USDA Natural Resources
Conservation Service

Ecological site F147XY001PA
Poorly Drained Fine Alluvial Terrace

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General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

MLRA notes

Major Land Resource Area (MLRA): 147X–Northern Appalachian Ridges and Valleys

This area is in the Middle Section of the Valley and Ridge Province of the Appalachian Highlands. It contains folded and faulted parallel ridges and valleys that are carved out of anticlines, synclines, and thrust blocks. The variability of erosion resistance of the underlying bedrock has resulted in resistant sandstone and shale ridges separated by less resistant limestone and shale narrow to moderately broad valleys. The ridges are strongly sloping to extremely steep and have narrow, rolling crests, and the valleys are mainly level to strongly sloping. The western side of the area is dominantly hilly to very steep and is rougher and much steeper than the eastern side, much of which is rolling and hilly. Elevation generally ranges from 330 to 985 feet (100 to 300 meters) in the valleys and from 1,310 to 2,625 feet (400 to 800 meters) on the ridges and mountains. It is as high as 2,955 feet (900 meters) on some mountain crests and is nearly 4,430 feet (1,350 meters) on a few isolated, linear mountain ridges. Local relief in the valleys is about 15 to 165 feet (5 to 50 meters). The ridges rise about 660 feet (200 meters) above the adjoining valleys. This area is underlain by Paleozoic sediments ranging in age from Cambrian to Pennsylvanian(USDA 2006).

Classification relationships

Land Resource Region: S – Northern Atlantic Slope Diversified Farming Region (USDA 2006)
Major Land Resource Area: 147 – Northern Appalachian Ridges and Valleys (USDA 2006)
US Forest Service Ecoregion: 221M Central Appalachian Broadleaf Forest-Coniferous Forest-Meadow Province (USDA/USFS, 2015)

Central Appalachian Floodplain Ecological System - CES202.608. (NatureServe, 2015)
USNVC Natural Vegetation Hierarchy (USNVC, 2015):
M503 Central & Appalachian Swamp Forest Macrogroup
CEGL006497 *Quercus palustris*-*Quercus bicolor*-Carex tribuloides-Carex radiata (Carex squarrosa) Forest Association
M029 Northern and Central Floodplain Forest Macrogroup
CEGL006548 Acer (rubrum, saccharinum) - *Fraxinus pennsylvanica* - *Ulmus americana* / *Boehmeria cylindrica* Forest Association

Pennsylvania: Oak-Mixed Hardwood Palustrine Forest (Zimmerman et. al. 2012).
Red Maple – Elm – Willow Floodplain Forest (Zimmerman et. al. 2012).

Similar forests:
Seasonally wet oak-hardwood woodlands - flat bottomed river valleys, Ohio, Arkansas, and Mississippi (Kennedy and Nowacki 1997);
Pin Oak-Sweet Gum forest - #65 (Eyre 1980);
Pin Oak swamp forests - Illinoian glacial till plains (Braun 1936).

Ecological site concept

The Poorly Drained Fine Alluvial Terrace ecological site includes very deep, poorly drained or very poorly drained soils formed in clayey sediments, primarily of silty clay, silty clay loam, and clay loam textures, and occur on old alluvial terraces. The seasonal high water table occurs within 0 to 12 inches of the soil surface, and supports a wetland oak, mixed hardwood reference vegetation community or sometimes one that is dominated by maple and green ash. Both communities are part of the Central Appalachian River Floodplain System as described by NatureServe (2015), but the ecological relationship between the two vegetation types is unclear.

In most cases these areas are no longer part of an active floodplain but are subject to seasonal inundation by surface water and some groundwater. The forest understory can be relatively clear, or may host a dense population of plants in the sapling, shrub, and herbaceous strata. The more light on the canopy floor, the denser the understory vegetation.

