical Survey Sections*). The division between sections was made using roads as much as possible, but also streams, utility lines, and property lines when necessary to keep the sections roughly the same size. Dividing the township into separate survey sections provided a better picture of both the frequency and distribution of plant species. More importantly, it insured that the surveyors looked at supposedly less interesting areas as well as the best habitats to develop a better feel for the relative quality and distribution of habitats.

The majority of surveying was performed by repeatedly walking the roads of the township and recording all species encountered along them and in the adjacent habitats. Some landowners gave permission for a more thorough survey of their property, thus providing access to the interior of most sections. Although they were included in the survey section lists, most of the township owned parks and nature areas were also surveyed as separate parcels for botanical baselines for conservation easements. Surveying began in early March and ended in late November, 2009.

Previous Survey Work and Additional Resources. East Bradford Township was likely part of the area botanized in the late colonial and early American periods by local botanists such as Humphrey Marshall, who lived in nearby Marshallton, West Bradford township, the Pierce brothers, Samuel and Joshua, from Longwood, and possibly Dr. William Darlington and Dr. Joseph Rothrock, both of West Chester, who collected plants for medicinal compounds in the 19th century. H. Stone compiled and published a *Flora of Chester County* in 1945, and in 1983, Dr. William Overlease compiled a *Checklist of the Flora of Chester County* while working at West Chester University.

The authors of this report have conducted several site-level botanical surveys since the late 1980's, the results of which are incorporated into this report. They include easement baseline surveys in Sections 13 (2007), surveys for the township for grant applications in Section 5 - Sugar Bridge (2007) and Section 22 -

Schramm (2008), and an inventory of West Chester University's Gordon Area (Section 23, 2007). Species not observed in 2009 but found during these surveys are included in the list. Lists from several older conservation easement baseline surveys were consulted for field checking but were not included in the final plant list.

Similar township botanical inventories conducted in London Britain (2008-2009), Franklin (2007), London Grove (2006), Wallace (2006), Pocopson (2002), Pennsbury (2001), Chadds Ford (2000), and Kennett (1999) were used to get a broader perspective of the flora of the township, with a special emphasis on areas in the Brandywine watershed. From a review of available literature, a fair amount of botanical work was conducted in East Bradford Township as there are frequent citations in Stone's *Flora* for Sconnelltown, Marshalltown (both serpentine barrens), the Bradford Hills (a portion of South Valley Hill), and Shaw's Bridge, among other locales.

THE SETTING

East Bradford Township, located in south-central Chester County, is approximately 9,664 acres, or 15.1 square miles, in size. Its southern boundaries from east to west abut Westtown, Birmingham, and Pocopson townships, West Bradford is its neighbor to the west, East Caln lies due north, while West Whiteland, West Goshen, and the Borough of West Chester line its eastern border from north to south.

Pre-settlement vegetation consisted almost entirely of deciduous forest punctuated by natural disturbances and burning and clearing by Native Americans, exceptions being several serpentine outcrops in the southern portion of the township, whose thin, metallic, even toxic soils inhibit tree growth and promote fire-tolerant grasses, forbs, and shrubs. European settlers quickly and thoroughly cleared the once-vast forest for farmland, pasture, and timber, and agriculture became the mainstay of the local economy. Both branches of the Brandywine, Valley Creek, Plum Run, and likely Broad and Taylor Runs were dammed to power mills, and the township was more industrialized and farmed in the 1800s than it is today; several old millraces, foundations, and overly broad and large wetlands all hint at the economic past of the township. As marginal farmland was abandoned after the Civil War the percentage of forest cover increased. At the same time, the number of non-native, or alien, plant species increased at an accelerating pace. Recently the conversion of farmland and woodland to residential development has accelerated, creating a shrunken patchwork of 'unused' natural habitats, farmland, and large areas of highly managed landscapes.

Today, the township's habitats are further fragmented by a busy road network. Route 322 and its bypass are the most heavily traveled roads in the township. They serve as conduits between West Chester and Downingtown as well as destinations further east, west, and south. Routes 842, 162, 52/100, and Boot Road (in the far northeast corner) are also important and well-used highways; lesser but important roads include Copeland School Road, Hillsdale Avenue, and Brandywine Creek Road. Commercial development is concentrated near West Chester along Rts. 322 and 162, with a few small retail establishments westward on Rt. 322 and along Rt. 52. A powerline crosses the southwest corner, headed for a substation between the Brandywine and Route 322 below Sugar Bridge. It then zigzags from the substation across the north center, exiting the township just north of Sunset Hollow Road. There are no active railroads, but an abandoned rail line cuts the extreme northeast corner, and a cut for and the bed of an old trolley line that ran from West Chester to Downingtown is still visible along the Brandywine.

The township owns about 540 acres of land, some developed for active recreation, with the majority designated as nature preserves, featuring trails and small parking lots. Most of the township lands are in the process of being placed in conservation easements. Other preserved lands open to the public include Stroud Preserve (Natural Lands Trust), Gordon Natural Area (West Chester University), and West Valley Nature Center (PECO). Elsewhere several land trusts and home owners associations own or hold land with easements restricting land use.

GEOLOGY, PHYSIOGRAPHY, AND DRAINAGE

Two major rock types underlie East Bradford Township, aligned in bands running roughly east-northeast see Map 2 – Watersheds & Geology). A small area of metasedimentary Doe Run schist underlies the lower Plum run corridor, but the rest of the southern half of the township is underlain by Precambrian Grenvillean or Baltimore gneiss. The central neck has a smaller strand of gneiss separated from the main mass by a finger if Doe Run schist and in fault contact with slightly younger Peters Creek schist, which underlies the northern part. The northern edge overlooks but does not extend into the Chester or Great Valley, a band of younger limestone. These rocks are all over 500 million years old, and have been involved in several episodes of compression and metamorphism. During one of these episodes, small blobs of ultramafic serpentinite were intruded into the overlying rock mass. In East Bradford Township mapped outcrops are all located near the edges of the gneiss. Several of the northern outcrops are not expressed at the surface, but three have at least fragments of a serpentine barren plant community, and an unmapped slope farther east has a sliver of weathered serpentinite.

East Bradford Township lies entirely within the Brandywine-Christina watershed. The east branch of the Brandywine is the northwest boundary. It then runs through the middle of the township before turning west to join the west branch at Shaw's Bridge. Major tributaries, including Valley Creek, Broad Run, and Plum Run drain south and west toward the Brandywine.

Both the schist and the gneiss are highly weathered and eroded into irregularly hilly topography, but the Peters Creek schist has been warped up slightly, causing ridge tops to rise in elevation from less than 400 feet on the gneiss to slightly over 500 feet in the north, near the crest of South Valley Hill. The streams have cut deeply into this rise, carving out several steep-sided ravines and valleys. The east branch of the Brandywine, following a cross-fault has cut a nearly linear gorge, entering the township at 220 feet or over 300 feet lower than the highest point in East Bradford, 531 feet, east of Skelp Level Road. By the time the main stem Brandywine leaves the township, south of Shaw's Bridge, it has dropped to 170 feet.

The influence of geology on plant distribution and communities is significant but varies considerably. The well-developed serpentine barrens have very poor soil and a distinct suite of species, many of them very rare in southeastern PA because of the limited distribution of serpentinite. The difference between the gneiss and schist is more subtle, and differences in plant communities have become blurred due to human activities, deer browsing, and invading alien plants, all of which contribute to eliminating more specialized species from the flora. However, there are a number of species that are much more common on or only occur on one substrate, such as *Allium tricoccum*, conspicuous on the richer gneiss soils but absent from the Peters Creek schist, and clubmosses and native hawkweeds, which are almost entirely absent on gneiss but thrive on the thinner schist soils. Some species are more influenced by the different weathering profiles of the gneiss and schist. Polypody (rock cap fern) can nestle in the angular cracks and crevices of schist, but does not grow on the smooth round boulders of gneiss. Wetlands tend to be smaller and shadier in the narrow valleys on the schist and more open and broader on the gneiss, causing an uneven distribution of both wetlands and some wetland species. For a number of reasons, ultimately related to the underlying geology, plants that seem to prefer to grow on schist are generally native, while species with a preference for gneiss have a much higher alien component.

THE FLORA

A total of 902 species of plants were recorded for East Bradford Township either during this survey or during the above-mentioned earlier surveys. Natives include 609 species, or 67.5% of the total, while 293 species, or 32.5%, are alien or introduced, a little below but still close to the average native/alien percentage of the seven townships previously surveyed (66.5% native, 33.5% alien). Included as aliens are 4 introductions (species native to the region but not the township) frequently planted in restorations, woodlots, or gardens.

Of the natives, 174 species, or 28.6% of the total native flora, were observed in only one or two sections, which again is fairly typical for a township survey. There are several reasons for their local rarity. Some require habitats with specific soil chemistries, temperatures, or moisture conditions that are uncommon in

the township. Others are at or near the edge of their ranges (mostly southern species moving north). A number are species once considered frequent or common in the county (See Stone's *Flora of Chester County*, 1945) which have declined drastically and are now in danger of disappearing, not only from the township but in many cases the entire region. Habitat loss from housing development and changes in land management has played a role in their reduction and disappearance, as well as the introduction of invasive aliens, the explosion in the deer population, and a decline in pollinators. Without protection, proper management, and in some cases restoration, the losses will increase. For a complete list of these species, see Appendix 1 - East Bradford Township Plant List.

GENERAL PLANT COMMUNITIES

A plant community, as defined by Fike (1999) is 'an assemblage of plant populations sharing a common environment and interacting with each other, with animal populations, and with the physical environment'. These interactions occur at a wide range of scales, from those involving regional factors such as climate and geology to those involving chemical reactions and soil microbes. With so many (and often conflicting) influences, plant communities, especially in this area, are not discrete, easily-classified units but more a continuum. In addition, the speed and magnitude of human- (and deer-) caused alterations of the environment appear to have degraded native plant communities faster than they can adjust, and many currently widespread plant communities are unstable and dominated by aliens, especially in the shrub and forb layers. Communities in this area can only be broadly delineated according to available moisture and dominant species.

Forests or older woodlands have a closed canopy of trees older than 60-70 years in age. They range from dry chestnut oak-heath, to oak mix, to moister (mesic) combinations of oaks, beech, and tulip, down to swamp forest dominated by red maple and pin oak. Chestnut oak-heath communities are found exclusively on schist on the drier ridges above the Brandywine and Valley Creek, with a good example in the dry parts of the Harmony Hill Nature Area, in what we have identified as Exceptional Natural Area (ENA) 1. ENAs are remnant higher quality botanical areas; see below for a definition of an Exceptional Natural Area.

Oak-mix forests are widespread, as are more mesic beech-tulip-oak or tulip forests. Often larger wooded areas are patchy with oaks and hickories more common on thinner, eroded slopes and beech and tulip dominant on richer deeper soils on lower slopes. Older beech and younger tulip woods indicate past logging, generally for oak, or clearing, although beech is intolerant of fire. Beech-dominated forests generally have little undergrowth; exceptions usually have a dense sapling layer of beech. Tulip-oak or tulip-dominated forests are richer in both shrub and herb diversity and quantity, but are also more likely to have considerable amounts of multiflora rose, garlic mustard, and other invasives, and spicebush is usually the only significant native shrub. Native herbaceous species can vary considerably, depending on canopy dominants, past use, deer pressure, and alien load. Examples include parts of ENA's 1, 8, and 11 on schist, and ENA's 17, 18, and 21 on gneiss.