Associated sites

F147XY007PA	**Loamy To Coarse Terrace** Loamy to Coarse Terrace

Similar sites

F147XY011PA	**Poorly Drained Fine Mixed Floodplain** Poorly Drained Fine Mixed Floodplain

Table 1. Dominant plant species

Tree	(1) *Quercus palustris* (2) *Quercus bicolor*
Shrub	Not specified
Herbaceous	(1) *Carex bromoides* (2) *Carex squarrosa*

Physiographic features

The ecological site includes areas of Purdy soils which are slack water-deposited alluvial materials on old terraces within the valley landscapes. The alluvial material is derived from sandstone, siltstone, shale, and limestone. Slopes range from 0 to 3 percent. Generally, these areas are no longer part of an active floodplain but are subject to seasonal inundation by surface water and some groundwater. In some areas, they may flood rarely. The landforms commonly occur as linear or concave surface shapes on nearly level slopes. In some cases this ecological site occurs on sinkhole ponds thought to have formed by solution or collapse of underlying bedrock strata.

Table 2. Representative physiographic features

Landforms	(1) Terrace (2) Depression
Runoff class	Very low to very high
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to rare
Ponding duration	Brief (2 to 7 days) to very long (more than 30 days)
Ponding frequency	Rare to frequent
Elevation	350–2,500 ft
Slope	0–3%
Ponding depth	0–12 in
Water table depth	0–12 in
Aspect	Aspect is not a significant factor

Climatic features

The climate of this region is temperate and humid. The Ridge and Valley Province is not rugged enough for a true mountain type of climate but it does have many of the characteristics of such a climate (Daily 1971). The influence of the high and low topography on air movement causes somewhat greater temperature extremes than are experienced in the Piedmont region to the east. The differences in elevation also affect the length of the frost free season on the ridges verses that in the valleys. The cooler temperatures and the shorter freeze-free periods occur at the higher elevations and in the more northern latitudes. The maximum precipitation occurs from early spring through mid-summer, and the minimum occurs in January and February. The average annual snowfall ranges from 16 to more than 51 inches (40 to 130 centimeters). The average annual temperature is 44 to 57 degrees F (7 to 14 degrees C). A portion of this region that extends from Maryland southward through most of the Shenandoah Valley in Virginia falls within a rain shadow cast by the Appalachian Mountains to the west and the Blue Ridge Mountains to the east. The mountains on either side block moist flowing air from either the east or the west causing the valleys to be drier. Average annual precipitation in this shadow area can average 34 to 36 in/year (86 to 91cm) compared to 40 to 42 in/year (102 - 107 cm) for the rest of the region (PRISM 2013).

Data for mean annual precipitation, frost-free and freeze-free periods and monthly precipitation for this ecological site are shown below. The original data used in developing the tables was obtained from the USDA-NRCS National Water & Climate Center (2015) climate information database for 6 weather stations throughout MLRA 147 at elevations in which this ecological site occurs. All climate station monthly averages for maximum and minimum temperature and precipitation were then added together and averaged to make this table.

Table 3. Representative climatic features

Frost-free period (characteristic range)	142-158 days
Freeze-free period (characteristic range)	174-183 days
Precipitation total (characteristic range)	37-40 in
Frost-free period (actual range)	140-164 days
Freeze-free period (actual range)	171-194 days
Precipitation total (actual range)	36-40 in
Frost-free period (average)	149 days
Freeze-free period (average)	181 days
Precipitation total (average)	38 in