Floodplain hardwood forests on alluvial soil are usually in small groves or fragments surrounded by younger woodlands with a walnut, ash, and /or box elder maple canopy over impenetrable thickets of multiflora rose and alien herbs and grasses. Older sycamore, silver maple, bitternut hickory, and pin oak sometimes line the stream edge, especially along the Brandywine. Typical floodplain herbs such as Jacob's-ladder, Virginia waterleaf, zigzag goldenrod, Virginia bluebells, and some sedges and grasses have been reduced greatly by choking carpets of lesser celandine. ENAs 8 and 18 have some floodplain hardwoods, and ENAs 14, 19, and 22 have communities typical of the lower slope above the Brandywine.

Younger woodlands often have a closed or nearly closed canopy similar to forests, but tend to be dominated by one or two species of native mostly early successional trees, usually tulip, ash, red maple, and black cherry. They rarely have a well-defined understory. Aliens frequently dominate the shrub and herb layers. Common shrubs include autumn olive, multiflora rose, spicebush, black-haw, and brambles *(Rubus spp.)*. Vines such as Japanese honeysuckle, bittersweet, grape, poison ivy, and Virginia creeper are generally frequent, both along the ground and climbing up trees along edges or in gaps where there is more light. Garlic mustard, stilt-grass, violets, and white avens are typical common herbs growing in this habitat. Most young woodlands have some native shrubs and herbs present, although isolated blocks are often

entirely lack them. Today it is an unusual young woodland that has more natives than aliens below and / or a significant amount of oaks and hickories in the canopy. Two parallel slopes of similar age in Paradise Farm Camp (ENA 4) have a maple-dominated canopy, but some oaks, few aliens, big patches of clubmosses, and a rich ground cover.

Wetlands. Most natural wetlands in East Bradford Township occur as springs and seeps along or at the 'head' of smaller streams and on the 'toes' of slopes and floodplains of larger streams. Man-made wetlands occur below ponds, in old ponds, in storm water detention basins, or where natural drainage has been impeded by roads or railroad beds.

Small wetlands in woods are usually marked in spring by the appearance of skunk cabbage, with violets, jewelweed, and tearthumbs appearing and flowering later in the season. Other typical woodland seep species include golden saxifrage, rough bluegrass, Pennsylvania bittercress, and certain sedges. Spicebush, arrowwood viburnum, elderberry, and winterberry are common shrubs; red maple (occasionally accompanied by black ash) is the typical tree if the wetland is large enough to influence the canopy.

Common marsh or open wetland plants include sensitive fern, jewelweed, tearthumbs, soft rush, purple-stemmed aster, goldenrods, rice cut-grass, reed-canary grass, and numerous sedges. Cattails and arrowhead generally grow only in the wettest areas where the ground is almost permanently inundated. Shrubs and trees such as black alder, swamp rose, buttonbush, red maple, and green ash begin the succession of a marsh to a swamp. The invasive purple loosestrife and giant reed (Phragmites) are frequent but patchy in the township, and the European strain of reed-canary grass is a common pest, commonly taking over marshes and open stream corridors, especially where there has been disturbance, and increased nutrient and sediment inflow. ENA 20 has a remnant of upland marsh, and ENA 23 has a large floodplain wetland.

Aquatic habitats include streams and ponds. Duckweed (*Lemna minor*) is the most common floating aquatic, found in both streams and ponds, sometimes with water meal or greater duckweed. Few ponds were visited during this survey, so frequency of pond weeds is likely underrepresented in the plant list. The alien water-starwort (*Callitriche stagnalis*) grows in mats along the edges of streams where there is a silty or muddy substrate. Open reaches of the Brandywine and old sloughs can support a number of aquatic or partly aquatic species such as spatterdock, bur-reed, mud plantain, riverweed (*Podostemum ceratophyllum*, SP), water stargrass, and pondweeds. Many of these specialists are hard to find when water levels remain high all summer. Probably the best single area for aquatic diversity seen in this survey is the bend in the Brandywine in ENA 22, but there are probably other pockets of aquatic diversity along the lower east branch.

Transitional habitats (Edges, hedgerows, thickets, old fields). These habitats have high light levels and are generally dominated by woody species with mobile seeds (spread by wind, birds, or mammals). Common trees along edges and hedgerows include black cherry, ash, sassafras, red maple, and walnut. They shade a mostly alien-dominated mixture of shrubs including multiflora rose, bush-honeysuckles, spicebush, black haw, crabapple, and brambles. Old hedgerows of Osage orange are the cores of many hedgerows, especially along old farm lanes. Most hedgerows and woodland edges are knit together by a woody suite of vines such as bittersweet, Japanese honeysuckle, poison ivy, grapes, Virginia creeper, and recently mile-a-minute and porcelain-berry. The ground flora is generally low in diversity and dominated by exotics. White avens, garlic mustard, garlic, and stilt-grass are some of the common ground species.

Old fields, or early successional habitat such as abandoned cropfields and pastures, are transitional and ephemeral in nature. As time passes after abandonment, these habitats progress from annual herbs or pasture grasses to perennials such as goldenrods, asters, and broomsedge. In this area they are quickly invaded by woody aliens such as multiflora rose, autumn olive, bittersweet, and Japanese honeysuckle, with natives such as poison ivy, grapes, and tree saplings contributing heavily.

Thickets are old fields where the shrubbery, vines, and tree saplings (especially red maple, black cherry, ash, and tulip) have grown tall or dense enough to form a low but closed canopy. The boundary between old field and thicket is not always clear, and the two habitats often interfinger until the patches of closed canopy merge. Old fields, thickets, and edges once supported a diverse mix of native grasses, sedges,

asters, goldenrods, tick trefoils, clubmosses, and shrubs. Today the majority of these habitats, especially along cropfields and in lowlands, contain a limited number of hardy natives and aggressive aliens.

Open Lands (Meadows, fields, heavily managed communities, and roadsides). Since any ground left alone in the region is soon colonized by woody vegetation, all non-wetland areas dominated by herbaceous plants are managed to some extent.

Meadows are areas defined as open ground (but not a full-blown wetland) where the majority of the flora is composed of native forbs, grasses, and sedges, with drainage, soil type, and slope determining the species present. Common wet meadow species include wide variety of sedges along with rushes, joe pye-weed, goldenrods, ironweed, heal-all, swamp milkweed, agrimony, and golden ragwort, with vegetation in less-managed areas frequently growing lush and tall. Drier or lower- and mid-slope meadows, whose vegetation is generally shorter in stature, are commonly dominated by goldenrods, asters, grasses (including fescue, purple top, sweet vernal grass, broomsedge, Indian grass), and sedges mixed with broader-leaved herbs such as dogbane and milkweed. The driest meadows, on upper slopes or hilltops, are generally dominated by warm-season grasses such as broomsedge and little bluestem mixed with shorter grasses like panic-grasses, accompanied by low-growing herbs including dwarf cinquefoil, hawkweeds, ox-eye daisy, tick-trefoils, grey goldenrod, uncommon milkweeds, and hardy sedges. Creepers, especially dewberry, frequently invade this habitat, especially near edges. Patches of bare ground, often the result of mowing practices or less often foot trails, are home to annuals including three-seeded mercury, sheep sorrel, and milkwort. Drier and wetter portions of meadows and stretches along woodland margins tend to have the greatest diversity of species and in general the older the meadow the higher native plant diversity it possesses.

Well-developed meadow habitat is uncommon in the township. Several township lands (Skelp Level and Paradise Valley) have been seeded with a meadow mix and now have a mixture of warm-season and alien pasture grasses, and annual weeds, but not the normal assemblage of native meadow species. Serpentine barrens are a highly specialized meadow habitat. Meadowy areas can be found here and there on steeper slopes, low spots, and infrequently though regularly mowed places. Parts of ENA 22 and the open space of several subdivisions have some meadow.

Unmown meadows are soon invaded by poison ivy, honeysuckle, multiflora rose, and tree and shrub seedlings. On the other hand too-frequent mowing discourages native herbs and grasses and turns a meadow into a Field, or an open area dominated by alien pasture or hay grasses such as orchard grass, fescue, bromes, bluegrass and timothy mixed with mostly alien broad-leaved herbs including clover and thistle. However most fields, even the most heavily utilitized or managed, usually possess a few native species, especially along edges, moister areas, or on steep slopes, and the distinction between a meadow and a field is often unclear.

Utility Corridors. East Bradford has several utility corridors, the largest a powerline zig-zagging through the township. By necessity right-of-ways must be kept clear, so as a result those portions not being actively farmed are kept in a state of early succession. Although too often this continually disturbed condition favors the explosive growth of alien invasives and hardy natives, occasionally native-dominated communities develop or persist, especially in dry exposed areas or wetlands. Several of the most outstanding natural communities in the township occur under this power line or in other right-of-ways in ENA 8 and 11.

Sand and gravel bars are the only open habitats in the township currently managed and perpetuated by 'natural' means, flooding and fluctuating water levels. Their substrate varies from coarse cobbles to mud, and if they occur in sunny areas and are not overrun by hops or reed-canary grass these sites can harbor a surprisingly large number of disturbance-tolerant species (both native and alien) in a small area. There is a large gravel bar complex in ENA 18 and smaller ones in ENA 22, but much of the Brandywine has steeply eroded or undercut, frequently shaded banks and scattered barren, rarely exposed cobble bars.

Heavily managed or ruderal communities include pastures, active cropland, lawns, roadsides, and golf courses. In additional to cultivated species each of these continually disturbed habitats possess a typical

suite of weedy, mostly alien, and annual species including chickweed, lamb's-quarters, ragweed, thistles, and various grasses. These habitats, characterized by unstructured, low-diversity plant assemblages and compacted and chemically altered soils, allow rapid runoff of rain and nutrients (including organic and inorganic fertilizer), degrading stream and groundwater quality.

Roadsides, especially in sunny areas, are typically dominated by a few hardy and adaptable species including knotweed, ragweed, bromegrass, and chicory which are able to tolerate the harsh environment of temperature and moisture extremes, excessive mowing, pollution, and poisoning. Nonetheless roadsides often possess a surprising diversity of species, both native and alien, just a few feet back from the pavement, especially in undeveloped areas. The richness of a roadside, especially in native species, is often a good indicator of the relative health of a neighboring plant community, open or wooded.

Barrens and Rock Faces. East Bradford is fortunate to have several varieties of 'extreme' habitats within its boundaries. Serpentine Barrens, with their unique geology and fire-based ecology and plant life, have been extensively botanized and studied for well over a century. In spring and early summer their open areas become ablaze with color, as showy low-growing herbs including barrens chickweed, moss pink, and barrens ragwort all bloom. As the season advances early-blooming warm-season grasses and drought-tolerant herbs including gamma-grass, whorled milkweed, and rose pink become more prominent. By the end of summer warm-season grasses and a smattering of specialized sedges are dominant. Marshallton and Sconnelltown Barrens are the two main examples present in the township of this ecotype.

Less well studied are the other types of barrens present in the township. Most striking are Heath balds or Barrens. The prime example of this type, more typically found in northern and central Pennsylvania, is in the powerline cut west of Copeland School Road (ENA 11), where huckleberry and blueberry form dense carpets of low greenery over the thin soil and the dry gaps in between host a variety of warm-season grasses and low-growing drought-tolerant herbs; a second smaller version occurs on the utility cut between the two Sugar Bridge Preserves (ENA 8). An even less well-known variety of barren are anthropomorphic, or man-made, barrens, often created when the soil on a site is removed down to bedrock. The old Sonoco site at Harmony Hill (ENA 2) with its bare soil thinly covered with a variety of warm-season poverty grasses and drought-tolerant low herbs is the most notable one in the township.