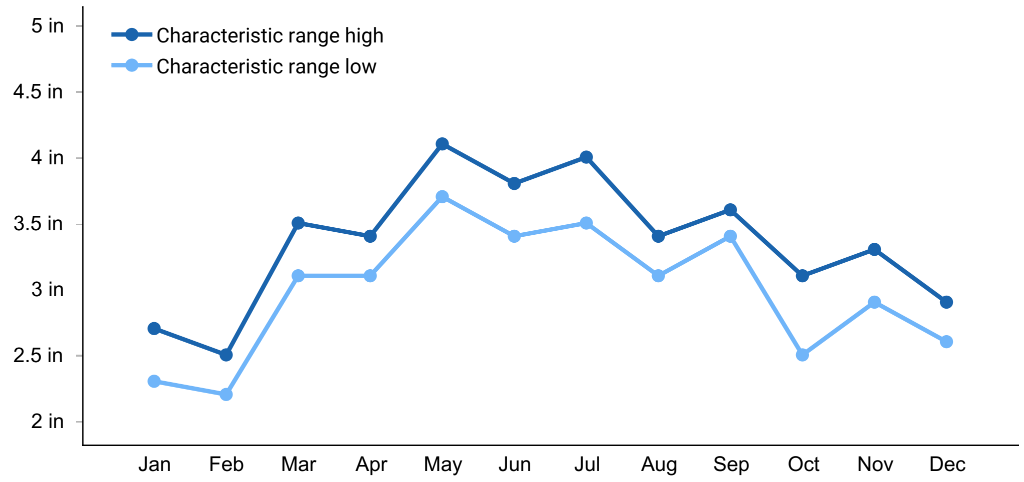

Figure 1. Monthly precipitation range

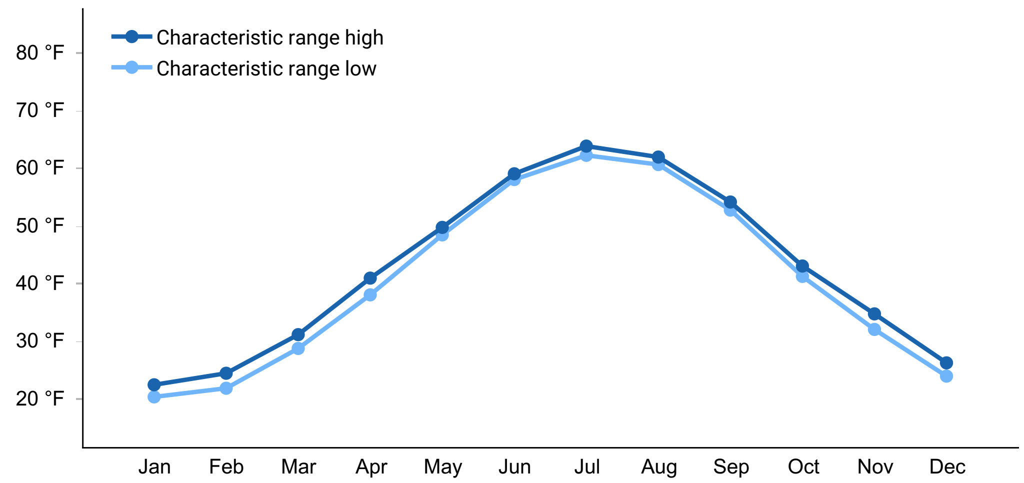

Figure 2. Monthly minimum temperature range

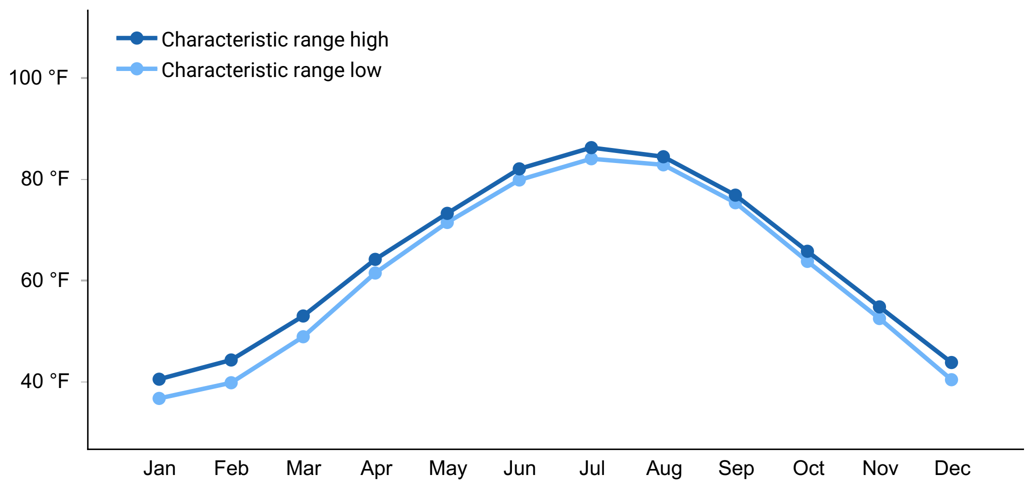

Figure 3. Monthly maximum temperature range

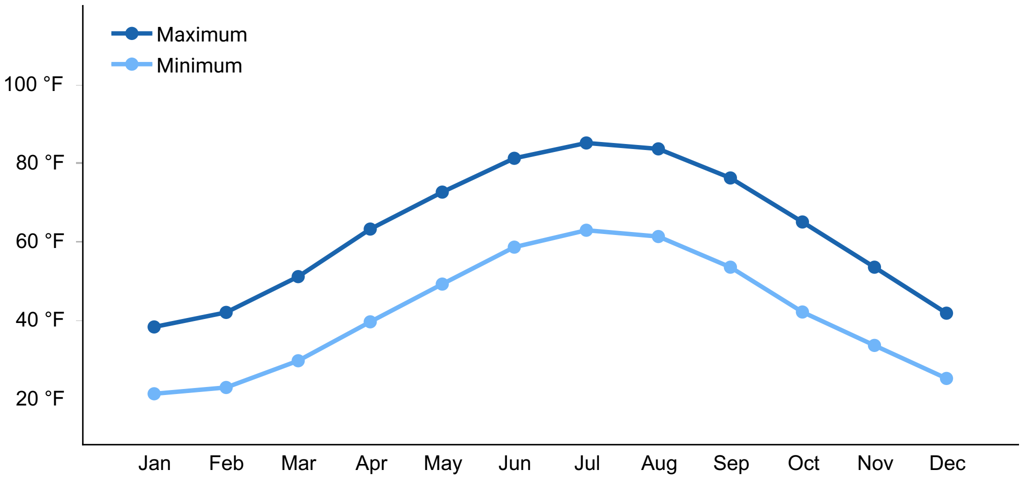

Figure 4. Monthly average minimum and maximum temperature

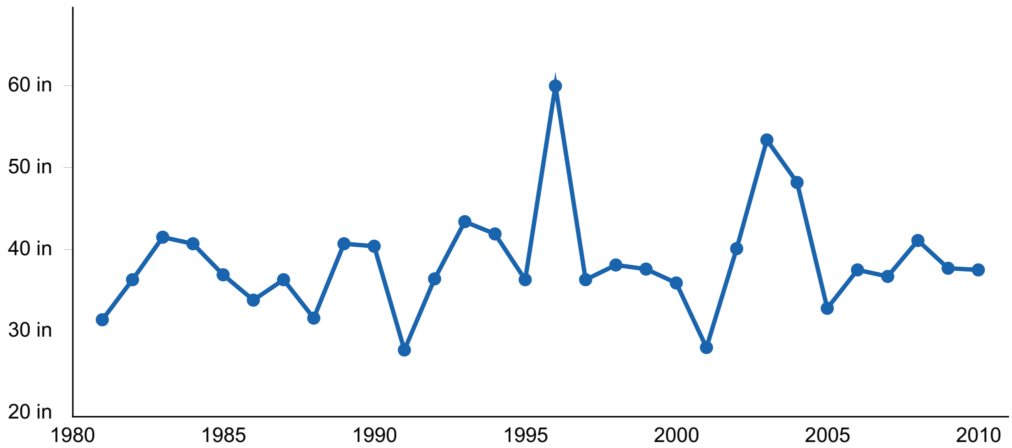

Figure 5. Annual precipitation pattern

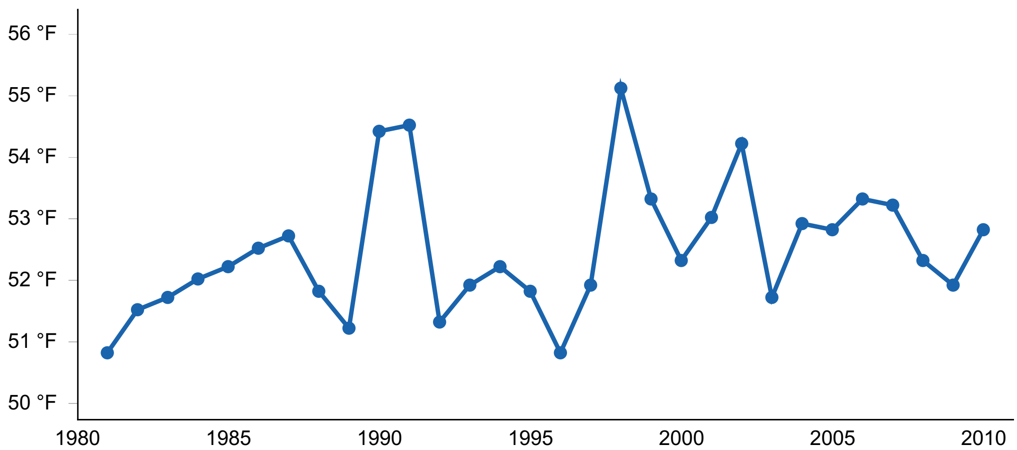

Figure 6. Annual average temperature pattern

Climate stations used

- (1) RAYSTOWN LAKE 2 [USC00367312], Hesston, PA
- (2) STATE COLLEGE [USC00368449], State College, PA
- (3) DALE ENTERPRISE [USC00442208], Dayton, VA
- (4) ROMNEY 1 SW [USC00467730], Romney, WV

- (5) SHIPPENSBURG [USC00368073], Shippensburg, PA
- (6) MARTINSBURG E WV RGNL AP [USW00013734], Martinsburg, WV

Influencing water features

In the National Wetland Inventory (NWI) classification, these ecological sites would be palustrine Forested Broad-leaved Deciduous Seasonally flooded/saturated wetlands (PFO1E) (Cowardin 1979) and can be described by multiple hydrogeomorphic (HGM) classifications which reflect the heterogeneity of alluvial landscapes. These include: Mineral Soil Flats, Riverine (Nonperennial), and Depression (Open, Surface Water) (Smith 1995). Using the Mid Atlantic HGM classification system, one could add an additional type, the Riverine headwater complex (R3c) which are wetlands that are part of a mosaic of small streams, depressions, and slope wetlands generally supported by ground water (Brooks, Brinson et. al. 2013).

Wetland description

Palustrine Forested Broad-leaved Deciduous Seasonally flooded/saturated wetlands (PFO1E) (Cowardin 1979)

Soil features

The Poorly Drained Fine Alluvial Terrace Ecological Site includes Purdy and similar soils, Maurertown, Robertsville and Zipp.. These soils are very deep to bedrock and poorly and very poorly drained with a seasonal high water table occurring within 12 inches of the soil surface. Some soils contain a thin organic horizon but more commonly have a mucky mineral or mineral horizon of silt loam or silty clay loam. The fine textured subsoil includes clay, silty clay loam, silty clay, or clay loam textures. The substratum may include sandy lenses or areas of increasing rock fragment content. The permeability of the subsoil is slow to very slow. These landforms include depressions formed from backwater areas on old alluvial terraces. Flooding is none however some locations may flood rarely. Seasonal ponding occurs due to its concave shape and the very slowly permeable subsoil. Soil pH is extremely acid to slightly acid throughout, except for sites close to managed agricultural land which may have higher pH’s due to runoff from surrounding areas. Available water capacity ranges from 6 to 11.1 inches in the upper 60 inches of the soil profile. These soils are considered hydric, in that they formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA, NRCS 2010). Nearby soils include the moderately well drained Monongahela and Zoar, the somewhat poorly drained Tyler, Tygart, Blairton, Newark, and Ernest, and the poorly drained Brinkerton.

Figure 7. Purdy silt loam soil profile, Plowden, JC 09/03/20

Table 4. Representative soil features

Parent material	(1) Alluvium–siltstone
Surface texture	(1) Silt loam (2) Silty clay loam (3) Loam
Family particle size	(1) Clayey
Drainage class	Very poorly drained to poorly drained
Permeability class	Very slow to slow
Soil depth	50–70 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	6.1–11.1 in
Soil reaction (1:1 water) (0-40in)	3.6–6.5
Subsurface fragment volume <=3" (Depth not specified)	2–25%
Subsurface fragment volume >3" (Depth not specified)	1–30%

Ecological dynamics

The information in this ecological site description (ESD), including the state-and-transition model (STM), was developed using archeological and historical data, professional experience, and scientific studies. The information is representative of a complex set of plant communities. Not all scenarios or plants are included. Key indicator plants, animals, and ecological processes are described to inform land management decisions.