Rock faces are the last type of 'extreme' habitat found in the township. Schist, with its alternating layers or bands of erosion-resistant or 'weak' rock, frequently forms sizable rock outcrops, especially along the Brandywine. These natural outcrops are home to a distinctive suite of plants, including columbine, early saxifrage, and several ferns. Their droughty tops are also frequently open and support members of barrens communities. The best rock outcrop in the township occurs at Sugar Bridge. Transportation cuts are another type of rock outcrop. Although generally too recent in origin and prone to disturbance to allow many of the natural outcrop species to colonize, they are nonetheless home to a several ferns as well as some weedy drought or disturbance tolerant herbs and creepers. Examples include the old railroad cut along South Valley Hill, the old trolley line south of Downingtown, and portions of Valley Creek Road on Paradise Farm Camp land.

ALIENS

Aliens are defined as species that did not co-evolve in the area over long periods of time. That is, these species did not naturally occur in the area prior to European settlement but have since become part of the flora. Most are exotics, introduced from other continents, many unintentionally. A few are adventives, native elsewhere in North America, which have moved into the area in response to changes in land use or climate. Many are disturbance species that are abundant only in ruderal habitats, continually disturbed areas such as farm fields, lawns, and roadsides, and other early successional areas. The most ecologically disruptive species are those that aggressively invade natural or less-maintained areas. Unencumbered by pests, predators, or diseases, they reproduce and spread rapidly, out-competing the natives for sunlight and water and frequently reducing the flora in many areas to a small group of contending aliens. Deer speed up this process (and prevent its reversal) by preferentially browsing the natives. Many aliens, including most of the worst woody invaders, were originally introduced as ornamental or landscape plantings that do not

immediately take over - it often takes years after the initial introduction for a plant's population to reach a 'critical mass' and start dramatically expanding its range and numbers.

During this survey, 293 non-native species of plants (32.6% of the flora) were recorded for East Bradford Township, 61 of which are considered invasive. Of the invasives, 31 or half were recorded in at least 20 of 24 sections (and most likely present in all sections). Besides well-known pests such as multiflora rose, autumn olive, bittersweet, garlic mustard, Norway maple, and Japanese stilt-grass, the widespread invasives include privet, barberry, long-bristled smartweed, mile-a-minute, cut-leaved bittercress, and Amur honeysuckle. Species that seem to be increasing rapidly in the area include porcelain berry, Callery pear, the grass *Arthraxon hispidus*, linden viburnum, and Higan or weeping cherry. Asian Hercules-club is still very local but frequently produces a dense seedling carpet near a founder tree. Purple loosestrife is locally abundant in several larger wetlands, especially at Shaw's Bridge, and mitigation wetlands. Lesser celandine has practically eliminated the native herbaceous floodplain communities along the Brandywine, Valley Creek, and Plum Run.

The percent of aliens in a township flora is usually around 33 %, so East Bradford is not notably worse off than the surrounding townships. On a positive note a number of older invaders such as kudzu, several buckthorns, balloon-berry, and privet as well as more recent introductions including snowflake lily, photinia, creeping raspberry, and Japanese magnolia were not seen in this survey, although they may well be present. See Appendix 2: Invasive Aliens in East Bradford Township.

DEER

The negative impact of overpopulated deer has been mentioned repeatedly, and is a significant problem throughout the region, but it is severe in East Bradford Township. This represents an almost complete reversal from conditions only about 100 years ago, when deer were virtually eliminated from the area. Many older woodlands have now deteriorated into 'cathedral forests', so stripped of their shrub and ground flora that one can see considerable distances through the living columns of their aging canopy. Other forests that retain some native diversity along roadsides, nurtured and protected by light and traffic, have interiors that are now dominated by invasive shrubs and ground covers. Rare is the woodland with any significant number of sapling oaks, hickory, or even tulip, a worrisome development as older trees die and are not replaced, the gaps created quickly filled with smothering carpets of alien weeds, vines, and 'trash trees.' As long as the deer population remains high, planting native trees and introducing native plants will need costly protection, and their ultimate flourishing will remain compromised. Efforts to drastically reduce the numbers of deer to a sustainable level are critical, and must be cooperative and widespread.

RARE PLANT SPECIES

The Pennsylvania Natural Diversity Inventory (PNDI) keeps track of all species in the state determined to be of special concern. Endangered species (PE) are those in danger of becoming extinct in the state; Threatened species (PT) may become endangered if their habitats and populations are not maintained at current levels, while Rare species (PR) are uncommon or restricted in range or numbers. Undetermined species (PU) are believed to be in danger of population decline but currently not enough is known of their range or population dynamics to categorize them as endangered, threatened, or rare. Vulnerable (PV) species are being actively gathered by commercial collectors, while Extirpated species (PX) are believed to be extinct in the state. Special Population (SP) includes 'watchlist' species for which more information is wanted, species that indicate special habitats, species that host uncommon insects, and species with a restricted distribution in PA. There are no plant species of federal concern known to occur in East Bradford Township.

Two Endangered, nine Threatened, and five Rare species of special concern were found during the survey, six of them at more than one site, as shown on the following chart:

Scientific Name	Common Name	# Sites	State Status	Habitat
Poa autumnalis	Late bluegrass	1*	PE	Woodland
Tripsacum dactyloides	Gamma grass	1	PE	Open

Bouteloua curtipendula	Side-oats grama grass	1*	PT	Serpentine
Cuscuta campestris	Dodder	3	PT	Open
Dichanthelium oligosanthes	Heller's witch-grass	2*	PT	Serpentine
Fimbristylis annua	Annual fimbry	2*	PT	Serpentine
Phemeranthus teretifolius	Fame-flower	2*	PT	Serpentine
Scleria pauciflora	Few-flowered nut-rush	2*	PT	Serpentine
Symphyotrichum depauperatum	Serpentine aster	1*	PT	Serpentine
Trillium cernuum v. cernuum	Nodding trillium	1*	PT	Woodland
Woodwardia areolata	Netted chain-fern	1	PT	Wetland
Andropogon gyrans	Elliott's beard-grass	5*	PR	Open
Elephantopus carolinianus	Elephant's-foot	1	PR	Open
Packera anonyma	Barrens ragwort	1*	PR	Serpentine
TIpularia discolor	Crane-fly orchid	1*	PR	Woodland
Zizania aquatica	Wild rice	1*	PR	Wetland

In addition, fourteen Special Population species were observed in the township:

Scientific Name	Common Name	# Sites	
Allium tricoccum	Wild leeks	9*	Woodland
Carex conjuncta	A sedge	10	Open
Carex davisii	Davis' sedge	3	Woodland
Carex jamesii	James' sedge	2*	Woodland
Carex planispicata	A sedge	3	Woodland
Carex striatula	A sedge	5	Woodland
Carex tonsa	A sedge	2	Barren
Cerastium velutinum *var. velutinum*	Barrens chickweed	2*	Serpentine
Dichanthelium polyanthes	A panic-grass	1	Woodland
Ipomoea lacunosa	Small white morning-glory	2	Open
Juglans cinerea	Butternut	4	Woodland
Nuttalanthus canadensis	Old-field toadflax	2*	Open
Pellaea glabella	Blue cliffbrake fern	1	Barren
Podostemum ceratophyllum	Riverweed	2*	Aquatic

* indicates that at least one population for that species was known before 2009

Of the 30 species, ten prefer woodlands, while fourteen can be loosely described as 'meadow' species, eight of which are restricted to serpentine barrens. Two (*Carex tonsa*, *Pellaea glabella*) can be described as non-serpentine 'Barrens' species, while *Podostemum ceratophyllum* is aquatic. Only two plants (*Woodwardia areolata*, *Zizania aquatica*) can be considered wetland species. Thirteen are southern species at or near the northern end of their range in Chester County. See Maps 3, 4 or 5 for rare plant locations. Following are brief descriptions of each species and their habitats:

Allium tricoccum **(Wild leeks or ramps) – Special Population**

Wild leek is becoming more common in rich woods in southern Chester County, partly because it is not bothered by deer. Locally abundant in rich woodlands and wooded slopes, especially on gneiss, it is not of special concern in Chester County.

Andropogon gyrans **(Elliott's beard-grass) – Rare SOUTHERN**

Grows on infrequently mown dry upland meadows and banks, usually found with (but almost always less common) than its close relative broomsedge (*Andropogon virginicus*). Five populations were observed in the township in the far north and south, though not on gneiss. In PA it is only found in the southeast, and is vulnerable to natural succession and loss of habitat.

Bouteloua curtipendula **(Side-oats gama grass) – Threatened PRAIRIE**

Restricted in southeastern Pennsylvania to open serpentine barrens (found on limestone barrens further west). It is common on the Marshalltown barren, where it is under threat by Kentucky bluegrass and other cool-season grasses and weeds.

Carex conjuncta **(A sedge) – Special population**

This sedge usually grows in small populations on moist roadsides and disturbed ground including pastures, and is underreported rather than uncommon.

Carex davisii **(Davis sedge) – Special population**

Three populations of this sedge were observed growing in floodplain forests (its preferred habitat) of the lower Brandywine in the southwestern part of the township.

Carex jamesii **(James' sedge) – Special population**

This unusual few-flowered sedge, with grass-like leaves and globular perigynia, were seen twice in the township; a large population in rich woodlands on gneiss west of the Brandywine, and a smaller colony on a rich loamy shaded roadbank further west.

Carex planispicata **(A sedge) - Special Population**

This sedge only grows on rich well-drained wooded slopes and ridges, usually above a major watercourse. Two small populations were found in this habitat overlooking the Brandywine.

Carex striatula **(A sedge) – Special population**

This sedge of rich woods and wooded slopes is frequent in Chester County, and really should not be of special concern.

Carex tonsa **(A sedge) – Special population**

This low-growing sedge prefers extremely dry barren open ground, although not necessarily serpentine soil. Two populations were seen growing along a powerline cut in the northern part of the township.

Cerastium velutinum *var. velutinum* **(Barrens chickweed) – Special Population**

As its name implies barrens chickweed is entirely restricted to barrens and bare bluffs, mostly on serpentinite. Although only observed in two sections there are three separate occurrences; Marshalltown Barren, Sconnelltown Barren, and Strodes Mill, where it is being crowded out by Kentucky Bluegrass and crown vetch. It is vulnerable to succession and management change.

Cuscuta campestris **(Dodder) – Threatened**

Occasional found near the banks of larger streams, this obscure parasitic vine was seen three times growing along the East Branch Brandywine.

Dichanthelium oligosanthes **(Heller's witch-grass) – Threatened SOUTHERN**

This bushy low-growing grass of dry meadows and serpentine barrens, was found on Sconnelltown Barren and the Strodes Mill serpentine remnant. Both populations are vulnerable to succession and management change.

Dichanthelium polyanthes **(A panic-grass) – Special Population SOUTHERN**

This grass is found in low open woods and edges, frequently on or just above floodplains, gravel bars, and rich open meadows. A small colony was seen growing along a utility cut in the northern part of the township near the East Branch of the Brandywine.

Elephantopus carolinianus **(Elephant's-foot) – Rare SOUTHERN**

A small population of this distinctive late-blooming member of the aster family was discovered in a pasture in the southwestern part of the township. Once considered threatened in the state (and quite rare in Chester County), it has recently been downgraded to rare because of a recently documented propensity to invade and thrive in overgrazed pastures, especially in western Pennsylvania. It may be making a similar habitat and range extension in this part of the state.

Fimbristylis annua **(Annual fimbry) – Threatened SOUTHERN**

This tiny sedge thrives on bare, seasonally moist rocky soil and gravel of serpentine barrens, to which it is entirely restricted in southern Pennsylvania. It is somewhat eruptive in wet summers, and was present on both Sconnelltown and Marshalltown Barrens in 2009.