The Poorly Drained Alluvial Terrace Ecological Site is located in the Ridge and Valley region of the Appalachian Highlands, an area that has undergone extensive human disturbance since pre and post-European settlement times (Braun 1950). The reference forest is part of the Central Appalachian River Floodplain System which encompasses floodplains of medium to large rivers in the Atlantic drainages from southern New England to Virginia, and can include a complex of wetland and upland vegetation (CES202.608 from NatureServe 2015). Although the Central Appalachian River Floodplain Forest System includes a number of diverse plant communities, two phases of the reference forest were consistently observed. These were an oak-mixed hardwood forest dominated by pin oak (*Quercus palustris*) and swamp white oak (*Quercus bicolor*), and slightly less frequently, a maple-ash community dominated by red maple (*Acer rubrum*) – green ash (Fraxinus pennsylvanicus) and sometimes American elm (Ulmus americanus).

The oak-mixed hardwood palustrine forest community has limited extent in the Ridge and Valley, occurring mainly on old alluvial terraces with clayey subsoils that are seasonally inundated, mostly along smaller tributaries in flat-bottomed valleys throughout the northern and southern extents of the region (Field observation; Zimmerman et. al. 2012; Fleming and Patterson 2013; WVDNR 2014). This community is characterized by a closed canopy forest, dominated by pin oak (*Quercus palustris*) and swamp white oak (*Quercus bicolor*). Associate canopy species may include red maple (*Acer rubrum*), blackgum (*Nyssa sylvatica*), black ash (*Fraxinus nigra*), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), and hickories (Carya spp.) The understory vegetation is generally sparse, but varies considerably depending on site hydrology and light availability. Under more open canopies, the lower layers may be quite dense and include species such as winterberry (*Ilex verticillata*), and spicebush (*Lindera benzoin*) in the shrub layer, and Small-spike false nettle (*Boehmeria cylindrica*), Spotted touch-me-not (*Impatiens capensis*), sedges (Carex spp.), and Poison ivy (*Toxicodendron radicans*) in the herbaceous layer.

The Red Maple – Green Ash community is similar to the Northern Piedmont/Central Appalachian Maple-Ash Swamp Forest and has been observed from New Jersey and Pennsylvania, south to West Virginia and Kentucky in the central Appalachians and elsewhere (CEGL006548: NatureServe 2015). The over story is dominated by variable combinations of green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), sometimes silver maple (*Acer saccharinum*), and often with American elm (Ulmus Americana) in the understory. The shrub and herb layers may include poison ivy (*Toxicodendron radicans*), small-spike false nettle (*Boehmeria cylindrica*l), spotted touch-me-not (*Impatiens capensis*), white avens (*Geum canadense*), fowl mannagrass (*Glyceria striata*), white grass (*Leersia virginica*), canadien clearweed (*Pilea pumila*), and various sedges (Carex spp.). This plant community has also been described in Pennsylvania as the Red Maple – Elm – Willow Floodplain Forest (Zimmerman et. al. 2012).

The ecological relationship between the two phases of the reference community are not fully understood. Micro-topography and soil texture may determine how long various habitats are inundated which would cause differences in plant communities, as would the characteristics of nearby forests and seedbanks from which to recruit species. It is possible that the maple-ash community is more likely to occupy habitats that are too deeply flooded to support the hydrophytic oaks; the clearest support for this hypothesis has been found on large floodplains that contain both the oak and maple communities along an apparent hydrologic gradient (Largay et. al. NatureServe 2015). In other instances, especially on smaller streams, cut-over stands of oak-dominated swamp forest have regenerated to stands dominated by red maple and green ash, suggesting a successional relationship between the two communities.

It is believed that fire and heavy disturbance since pre-settlement times, including use of fire by Native Americans, has favored the expansion of oak forests throughout the eastern United States. Moreover, suppression of fire since the early 1900's is leading to the eventual replacement of oak-dominated forests with mesophytic species that are much more shade tolerant and fire-sensitive, particularly in uplands (Nowacki and Abrams 2008; Abrams and Ruffner 1995; Dey 2002a; Hutch 2000; Delcourt 1997). Some examples of mesophytic species include maples and ashes. It is not clear if this pertains to bottomland oak forests like those represented by this ecological site description, but Native Americans burned bottomland areas, and even wetlands would have burned during drought periods (Dey 2002a). Fire suppression and reduced- cutting practices seem to accelerate the succession from oak-dominated to mixed mesophytic species in many bottomland forests (Motsinger et. al. 2010; Kennedy and Nowacki 1997; Hosner and Minckler 1963). Unless there is a bumper crop of acorns in conjunction with removal of the over story, oak-dominated stands on mesic and hydric sites do not usually regenerate to oak in the absence of disturbances that limit competing vegetation (Larsen and Johnson 1998; Dey 2002b). This would support the theory that the maple-ash dominated wetland forests of this ecological site could be a successional stage of the pin oak-swamp white oak phase.

It is difficult to determine if either the pin oak – swamp white oak or maple-ash communities existed in their current compositional form during pre-settlement times. Since the early 1900's when Dutch elm disease (Ceratocystis ulmi) was introduced to the U.S., mature American elm trees have been virtually eliminated from lowland forests in much of eastern North America (Barnes 1976). They continue to grow and propagate but the disease limits their age and size. Green ash has expanded its range across the eastern United States, probably as a result of the decline of American elm, but also because it has been extensively planted (Hanberry 2014). Green ash populations may eventually decline as a result of the Emerald Ash Borer (Agrilus planipennis).

Most of the Ridge and Valley forests are now secondary growth, and are of relatively uniform age which reflects the extensive logging and land clearing that took place at the turn of the century (Braun 1950). Research examining the relationship between historic plant communities and edaphic factors used data from early settlement property maps which listed identifying trees, called witness trees. Valley floor landscapes, which would have included the river terraces and floodplains of this ecological site, were populated with variations of white oak, eastern white pine, hickory, sugar maple, hemlock, and black gum (Nowacki and Abrams 1992; Abrams and Ruffner 1995; Thomas-Van Gundy and Strager 2012; Abrams and McCay 1996). Noticeably absent from much witness tree data of pre-settlement forests was red maple which is a significant component of modern forests. This may be an accurate depiction of forest composition at that time, or certain species may have been under-reported due to surveyor bias for characteristics like tree size, longevity, vigor, or relative abundance (Bourdo 1956).

Other phases observed on these ecological sites include a cleared agricultural pasture state, an old field state and an invaded woodland state where non-native species occupy significant areas of the understory. These non-natives may have detrimental effects on the reproduction and advanced recruitment of the reference tree species. One such invasive species is Nepalese browntop (Microstigeum vimineum) in the herbaceous layer. In some sites, Nepalese browntop, created a carpet of grass that effectively inhibited the growth of other plant seedlings. Multiflora rose (*Rosa multiflora*) is another invasive that is often present in the shrub layer.

Plant communities will differ across the MLRA because of the naturally occurring variability in local weather events, small inclusions of other soils, and micro relief. The reference plant community is not necessarily the management goal. The biological processes on this site are complex. Therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Various field guides were used for identification of vegetation. Current taxonomy and nomenclature were verified using the Plants of Pennsylvania (Rhoads and Block, 2007) and the USDA Plants database (2015).

The following diagram suggests pathways that the vegetation on these sites will most likely take, given the above general descriptions of climate, soils, and disturbance histories. Specific areas with unique soils and disturbance histories may have alternative pathways not shown on this diagram. This information is intended to show what might happen given average site conditions and a history of repeated disturbances as described above. Local professional guidance should always be sought before pursuing a treatment scenario.