Ipomoea lacunosa **(Small white morning-glory) – Special Population SOUTHERN**

This morning glory is not of concern unless it is growing in a native habitat. In southeastern Pennsylvania it occurs only as a weed at the edges of cornfields or highly disturbed bare ground.

Juglans cinerea **(Butternut) – Special Population**

A tree of rich low or floodplain woods, rarely present in any sizable quantity but sometimes overlooked due to a superficial resemblance to its much more common relative black walnut. Four individual trees were observed in the township. It is threatened throughout its range by a canker disease.

Nuttallanthus canadensis **(Old-field toadflax) – Special Population SOUTHERN**

A small perennial herb with spikes of small but showy bluish flowers, this plant prefers sandy dry sunny soil with little competition. Populations were found in two separate sections in appropriate (albeit man-made) habitat, a dry stretch of powerline cut and in sandy dry ground near an old house site

Packera anonyma **(Barrens ragwort) – Rare SOUTHERN**

This late spring-blooming member of the aster family, almost entirely restricted to serpentine barrens in southeastern Pennsylvania, is common at Sconneltown Barren but apparently no longer present at Strodes Mill or Marshalltown Barren.

Pellaea glabella **(Blue cliffbrake fern) – Special Population**

This relatively small fern of dry limestone or calcareous exposed cliffs and outcrops seems to be entirely restricted to cracks in masonry walls and bridges in southeastern Pennsylvania, as is the case in East Bradford Township, on what is now a foot bridge over the East Branch Brandywine Creek. There is also one site for the slightly more common purple cliff-brake (*Pellaea atropurpurea)*, on an active road bridge over the Brandywine.

Poa autumnalis **(Late bluegrass) – Endangered SOUTHERN**

This low-growing grass of moist rich wooded bottomlands and floodplains (which despite its name actually blooms in June, still late for a *Poa*) seems to be on the increase in southeastern Pennsylvania. A small population of this species was observed growing just above the floodplain of the Brandywine in 2007.

Podostemum ceratophyllum **(Riverweed) – Special Population**

River weed clings tightly to large rocks in fast-moving water in sunny stretches of a stream. It is widespread but has become uncommon due to declines in water quality.

Scleria pauciflora **(Few-flowered nutrush) – Threatened SOUTHERN**

This small unusual sedge, with tiny globular seeds resembling golf balls, is almost entirely restricted to serpentine barrens in southeastern Chester County. It occurs at both Marshalltown and Sconnelltown Barrens.

Symphyotrichum depauperatum **(Serpentine aster) – Threatened**

This aster is entirely restricted to serpentine barrens. It is abundant at the remnant of the Sconnelltown Barren but surprisingly is not present at the Marshalltown Barren and apparently is no longer present at Strodes Mill.

Tipularia discolor **(Crane-fly orchid) – Rare SOUTHERN**

This winter-leafing orchid of young to middle-aged woodlands has definitely expanded its range and abundance in the last 50 years in PA in the township. Unless it flowers, which only does irregularly, it is only visible from November to April. Only a single plant was seen in the township, in 2007 in the far southeast corner, but there is almost certainly more *Tipularia* in the township.

Trillium cernuum v. cernuum **(Nodding trillium) – Threatened**

This woodland herb favors moist rich woods, frequently growing on the upper edges of floodplains or in lower slopes of woodlands. Once considered frequent, it is a species of concern because of deer predation, and the only population observed in the township was small with mostly non-flowering plants.

Tripsacum dactyloides **(Gamma grass) – Threatened SOUTHERN**

A small population of this tall husky grass was observed growing along Brandywine Creek Road south of Route 162. Once promoted as a favored forage crop for cattle, known native occurrences in the state are rare. A roadside population in PA is probably introduced , but gamma grass often occurs in ditches farther south, so the origin of this population is problematical.

Woodwardia areolata **(Netted chain-fern) – Threatened SOUTHERN**

A small population of this acidic seep specialist was found growing near the mouth of a wooded rivulet just west of Valley Creek in ENA 4.

Zizania aquatica **(Wild rice) - Rare**

This tall annual grass, more common in freshwater tidal marshes, has been known from the wetlands south of Shaw's Bridge for some time, but the population has fluctuated widely, so it was a pleasant surprise to see close to a hundred plants flowering and fruiting in 2009.

OTHER NOTABLE SPECIES, COMMENTS AND MYSTERIES

During every township survey there are unexpected finds, identification problems, and discoveries of species with broader significance or interest. Following are some of these findings for East Bradford Township:

Actaea pachypoda – Doll's-eyes or white baneberry - CC=7 (see definition of 'CC' below).

Actaea pachypoda is frequent in PA except in the extreme southeast. Vegetatively it closely resembles its larger cousin *Actaea (Cimicifuga) racemosa*. As the small plants seen in Sections 1 and 2 did not flower, its identification was not absolutely confirmed. It is included in the list since the ID is probably correct, and it is a significant species for the township, being of northern affinity. Both sites are somewhat protected due to terrain and remoteness.

Apocynum androsaemifolium - Pink dogbane - CC=4

A combination of development, open land management changes, and 'tidying up' of edges and roadbanks has made this already uncommon but showy relative of the milkweeds almost extinct in the area. A possible population of this species was observed on the eastern edge of the South Valley Hill (ENA 5), but it was in the shade and did not flower.

Asclepias incarnata var. incarnata vs. var. pulchra – Swamp milkweed – CC=4

The two varieties of swamp milkweed differ in leaf shape and pubescence and are mapped separately in the PA flora atlas. The range of the varieties is what makes this species interesting, as var. pulchra is seen exclusively in southern Chester County while var. incarnata grows uncommon south of the Great Valley, with little overlap. East Bradford Township is apparently in the narrow overlap zone, with both varieties fairly common and seen together in several sites.

Crataegus pensylvanica – Pennsylvania hawthorn – CC=6 = State Rank of PT (Threatened)

A sapling of what might be this threatened small thorny tree was observed in the township, but a positive identification could not be made as it did not flower or fruit.

Didiplis diandra – Water purslane – Adventive

This was a "what is that?" plant for the surveyors when they found it growing with snailseed pondweed in a shallow pond/depression at the old Sonoco industrial site. A member of the loosestrife family, it is a mid-western species, reported once in Virginia, but never before in PA. This is an inconspicuous plant, and may be overlooked, but how it got into a temporary pond in southeastern PA far out of its native range is a mystery.

Galium pedemontanum – Piedmont bedstraw – Alien

This is a rare alien in Pennsylvania, only seen twice before in the state by the surveyors, in York County and more recently in Tredyffrin Township, Chester County. It is a ruderal species and does not appear to be a threat, but it may be extending its range.

Lapsana communis – Nipplewort – Alien

Nipplewort, an inconspicuous plant of moist to dry roadsides, is fairly frequent in East Bradford and eastward, but is uncommon westward in Chester County.

Malus coronaria – Crabapple

Our native crabapple, already an uncommon species by the 1940's, has become even rarer with both the takeover of its preferred habitat, hedgerows and edges, by non-native hybrids, multiflora rose, autumn olive, and other woody invasives. A single plant of what might have been this species was seen, but no positive ID could be made.

Monarda fistulosa – Wild bergamot – CC=4

Wild bergamot was once considered frequent in Chester County (Stone, 1945) and northern Delaware (Tatnall, 1946), but has become rare. The only confirmed site in East Bradford was obviously introduced. Three sites where it may occur naturally were seen too early in the season to positively identify (flowers and fruits are necessary), and were either not revisited at the proper time or the populations were sterile.

Prunus americana - American wild plum – CC=5

Our native plum is another species once considered frequent that has vanished throughout much of its range. Only one confirmed specimen of this shrub exists in the entire county, and it is under threat by succession. Two small potential populations of this species were observed in the township, one on the west bank of Copeland School Road, the other on the north side of the Plum Run Marsh, but neither flowered or fruited, leaving their identity a mystery.

Rubus pascuus (?) a blackberry

This very stout heavily-armored and aggressive blackberry of uncertain identification (or origin) was seen in three places in the northern part of the township, twice in planted meadows, which leaves some questions about how it got there. It should be watched carefully, as it has already taken over large portions of Valley Forge National Historical Park.

Rumex altissimus –Pale dock – CC=6

In this area pale dock is only found along the banks of the lower Brandywine. It was seen once in the township at the confluence of the east and west branches, and earlier on the west branch in Pocopson Township. Apparently it does not go any farther upstream on the east branch, or its habitat has been destroyed.

Prenanthes trifoliolata – Gall-of-the-earth – CC=7

Prenanthes species can only be identified by flowers or seeds, as the leaves are variable in shape, especially on young plants. However, many plants do not flower, and larger plants often grow on roadbanks, where they are subject to mowing. Potential members of this species were seen twice but never confirmed.

EXCEPTIONAL NATURAL AREAS

An Exceptional Natural Area (ENA) is defined as an area composed of relatively intact, species rich, native plant dominated communities. ENAs are reservoirs of biodiversity. They may contain more than one type of plant community, including woodland, meadow, and wetland, and can vary widely in size and configuration. ENAs may also contain managed landscapes including occasionally mowed or grazed meadows or utility cuts which exhibit one or more of the characteristics noted below, and which would disappear without continued management or human intervention. The following are some biological community characteristics used to locate and determine ENAs in East Bradford Township:

- Communities containing species uncommon or declining in the township, region, or state.
- Communities that are unusually rich and diverse examples of characteristic plant communities in the township, or are the only remaining examples of these communities in the township.
- Communities that reflect unusual or regionally uncommon geologic features or structures
- Communities with a high number of species with limited ranges of ecological tolerance, or high degree of fidelity to narrow ranges of habitat condition, indicating a specialized or long-established community (Coefficient of Conservatism of 7 or greater).

Starting in the late 1970's two professors in the Chicago area developed and expanded a method for evaluating natural areas for quality and environmental integrity. Several years ago Bowman's Hill Wildlife Preserve adapted this method for use in Pennsylvania. The first and most important step in this method is to assign a Coefficient of Conservatism (CC) to every native plant found in the specified region. Bowman's Hill, in consultation with regional botanists, created lists of species with CC's for southeastern PA, which is available on their website: www.bhwp.org

The criteria for assigning coefficients are:

- 0 to 3 Plants with a high range of ecological tolerances, found in a variety of communities
- 4 to 6 Plants with an intermediate range of ecological tolerances, usually associated with a specific plant community
- 7 to 8 Plants with a narrow range of ecological tolerances or associated with an advanced stage of plant community succession
- 9 to 10 Plants with a high degree of fidelity to a narrow range of habitats

Species with a CC of 7 or greater are used as indicators of high quality habitat and potential Exceptional Natural Areas (see *Appendix 3 - Species with a Coefficient of Conservatism of 7 or Greater*).

In East Bradford Township, 28 ENAs were identified during this survey (see maps 3, 4 or 5 for ENA locations). Their approximate size ranges from less than one acre to well over 100 acres, with an average size of about 15 acres each (see table below). Most of the areas are wooded, although many sites are mixed and there are wetland and meadow ENAs as well. It is well worth noting that, although many ENAs are legally protected either by conservation ownership or conservation easement, they still need active management of especially invasives and deer to maintain their high quality condition. New sources of erosion or pollution, modification to site hydrology, climate change impacts, new utility corridor projects, potentially even new trails, the recreating public or certain adjacent land uses may also affect them adversely. Ideally, all would receive nurturing management and monitoring.

Due to time and accessibility constraints not all parts of the township were thoroughly surveyed, so some areas that might qualify as ENAs were probably not observed. Woods that existed in the 1937 aerial photo

should also receive preservation priority, even if they are not designated as ENAs (see Map 4 for ENAs superimposed on a 1937 aerial of the Township).

East Bradford Exceptional Natural Areas			
I.D. Number	**Acreage**	**I.D. Number**	**Acreage**
1	131.2	15	5.9
2	2.3	16	1.8
3	17.0	17	10.7
4	2.3	18	17.2
5	9.4	19	2.4
6	5.0	20	0.4
7	4.6	21	11.6
8	34.8	22	63.4
9	3.0	23	17.8
10	1.8	24	1.4
11	27.4	25	0.8
12	1.1	26	23.7
13	3.6	27	13.7
14	12.6	28	2.2
		Total	**428.9**

1. HARMONY HILL BRANDYWINE SLOPES

Following an old fault, the Brandywine has carved a straight deep valley through North Valley Hill. The rocky sides of the gorge have been further dissected by small streams into narrow side valleys. Upper slopes, especially in the south, host chestnut oak-heath forest, with sizable amounts of mountain laurel, which downslope grade into more mesic oak-beech woods; the side valleys are mostly canopied by tulip shading thorn-choked slopes. Closer to the Brandywine several rocky slopes above the old trolley cut have small stands of native hemlock along with a few spring seeps. In the north the edges of and phone cuts near the old Downingtown water works are home to patches of dry upland meadow and thin woods. The two sections of the ENA are split by an overgrown stream corridor draining a former industrial site.
Section 1 Township owned - Harmony Hill Nature Area, and privately owned
DRAINAGE: East branch Brandywine GEOLOGY: Peters Creek schist
APPROX. SIZE: 131.2 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq. PA Rank
Actaea pachypoda	Wooded ravines	7	2
Crysosplenium americanum	Wooded seeps	7	3
Diphasiastrum digitatum	Barrens, dry woods	5	4
Epigaea repens	Dry banks	7	3
Floerkea proserpinacoides	Floodplain woods	4	2
Goodyera pubescens	Rocky woods	6	3
Lycopodium hickeyi	Open woods	7	3
Melampyrum lineare	Dry woods	7	3
Pteridium aquilinum	Barrens, dry edges	4	3
Pyrola elliptica	Rich woods	6	1
Sceptridium dissectum	Rich woods	3	1
Tsuga canadensis	Cool woods	6	3

2. HARMONY HILL SONOCO BARREN

This former industrial site (Sonoco Paper), had its soil cleaned off down to bedrock. A unique mix of native successional species has grown up on the site on dry sandy areas interspersed with poorly drained clay-lined depressions. An attempt to revegetate the lower portion of the site has resulted in a weedy mix of alien shrubs and cool-season grasses, and coarse herbs. The site is being swallowed by autumn olive.
Section 1 Township owned - Harmony Hill Nature Area
DRAINAGE: East branch Brandywine GEOLOGY: Peters Creek schist
APPROX. SIZE: 2.3 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Andropogon gyrans	Dry fields, meadows	6	4	PR
Antennaria neodioica ssp. neod.	Barrens, dry edges	3	3	
Aristida dichotoma v. dichotoma	Barrens, dry edges	0	3	
Betula populifolia	Dry upland edges	2	2	
Desmodium marilandicum	Dry edges, fields	5	1	
Didiplis diandra	Muddy puddles	NA	1	
Eupatorium altissimum	Waste ground	NA	2	
Hypericum gentianoides	Barrens, dry edges	4	3	
Potamogeton diversifolius	Streams, stagnant water	4	1	
Solidago bicolor	Dry meadows	6	5	
Spiranthes cernua	Poorly drained soil	6	4	
Strophostyles helvola	Dry edges	4	1	

3. PARADISE FARM CAMP YOUNG WOODLANDS

Two adjacent ravines draining southeast into Valley Creek have similar young maple-oak woods on their western slopes. The mid-slopes are not dominated by aliens and have large patches of club mosses and other native early to mid-successional species. Occasional spring seeps along the rock-filled watercourses are home to a specialized flora.
Section 2 Privately owned - Paradise Farm Camps
DRAINAGE: Valley Creek GEOLOGY: Peters Creek schist
APPROX. SIZE: 17.0 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Chamaelirium luteum	Rich woods	8	2	
Danthonia compressa	Dry woods	7	3	
Diphasistrium digitatum	Dry young woods	5	4	
Goodyera pubescens	Rich woods	6	3	
Hydrocotyle americana	Spring seeps	7	1	
Isotria verticillata	Dry woods	7	1	
Lonicera sempervirens	Dry woods	5	2	
Lycopodium hickeyi	Dry young woods	7	3	
Lycopodium obscurum	Dry open woods	5	5	
Thalictrum dioicum	Rich woods	6	3	

4. PARADISE FARM CAMP SOUTH RAVINE

Near the mouth of the most southerly stream draining Paradise Farm Camp a wooded streamside seep hosts a small population of netted chain fern, a state rarity. Just north of the stream the land rises abruptly, forming a spectacular nearly vertical face plunging straight down into Valley Creek. Above the cliff and on the slope down to the stream is a remnant oak-heath mix woodland that has been mostly stripped by deer, with occasional uncommon species present near and on rock outcrops where they are somewhat protected from browsing.
Section 2 Privately owned - Paradise Farm Camp
DRAINAGE: Valley Creek GEOLOGY: Peters Creek schist
APPROX. SIZE: 2.3 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Carex gracillima	Moist woods	5	2	
Lonicera sempervirens	Dry woods & banks	5	2	
Muhlenbergia sobolifera	Dry wooded slopes	5	2	
Solidago ulmifolia	Dry woods, edges	6	5	
Woodwardia aerolata	Wet woods	8	1	PT

5. SOUTH VALLEY HILL RIDGE AND RAILROAD CUT

East of Boot Road near the crest of South Valley runs an old railroad bed in a deep cut. Much of the railroad bed is overgrown by a mixture of alien shrubs and drought-tolerant grasses and herbs, and the extremely steep cliff-like north side of the cut is relatively barren and festooned with vines and creepers, with some less common herbs growing out of cracks. North of this cut and overlooking it is a narrow strip of open dry oak woods. Although infested with Amur honeysuckle, this dwarfed woodland is home to a variety of uncommon herbs, several not found elsewhere in the township.

Section 3 Privately owned
DRAINAGE: Valley Creek GEOLOGY: Peters Creek schist
APPROX. SIZE: 9.4 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Baptisia tinctoria	Dry edges, openings	7	2	
Boechera laevigata	Dry woods	7	3	
Boechera canadensis	Dry woods & banks	5	1	
Calystegia spithamea	Dry meadows	4	1	
Carex tonsa	Dry ground	7	1	SP
Comandra umbellata	Dry woods, edges	7	2	
Galium pilosum	Dry ground	5	2	
Lespedeza capitata	Dry meadows, edges	6	2	
Paronychia fastigiata	Dry ground	7	3	
Populus tremuloides	Dry upland edges	4	1	
Pteridium aquilinum	Dry open woods, edges	4	3	
Rosa carolina	Dry fields, edges	5	3	
Quercus ilicifolia	Dry edges, barrens	8	3	

6. PARADISE VALLEY/VALLEY CREEK MITIGATION WETLANDS

These wetlands along both sides of Valley Creek between Ravine Road and Paradise Valley Nature Area were created to mitigate for wetlands destroyed by the Rt. 30 bypass. Over time some of these wetlands have been taken over by giant reed, especially in the south (Township owned, and not of ENA quality), while others are threatened by invasions of purple loosestrife and black alder. Despite the artificial nature of these wetlands a surprising amount of natives has either survived, survived introduction, or naturally spread into them, especially northward.

Section 4 Privately owned - Paradise Farm Camp
DRAINAGE: Valley Creek GEOLOGY: Peters Creek schist
APPROX. SIZE: 5.0 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Carex debilis	Moist woods	6	2	
Carex hystricina	Wetlands	8	1	
Cyperus erythrorhizos	Wet ground	3	2	
Cyperus odoratus	Wet ground	3	1	
Heteranthera reniformis	Streambanks, rivulets	4	4	
Mimulus alatus	Streambanks, rivulets	6	5	
Saururus cernuus	Wetlands	7	1	
Scirpus atrovirens	Marshes	4	4	
Sparganium eurycarpum	Open wetlands	8	2	

7. PARADISE VALLEY NATURE AREA SOUTH

At the south edge of Paradise Valley Nature Area a steep ridge and protruding rock outcrop support a number of uncommon plants. Richer habitat continues upslope along the edge of a planted meadow and in a wet edge and old road in the nature area.
Section 4 Township owned - Paradise Valley Nature Area, and Privately Owned
DRAINAGE: Valley Creek GEOLOGY: Peters Creek schist
APPROX. SIZE: 4.6 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Carex communis	Dry woods	5	1	
Carex planispicata	Dry woods	9	3	SP
Cerastium nutans	Dry wooded banks	5	2	
Epigaea repens	Dry woods	7	3	
Dichanthelium boscii	Dry woods	5	5	
Lechea pulchella	Dry edges	6	2	
Lespedeza intermedia	Dry fields, edges	4	4	
Huperzia lucidula	Rich woods	6	1	
Polemonium reptans	Floodplain woods	6	5	
Solidago ulmifolia	Dry woods, edges	6	5	
Thalictrum dioicum	Rocky rich woods	6	3	
Trichophorum planifolium	Dry rich woods	6	5	

8. SUGAR BRIDGE NATURE AREA AND R.O.W.

The floodplain and slope above the Brandywine south of Harmony Hill Road is home to a wide variety of specialized habitats. The floodplain near Harmony Hill Road has a meadowy area, partly open to shady wetlands, an old pond, and a dry open sandy disturbed edge with a grove of oak saplings partly shading a grass-dominated flora full of uncommon low-growing herbs. Farther south, a powerline R.O.W. has both meadow and xeric habitats. A rock outcrop looming over the Brandywine has unusual ferns growing on its lower edge and an open dry woods community on top.
Section 5 Township owned – Sugar Bridge Nature Area, and powerline R.O.W.
DRAINAGE: East branch Brandywine GEOLOGY: Peters Creek schist
APPROX. SIZE: 34.8 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Asplenium trichomanes	Large rock outcrops	8	1	
Arisaema dracontium	Floodplain woods, edges	7	2	
Boechera laevigata	Rich woods	7	3	
Callitriche heterophylla	Sloughs, vernal pools	5	1	
Carex muhlenbergii	Dry banks, edges	5	1	
Carex tonsa	Dry banks, woods	7	1	SP
Cephalanthus occidentalis	Wetlands	7	3	
Comptonia peregrina	Dry edges	7	1	
Danthonia compressa	Dry woods	7	3	
Dichanthelium latifolium	Dry woods	5	2	
Dichanthelium polyanthes	Edges	8	1	SP
Diodia teres	Dry ground	6	1	
Epigaea repens	Dry woods, banks	7	3	
Eragrostis hypnoides	Vernal puddles	7	1	
Glyceria septentrionalis	Vernal pools	6	1	
Hypoxis hirsuta	Woods, edges	5	1	
Krigia virginica	Dry ground	6	1	
Lechea pulchella	Dry ground	6	2	
Lechea racemulosa	Dry ground	7	1	

Lespedeza procumbens	Dry ground	4	1	
Lespedeza repens	Dry ground	4	1	
Lycopodium clavatum	Dry edges	7	1	
Nuttallanthus canadensis	Dry ground	7	2	SP
Ostrya virginiana	Woods	6	3	
Paronychia fastigiata	Dry ground	7	3	
Quercus stellata	Dry woods	7	2	
Scutellaria elliptica	Rich dry woods	6	3	
Scutellaria integrifolia	Low meadows	5	2	
Viburnum lentago	Moist woods	5	1	

9. VALLEY CREEK ROAD WOODS

Along and above Valley Creek north of Sunset Hollow Road is a stretch of dry open youngish oak woods facing Valley Creek. This strip, with a steep dry roadbank cut by a phone line, possesses one of the richest assemblages of dry rich woods and edges species in the township, including several rarities not seen elsewhere.

Section 6A Privately owned
DRAINAGE: Valley Creek GEOLOGY: Peters Creek schist
APPROX. SIZE: 3.0 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Endodeca (Aristolochia) serpentaria	Dry woods, edges	6	1	
Aureolaria virginica	Dry woods	6	1	
Cardamine parviflora v. arenicola	Dry woods	6	1	
Cunila origanoides	Dry woods	6	5	
Dichanthelium latifolium	Dry woods	5	2	
Eurybia macrophylla	Rocky rich woods	5	2	
Ipomoea pandurata	Dry fields, edges	4	2	
Lespedeza intermedia	Dry fields, edges	4	4	
Paronychia canadensis	Dry woods, edges	6	6	
Scrophularia lanceolata	Dry woods, edges	6	3	
Solidago arguta v. arguta	Rocky rich woods	6	6	
Solidago ulmifolia	Dry woods, edges	6	5	
Trichophorum planifolium	Dry woods	6	5	

10. SUNSET HOLLOW PARK WETLAND

The eastern portion of Sunset Hollow Park is perhaps East Bradford's best example of a small stream wetland complex, with red maple above and spicebush and skunk cabbage below as the dominant species. Although overrun by lesser celandine in spring and stilt-grass and long-bristled smartweed later in the season, this swamp still retains a wide diversity of wetland ferns, herbs, sedges, and shrubs. Scattered specimens of plants typically found in more open wetlands indicate this site was once an open marsh

Section 6A Township owned – Sunset Hollow Park
DRAINAGE: Broad Run GEOLOGY: Peters Creek schist
APPROX. SIZE: 1.8 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Alnus serrulata	Marshes, swamps	7	4	
Cardamine bulbosa	Seeps, wetlands	6	6	
Dryopteris cristata	Wetlands	6	4	
Lobelia cardinalis	Wetlands	6	1	
Osmunda cinnamomea	Wet woods, swamps	5	5	
Osmunda regalis	Wet woods	7	2	
Pilea fontana	Wooded seeps	8	4	
Quercus bicolor	Wet woods	7	4	

Rosa palustris	Wetlands	7	4
Rubus hispidus	Wet woods	6	2
Sparganium americanum	Marshes, swamps	7	5

11. SUNSET HOLLOW WOODS AND POWERLINE CUT

The section of powerline southwest of the junction of Copeland School and Sunset Hollow Roads contains the finest and largest example of scrub shrub heathland in the township. The view from the west down the open boulder slope towards Copeland School is spectacular, especially in early autumn when the huckleberries are turning color. Breaks in the shrub cover are home to clubmosses, uncommon grasses, sedges, and numerous unusual herbs including the only township population of birds'-foot violet. A wet seepage slope downslope from a promontory is home to sphagnum and violets. Jutting out from the side of one outcrop is a large specimen of bear oak *(Quercus ilicifolia)*.

Section 6B Privately owned
DRAINAGE: Broad Run GEOLOGY: Peters Creek schist
APPROX. SIZE: 27.4 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Asclepias tuberosa	Dry fields, meadows	6	4	
Baptisia tinctoria	Barrens, dry edges	7	2	
Bulbostylis capillaries	Barrens, dry edges	4	3	
Carex lucorum	Barrens, dry edges	6	1	
Carex tonsa	Barrens, dry edges	7	2	SP
Dichanthelium depauperatum	Dry woods & edges	5	4	
Diphasiastrum digitatum	Barrens, dry edges	5	4	
Eupatorium hyssopifolium	Barrens, dry edges	4	1	
Galium pilosum	Barrens, dry edges	5	2	
Hypericum gentianoides	Barrens, dry edges	4	3	
Lechea pulchella	Barrens, dry edges	6	2	
Lespedeza capitata	Barrens, dry edges	6	2	
Lycopodium hickeyi	Dry open woods	7	3	
Lycopodium obscurum	Dry open woods	5	5	
Melampyrum lineare	Dry woods & edges	7	3	
Nuttallanthus canadensis	Barrens, dry edges	7	2	
Paronychia fastigiata	Dry woods & edges	7	3	
Quercus ilicifolia	Barrens, dry edges	8	3	
Rhus copallina	Barrens, dry edges	4	2	
Rubus hispidus	Swamps, boggy pockets	6	2	
Viola fimbriatula	Dry woods & edges	7	2	
Viola pedata	Barrens, dry edges	8	1	
Viola primulifolia	Wet boggy pockets	6	2	

12. BROAD RUN MARSH

This small stretch of open marsh and meadow east of Copeland School Road under the powerline contains a good diversity of sedges and tall herbaceous species. The edges are currently growing in, but powerline maintenance will keep woody species in check. Eastward the wetland and meadow grade into a patchy mosaic of thickets and disturbed meadows, the latter planted in meadow species presumably as part of a reclamation or mitigation project.

Section 7 Privately owned - PECO
DRAINAGE: Broad Run GEOLOGY: Peters Creek schist
APPROX. SIZE: 1.1 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Carex crinita	Marshes, swamps	5	8	
Eutrochium dubium	Marshes, wet meadows	6	5	

Rhynchospora capitellata	Meadows, wet edges	8	1
Rosa palustris	Marshes	7	4
Thelypteris palustris	Marshes	5	8

13. SUNSET HOLLOW ROAD EAST / GREEN COUNTRIE ROADBANK

This small stretch of woods along Sunset Hollow between Copeland School Road and Green Countrie Lane, especially in the east, is an outstanding example of open dry oak-heath woodland. Large stretches of roadbank, partly protected from browsing by a wire fence separating it from the forest interior, are composed of heaths. Both the roadbank and the more open interior support considerable quantities of less common herbs, including sizable populations of bastard toadflax and cow-wheat.
Section 7 Privately owned
DRAINAGE: Broad Run GEOLOGY: Peters Creek schist
APPROX. SIZE: 3.6 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq. PA Rank
Cerastium nutans	Dry wooded roadbank	5	2
Comandra umbellata	Dry wooded roadbank	7	2
Hieracium venosum	Dry open woods	6	5
Ipomoea pandurata	Dry wooded roadbank	4	2
Melampyrum lineare	Dry wooded roadbank	7	3
Solidago bicolor	Dry wooded roadbank	6	5
Trichophorum planifolium	Dry woods	6	5
Viola sagittata v. sagittata	Dry woods & edges	6	8

14. INGRAMS MILL / CREEK ROAD WOODED SLOPE AND SWAMP

Opposite Ingrams Mill is a scenic stretch of boulder-strewn woods above the road whose steep slopes and scenic rock outcrops have become a refuge for a number of less common rocky rich woods species. Further north towards Route 322 is a separate stretch of moderately steep and dry open oak mix woodland with a scattering of less common dry woodland and edge herbs and shrubs. North of the Ingrams Mills parking lot is a swampy low woods that hosts several uncommon floodplain wetland plants; south of Ingrams Mills, below the road, is a strip of floodplain woods and low wooded slope with yet more floodplain specialists.
Section 9 Privately owned – Natural Lands Trust and Ingram's Mill Nature Area
DRAINAGE: East branch Brandywine GEOLOGY: Doe Run schist
APPROX. SIZE: 12.6 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq. PA Rank
Boechera laevigata	Rocky slopes & outcrops	7	3
Carex grisea	Floodplain woods	7	8
Carex lupulina	Floodplain swamps	7	7
Carex torta	Streambanks	7	2
Cunila origanoides	Dry open woods	6	5
Dicentra cucullaria	Rich wooded slopes	7	5
Eurybia schreberi	Rich wooded slopes	5	4
Mertensia virginica	Floodplain woods	7	10
Peltandra virginica	Floodplain swamps	6	2
Ranunculus caricetorum	Swamp buttercup	7	1
Rosa carolina	Dry edges, roadbanks	5	3
Scrophularia lanceolata	Dry woods, edges	6	3
Scutellaria elliptica	Dry open wods	6	3
Sedum ternatum	Floodplain woods	7	1
Silene stellata	Rocky rich woods	6	9
Solidago arguta v. arguta	Rocky rich woods	6	6
Solidago ulmifolia	Dry woods, edges	6	5

Symphyotrichum undulatum	Barrens, dry edges	6	2
Thalictrum dioicum	Rocky rich woods	6	3
Vaccinium stamineum	Dry woods	7	9

15. JANE REED PARK

This small sliver of woodland tucked between Route 322 and Frank Road is a good example of rich upland woods on Baltimore gneiss. The steep roadbank and phone cut along Frank Road provides additional habitat for woodland edge species. The park has some aliens including a number of ornamental escapes, but may have been spared heavy deer traffic because of its location and frequent foot traffic.
Section 10 Township owned
DRAINAGE: East branch Brandywine GEOLOGY: Baltimore gneiss
APPROX. SIZE: 5.9 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Agastache nepetoides	Rich edges	4	3	
Anemone americana	Rich woods	5	5	
Phegopteris hexagonoptera	Rich woods	6	2	
Thalictrum dioicum	Rich woods	6	3	
Veronicastrum virginicum	Rich woods, edges	8	2	

16. MARSHALLTON SERPENTINE BARREN

Despite recent burning this small but notable serpentine barren is being overgrown with pasture grasses and species that threaten its diversity. Nonetheless it still retains most of its barrens flora, including five state-listed species.
Section 11 Privately owned – Natural Lands Trust Stroud Preserve
DRAINAGE: East branch Brandywine GEOLOGY: Serpentinite
APPROX. SIZE: 1.8 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Arabidopsis lyrata	Serpentine barrens	8	3	
Asclepias verticillata	Serpentine barrens	9	1	
Bouteloua curtipendula	Serpentine barrens	9	1	PT
Cerastium velutinum var. velutinum	Serpentine barrens	9	2	SP
Cyperus lupulinus	Dry fields barrens	3	2	
Dichanthelium oligosanthes	Serpentine barrens	7	2	PT
Dichanthelium sphaerocarpon	Barrens, dry edges	4	2	
Fimbristylis annua	Serpentine barrens	9	2	PT
Juncus secundus	Barrens	6	3	
Phemeranthus teretifolius	Serpentine barrens	10	2	PT
Polygonum tenue	Serpentine barrens	7	2	
Sabatia angularis	Serpentine barrens	7	2	
Scleria pauciflora	Serpentine barrens	8	2	PT

17. STROUD PRESERVE WOODED VALLEY

This is another good example of rich older wooded slopes on gneiss with a relatively alien-free shrub layer and forest floor.
Section 11 Privately owned – Natural Lands Trust Stroud Preserve
DRAINAGE: East branch Brandywine GEOLOGY: Baltimore gneiss
APPROX. SIZE: 10.7 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Agrimonia pubescens	Rich woods	4	4	
Eurybia schreberi	Rich wooded slopes	5	4	

Thalictrum thalictroides	Rich wooded slopes	6	6

18. MIDDLE BRANDYWINE WOODLAND/FLOODPLAIN COMPLEX

This rich rocky wooded lower slope is a classic example of Brandywine slope forest, with an oak-mix canopy and understory, a thin spicebush-maple-leaved viburnum shrub layer, and an enormous variety of herbs, grasses, and sedges. The upper slopes of the woods have been heavily browsed by deer, but still retain some diversity, including a huge population of the state-listed sedge *Carex jamesii*. On the floodplain the Brandywine has several channels lined with gravel bars. The island in the Brandywine has become overrun by non-natives, but again retains some of its native flora. The floodplain woodland on the east side of the Brandywine by Creek Road is less compromised and has a greater diversity of floodplain forest specialists.

Section 13 Privately owned, conservation easement
DRAINAGE: East branch Brandywine GEOLOGY: Baltimore gneiss
APPROX. SIZE: 17.2 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Adiantum pedatum	Rich woods	6	1	
Anemone americana	Rich woods	5	5	
Carex gracilescens	Low moist woods	4	2	
Carex grisea	Floodplain woods	7	8	
Carex jamesii	Rich woods	7	2	SP
Carex lupulina	Floodplain swamps	7	7	
Ceratophyllum demersum	Sloughs	6	2	
Desmodium glutinosum	Rich wooded slopes	5	3	
Dicentra cucullaria	Rich wooded slopes	7	5	
Eutrochium purpureum	Rich wooded slopes	5	3	
Galearis spectabilis	Rich woods	6	1	
Lilium canadense	Rich woods	6	1	
Mimulus alatus	Wooded streambanks	6	5	
Mitella diphylla	Wooded banks	8	1	
Nuphar advena	Sloughs, ponds	7	3	
Obolaria virginica	Rich woods	7	1	
Phegopteris hexagonoptera	Rich woods	6	2	
Poa autumnalis	Low woods	7	1	PE
Poa cuspidata	Rich wooded slopes	6	3	
Podostemum ceratophyllum	Rocky streams	6	2	SP
Polemonium reptans	Floodplain woods	6	5	
Trillium cernuum	Rich woods	6	1	PT
Scirpus expansus	Marshes, streambanks	6	2	
Symphyotrichum prenanthoides	Floodplain woods	6	3	
Stellaria alsine	Seeps, gravel bars	6	2	
Symphyotrichum prenanthoides	Stream banks	6	3	
Viola blanda	Rich woods	5	2	
Veratrum viride	Floodplain woods	6	2	

19. CREEK ROAD ROADBANK

The steep rocky roadbank along Creek Road opposite Harry Waite Nature Area is home to a quality diversity of showy Brandywine Slope and floodplain species. Unfortunately the high-quality habitat does not extend into the nature area, which has been overrun by lesser celandine.

Section 14 Privately owned
DRAINAGE: East Br. Brandywine GEOLOGY: Baltimore gneiss
APPROX. SIZE: 2.4 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank

Tradescantia virginiana	Floodplain woods, banks	4	2
Mertensia virginica	Rich wooded slopes	7	10
Dicentra cucullaria	Rich wooded slopes	7	5
Poa cuspidata	Rocky wooded slopes	6	3
Solidago bicolor	Dry wooded banks	6	5

20. MINER STREET WETLAND

A tiny seepage wetland by a silted-up pond is still has a good assemblage of wet meadow / wetland species.
Section 14 Township owned
DRAINAGE: Black Horse Creek GEOLOGY: Baltimore gneiss
APPROX. SIZE: 0.4 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Juncus marginatus	Wet meadows	3	2	
Scirpus expansus	Wetlands	6	2	
Spiranthes cernua	Wet meadows	6	4	

21. ALLERTON ROAD WOODS

This upland forest has a nice variety of rich upland woodland species typically found growing on Baltimore gneiss. Notable also for its size in a portion of the township with few quality woodlands along with a relative lack of alien invasives.
Section 16 Privately owned, conservation easement
DRAINAGE: East branch Brandywine GEOLOGY: Baltimore gneiss
APPROX. SIZE: 11.6 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Agrimonia pubescens	Rich woods	4	4	
Sanicula trifoliata	Rich woods	5	2	
Brachyelytrum erectum	Rocky rich woods	5	4	
Carex davisii	Wooded roadbank	7	3	SP
Carex striatula	Rich woods	6	5	SP

22. SHAWS BRIDGE NORTH BRANDYWINE SLOPE WOODS & MEADOWS (Rt 842)

Much of the wooded uphill side of this long stretch of ENA along Route 842 has almost no shrub layer, but a carpet of native herbs, especially spring ephemerals. The roadbank , with more light and fewer deer, is more diverse. Below Rt. 842 is a sweeping field / meadow that varies from dry to wet as it approaches the Brandywine, with several old sloughs near the bottom.
Section 17 Privately owned
Section 20 Privately owned, Brandywine River Estates open space
DRAINAGE: East branch Brandywine GEOLOGY: Baltimore gneiss
APPROX. SIZE: 63.4 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Anemone americana	Rich wooded slopes	5	5	
Anemone quinquefolia	Low moist woods	5	4	
Asclepias incarnata v. incarnata	Marshes, wet meadows	4	9	
Asclepias incarnata v. pulchra	Marshes, wet meadows	4	6	
Bromus pubescens	Rich wooded slopes	5	2	
Carex grisea	Floodplain woods	7	8	
Carex lupulina	Floodplain sloughs	7	7	
Carex planispicata	Rich wooded slopes	9	3	SP
Cephalanthus occidentalis	Marshes	7	3	
Cuscuta campestris	Open streambanks	6	3	PT

Dicentra cucullaria	Rich wooded slopes	7	5
Erigeron pulchellus	Rich open wooded slopes	3	2
Eutrochium purpureum	Rich wooded slopes	5	3
Heteranthera dubia	Streams, flowing water	6	1
Mertensia virginica	Floodplain woods	7	10
Muhlenbergia sobolifera	Rocky rich woods	5	2
Ostrya virginiana	Rocky rich woods	6	3
Paronychia canadensis	Dry woods & edges	6	6
Poa cuspidata	Rocky rich woods	6	3
Poa sylvestris	Rich wooded slopes	4	6
Podostemum ceratophyllum	Rocky flowing water	6	2
Scutellaria elliptica	Dry open woods	6	3
Solidago nemoralis	Dry wooded roadbanks	6	5
Veronicastrum virginicum	Dry wooded roadbanks	8	2
Zizia aptera	Dry wooded roadbanks	7	1

23. SHAW'S BRIDGE SOUTH FLOODPLAIN WETLAND COMPLEX

The floodplain of the Brandywine from the confluence of the two branches to Lenape is broad and contains extensive stretches of wetland. Sedimentation and nutrient loading tend to degrade such wetlands and leave them vulnerable to invasion by reed canary grass and purple loosestrife. High-quality habitat still exists from the shallow pond at the southern end of Shaw's Bridge Park to the end of the wetlands in back of the athletic fields. The first stretch of wetland, in the park, is a seasonally flooded open pond, with wetland grasses and herbs, a large quantity of bur-reed, and a few buttonbushes. South across Cottage Lane is an older scrub-shrub marsh dominated by scattered large old willows shading a relatively permanent pond dotted by tussock sedges and rimmed by tangles of shrubs. Downstream this pond gives way to path-veined thicket. Yet further south the shrubbery yields to an open floodplain marsh and meadow complex, the centerpiece of which is a more or less permanent pond and ditch that in wet years is lined with wild rice. The south end of the complex is another wet meadow, recently cleared of most of its shrubbery, which is home to a variety of meadow herbs, grasses, and sedges. A red maple thicket and swamp between the western soccer field and the Brandywine is of lower quality and diversity.
Section 19 Township owned park and privately owned
DRAINAGE: East branch Brandywine GEOLOGY: Doe Run schist
APPROX. SIZE: 17.8 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Asclepias incarnata v. incarnata	Marshes, wet meadows	4	9	
Asclepias incarnata v. pulchra	Marshes, wet meadows	4	6	
Campanula aparinoides	Marshes	6	2	
Carex caroliniana	Moist meadows	5	3	
Carex lupulina	Floodplain sloughs	7	7	
Carex pellita	Marshes, wet meadows	7	3	
Carex squarrosa	Floodplain marshes	6	2	
Carex stricta v. strictior	Floodplain marshes	5	3	
Cephalanthus occidentalis	Marshes	7	3	
Cicuta maculata	Marshes, swamps	5	2	
Cyperus erythrorhizos	Marshes, drawdowns	3	2	
Dulichium arundinaceum	Marshes	7	1	
Echinochloa muricata	Marshes, wet meadows	3	1	
Eutrochium dubium	Marshes, wet meadows	6	5	
Galium asprellum	Marshes	5	2	
Heliopsis helianthoides	Meadows	4	4	
Iris versicolor	Marshes	7	1	
Nuphar lutea	Floodplain sloughs	7	3	
Panicum rigidulum	Floodplain marshes	6	1	
Peltandra virginica	Floodplain marshes	6	2	

Pilea fontana	Marshes	8	4	
Pycnanthemum muticum	Meadows	5	1	
Rosa palustris	Marshes	7	4	
Sparganium americanum	Marshes	7	5	
Sparganium eurycarpum	Floodplain marshes	8	2	
Zizania aquatica	Floodplain marshes	8	1	PR

24. SCONNELLTOWN SERPENTINE BARREN

This once extensive barren has been greatly reduced in size by housing development. Fortunately the bulk of the remnant has been maintained by its owner as a serpentine barren. As a result it contains large and healthy populations of a number of state rarities and serpentine specialists, with large and showy displays of wildflowers in spring and early summer.
Section 20 Privately owned
DRAINAGE: East branch Brandywine GEOLOGY: Serpentinite
APPROX. SIZE: 1.4 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Arabis lyrata	Serpentine barrens	8	3	
Cerastium velutinum v. velutinum	Serpentine barrens	9	2	SP
Cirsium pumilum	Dry fields	4	2	
Fimbristylis annua	Serpentine barrens	9	2	PT
Juncus secundus	Barrens, bare ground	6	3	
Lobelia spicata	Dry meadows, serpentine	6	1	
Phlox subulata ssp. subulata	Serpentine barrens	8	1	
Packera anonyma	Serpentine barrens	8	1	PR
Phemeranthus teretifolius	Serpentine barrens	10	2	PT
Polygonum tenue	Serpentine barrens	8	2	
Pycnanthemum tenuifolium	Dry fields	4	1	
Quercus stellata	Dry woods, serpentine	7	2	
Rosa carolina	Dry fields, meadows	5	3	
Sabatia angularis	Serpentine barrens	7	2	
Scleria pauciflora	Serpentine barrens	8	2	PT
Scirpus atrovirens	Wet fields, marshes	4	4	
Sisyrinchium mucronatum	Serpentine, meadows	6	1	
Spiranthes lacera v. gracilis	Serpentine, meadows	7	1	
Symphyotrichum depauperatum	Serpentine barrens	9	1	PT

25. STRODES MILL SERPENTINE OUTCROP

This tiny highly degraded remnant of a serpentine barren, despite physical abuse and being overrun by aliens, especially bluegrass and crown vetch, still retains a small fraction of its original plant community, including a few red cedars. This site would be a worthy restoration project.
Section 20 Privately owned
DRAINAGE: Plum Run GEOLOGY: Serpentinite
APPROX. SIZE: 0.8 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Cerastium velutinum v. velutinum	Serpentine barrens	9	2	SP
Dichanthelium oligosanthes	Serpentine, dry fields	7	2	PT
Symphyotrichum depauperatum	Serpentine barrens	9	1	PT

26. PLUM RUN WEST MARSH

The Plum Run corridor from Strodes Mill to Radley Run Golf Course is an enormous stretch of wet open ground, occasionally interrupted by thickets or hedgerows. Crumbling side walls and traces of old dams

and ditches hint at the origins of this outsized marsh complex, a series of old ponds that silted up over the years and were then abandoned. The east end is dominated by common wetland species such as reed canary grass, goldenrods, and common horse tail. Further west, past the first line of trees, sedges become common, particularly the rhizomatous sedge *Carex trichocarpa*, which forms dense stands. After a small stretch of thickety red maples the wetland opens up again, with more sedges and wetland herbs forming the bulk of the vegetation.

Section 21 Privately owned, open space for Chesterdale Farm
DRAINAGE: Plum Run GEOLOGY: Baltimore gneiss
APPROX. SIZE: 23.7 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Cardamine bulbosa	Marshes, spring seeps	6	6	
Carex lupulina	Sloughs, wet thickets	7	7	
Carex trichocarpa	Marshes	5	7	
Lysimachia terrestris	Marshes	8	1	
Quercus bicolor	Low woods, meadows	7	4	
Scirpus hattorianus	Marshes	4	2	
Sparganium americanum	Marshes, sloughs	7	5	

27. SCHRAMM ESTATE

A sizable open field/meadow dominated by warm-season grasses grades downslope into a dryish open scrub shrub slope above West Miner Street. Although cut with wooded gullies and heavily overgrown by autumn olive, it is still one of the best remaining example of an early successional dry meadow. Without management it will soon become a dense autumn olive thicket with almost no ground vegetation. Overall the woods is ordinary, but it has a few richer pockets and a few uncommon species.

Section 22 Township owned Schramm Estate
DRAINAGE: Black Horse Creek GEOLOGY: Baltimore gneiss
APPROX. SIZE: 13.7 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Andropogon gyrans	Dry fields	6	5	PR
Aralia racemosa	Rich woods	6	1	
Asclepias tuberosa	Dry fields	6	4	
Carex caroliniana	Meadows	5	3	
Carex umbellata	Barrens, dry edges	5	6	
Cirsium pumilum	Dry fields, meadows	4	2	
Dichanthelium depauperatum	Dry woods, edges	5	4	
Fraxinus nigra	Wet woods	7	1	
Viola sagittata v. sagittata	Dry woods & edges	6	8	

28. GORDON NATURAL AREA PLUM RUN WETLAND

Between the low weedy field south of Tigue Road and the wooded floodplain of Plum Run lies an extensive lengthy wet area. The north and center are dominated by cattails and other weedy species, but a narrow strip at the edge of red maple woods has a diverse wetland plant assemblage.

Section 23 West Chester University Gordon Natural Area
DRAINAGE: Plum Run GEOLOGY: Baltimore gneiss
APPROX. SIZE: 2.2 acres

NOTABLE SPECIES	Habitat	CC	Twp. Freq.	PA Rank
Carex bromoides	Swamps	7	1	
Cicuta maculata	Marshes, swamps	5	2	
Dryopteris cristata	Swamps	6	4	
Galium asprellum	Marshes	5	2	
Pilea fontana	Marshes, spring seeps	8	4	

Platanthera lacera	Meadows, wet edges	4	2
Quercus bicolor	Marsh edges, swamps	7	4
Sagittaria latifolia v. pubescens	Marshes, seeps	5	4
Spiranthes cernua	Wet meadows	6	4

PROTECTION AND MANAGEMENT STRATEGIES

When trying to decide how to conserve and protect the natural resources of the township, both plant communities and land functions must be considered. The ENAs contain examples of the best quality habitats and richest plant communities and, where not already preserved, should be the top priorities for preservation. Virtually all lands that are preserved legally, however, need active management to retain their high quality. Surrounding lands that may not have well-developed native plant communities but which function as buffers or connectors might be critical to the long-term health of contiguous ENAs, and should also be protected if possible. Alternatively, they can be the source of invasive aliens and other kinds of disturbance that are detrimental to vulnerable ENAs.

Overall, the outstanding natural features of the township are the serpentinite outcrops and the stream corridors, especially the steep slopes and the large wetlands along the Brandywine. Only one of the three serpentine barrens is now protected, and it is not managed as aggressively as one of the privately owned barrens. The third and smallest barren is privately owned and ignored. Some of the richest areas in the Brandywine corridor are already protected, notably Harmony Hill, Sugar Bridge, and Shaw's Bridge, but there are adjacent lands that are worthy of protection as significant habitats and buffers. There are other stretches, especially along Creek Road and Rt. 842 that have important but unprotected or unappreciated habitat. See Map 5 – Land Status, Exceptional Natural Areas, and Rare Plant Species.

There are other areas in the township besides the designated Exceptional Natural Areas that have significant plant species or communities and are worthy of conversation attention, including both preservation and management. Some of these habitats are undervalued and easily lost by short-sighted management. Some are mapped or included as part of wetlands, woodlands, or riparian buffers, but others are not accounted for. They can be described in rough categories:

- Small wetlands. Wetlands species can be surprisingly resilient, and stream edges, the lower edges of hayfields and pastures, and even ditches can support a diverse native wetlands flora. No wetland should be considered too small for protection, and existing wetlands should be preserved rather than replaced by created wetlands, especially in non-wetland areas. Numerous studies have shown that created wetlands are never as rich in either plant or animal life as naturally-occurring ones.

- Ponds. Ponds, especially shallow ones with fluctuating water tables, usually contain a specialized group of wetland plants growing on their banks and edges, species which often also occur in storm water detention basins and larger stream sand and gravel bars. An unmown or infrequently mown pond edge or detention basin provides habitat for insects and amphibians.

- Floodplain wetlands. All the larger waterways and their tributaries contain stretches of both forested and open floodplain, essential components of a natural flood control system which is increasingly needed with continued development and resultant rapid runoff from hardscapes.

- Meadows. Open areas managed to sustain native grasses and herbs are uncommon in the township. Much more common are pastures and hayfields, especially in the western uplands, and lawns, which are usually extremely sterile habitats. Some of these grasslands, especially in wetter and drier areas, have significant native components that could be encouraged. Esthetic and economic compromises and decisions could easily make parts of these managed habitats more diverse and richer in native species, more resilient under stressful weather conditions, and more easily and cheaply maintained.

- Roadbanks. These infrequently or indifferently managed habitats can support surprisingly rich native plant (and animal) communities, including pockets of dry meadow and woodland edge, the last of which are often richer than adjacent forest interiors. More knowledgeable management could restore dry edge communities which have been nearly eliminated in many places. These communities require less maintenance than close-cut grassy banks and with their variety of plants are more pleasing to the eye.

The biggest threats to all these communities are outright destruction, invasive alien plants, deer, and indifferent or hostile management. The battle with aliens seems unending, but can become less of a war by long-term management plans that emphasize deer control and strengthening native plant communities. Any efforts to manage or restore native plant communities of any size as long as they are kept up or followed through can go a long way towards improving the biological health of the township. It must be emphasized that rescue or restoration, rather than creation of a plant community, should be the preferred strategy for preserving biodiversity; studies have shown that artificial wetlands and other created habitats, even with intensive management, never achieve the richness or diversity of natural plant assemblages. The same is likely true of reforestation efforts, especially in terms of the restoration of the shrub and forb layers, even though a vigorous reforestation campaign is still a well-advised effort for the township to make.

Protection and management of many of these habitats depends on education and cooperation of landowners. Many tracts of older woods in the township, especially in the south have been fragmented and divided into small lots with houses, but generally still have some functioning native plant communities along edges and property lines that are valuable resources for regeneration. Significant plant resources are also found in open spaces of developments controlled by Homeowner Associations that may be unaware of the natural value of the land. Deer and invasive aliens are two of the biggest threats to native plant communities, and education and cooperation are needed to help control them.

- Deer. Fencing, birth control, and hunting are the three main methods used in controlling our native ungulate over-population problem. All have drawbacks, though a regional hunting approach is likely the only viable alternative. Fencing is expensive, since only metal fences erected high enough to keep deer from leaping over them are effective and have the additional drawback of confining deer to smaller areas, with resultant greater devastation to the flora. Birth control has not proven effective except when used in isolated populations, and is also expensive, time-consuming, and requires specialized knowledge and application. Hunting on the present scale has also shown that it cannot control our local deer herds, and in fact may be ironically increasing the population. The only method not yet tried is consistent, sustained, significant herd reduction. The proposed Valley Forge hunt, currently still in litigation, will provide one case study for the effects of this method of control on plant communities.

- Invasives. Many invasive plants such as Japanese honeysuckle and bittersweet have become widespread and thoroughly established, and can only be controlled in small areas by continuous effort. Others, such as lesser celandine buttercup, are thoroughly entrenched in specific habitats such as floodplains but have not yet fully established themselves in less preferred habitats. Still more, including Callery pear and the ornamental viburnums, are just now getting started. Except in isolated instances any major efforts to control invasives should be restricted to more recent or habitat-specific invaders, as this would give the best chance of success. In addition homeowners and businesses should be encouraged to plant only native species for landscaping, since the great majority of our woody invaders, especially the more recent ones, are horticultural escapees. A list of unwanted ornamentals could be made.

The means to control invasives are as varied as the plants themselves. Mechanical means (cutting, girdling) are the preferred methods for shrubs and trees. Spraying is more cost-effective with herbaceous species (although hand-pulling small or isolated populations is preferable), but both drift and non-specificity of sprays have been problems in the past. Biological control has had mixed results. Rose rosette disease, which afflicts multiflora rose, is now established in the area, but although it has seriously weakened local populations of rose it remains to be seen whether this virus will eliminate it. The same goes for the weevil recently introduced to control mile-a-minute and pests brought in for purple loosestrife,

the last of which seem to be less effective this far south. Some biological controls have been counterproductive, such as BT spraying for gypsy moth, which not only does not control that insect but has seriously affected native moths and butterflies and as a result the plants they pollinate. One method that has not been locally tested is fire, which further west has been shown to be effective in reducing the populations of our generally fire-intolerant alien invaders. It must be emphasized when engaging in alien removal that soil disturbance should be kept to a minimum, since freshly broken ground is usually quickly taken over by especially noxious species such as stilt-grass.

Mechanical removal of invasive aliens, especially shrubs and garlic mustard, make good community service projects, but follow-ups should also be planned so the initial effort is not lost. The Sonoco and Schramm properties, both of whom have ENAs under threat by autumn olive, and Jane Reed Park, also afflicted by woody aliens, would be good areas to conduct them. Jane Reed Park, because of its size and proximity to a school, would be ideal for an Adopt-a-Park group.

Several ENAs are in utility R.O.W.s, over which the township has little control. The township could request that the utility inform them of upcoming maintenance and tell the utility about important plant communities.

THE BIG PICTURE

Over the long term the flora of an area is never static, but always adjusting to changes in climate and interactions with animals, insects, diseases, etc. However, since the arrival of Europeans in North America the rate of change has accelerated. The once-most common tree (American chestnut), the once-most common vertebrate (Passenger pigeon), and the once seasonally abundant migratory shad and herring runs are gone, at least functionally so, from the landscape. The trends toward more aliens and fewer natives, both in number of species present and biomass, toward an increase in the number of 'southern' species present are easy to see in the township. A few alien agricultural weeds such as corn cockle *(Agrostemma githago)* and flax dodder *(Linum epithynum)* have disappeared as the result of changing agricultural practices, but they are far outweighed by the newcomers, many not even listed in Stone's Flora. It is hard to know how many natives have already been lost, but those species only seen once or twice in the township and in very low numbers are in danger of local extinction. Only a small number of natives, mainly more southerly species such as cranefly orchid and autumn blue grass, seem to be on the increase.

Despite all the threats, some quite severe, the land area now known as East Bradford Township still sustains an exceptionally rich native flora. Not only do its 902 total species but also its 609 known natives exceed the totals for any other township surveyed in Chester County, including some surveyed over multiple years. There are several reasons for this diversity, both native and exotic. Geology is of course the biggest single reason, with several major rock types, including serpentinite, a globally rare formation, underlying the township. Another is significant portions of the township, due to the foresight of the township and individual landowners, have been protected.

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