State and transition model

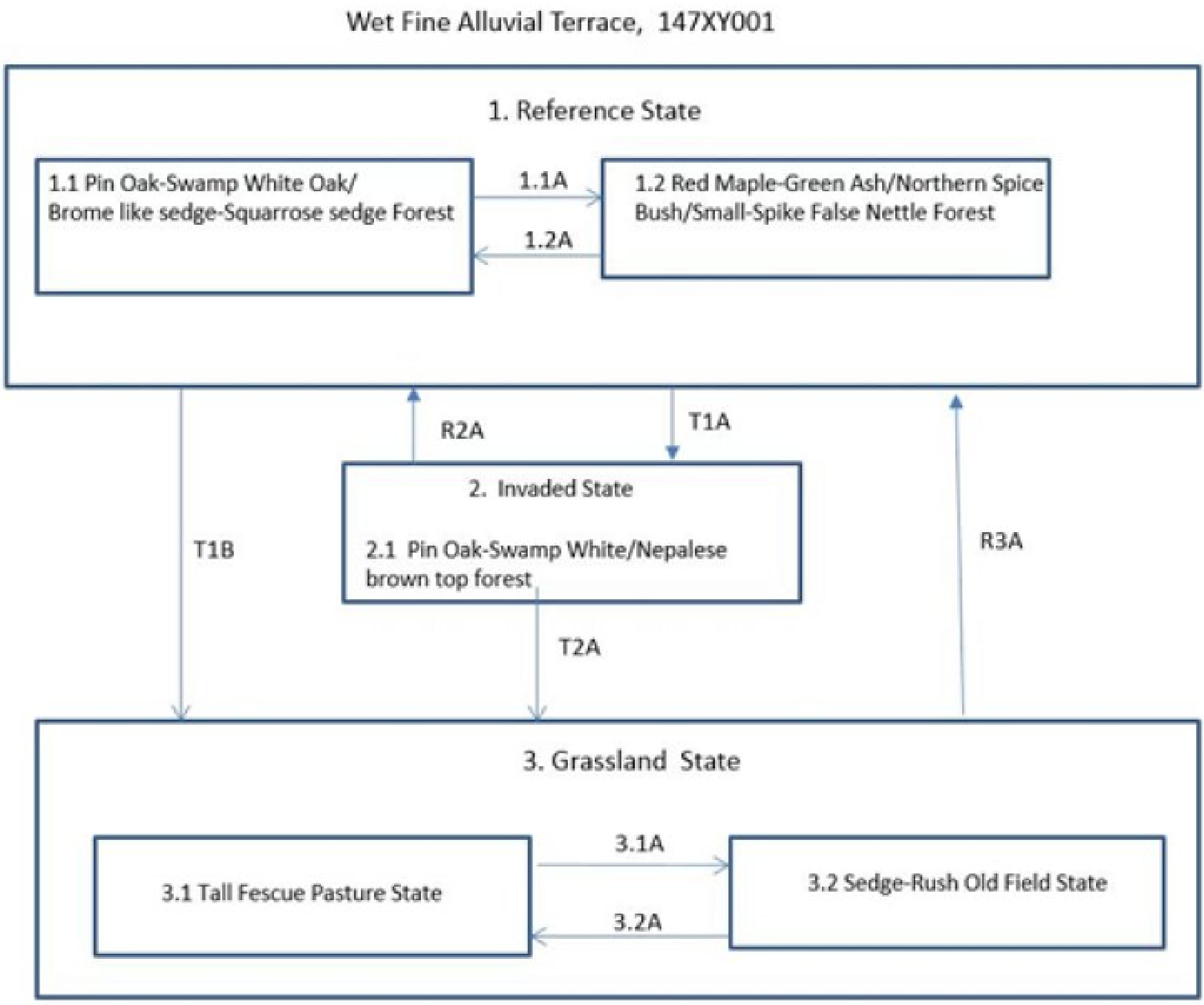

Figure 8. State-and-Transition Diagram

Code	Event/Process
1.1A	Natural succession, natural canopy openings, or possibly fire exclusion.
1.2A	Partial removal of over story canopy cover, and management of the understory to increase oak advancement.
3.1A	Abandonment of artificial drainage, natural succession, limited grazing
3.2A	Drainage installation, and management for pasture
T1A	Invasion of Nepalese browntop
T1B, T2A	Clearing, draining, and managing for pasture
R2A	Control of Nepalese browntop and other invasive species
R3A	Abandonment of artificial drainage, planting of native species, management of weeds and undesired species

Figure 9. Wet Fine Alluvial Terrace 147XY001

State 1

Oak Mixed Hardwood Wetland Forest

The reference state is a combination of several vegetation communities within the Central Appalachian Floodplain system. The two phases most consistently encountered are a wet oak-hardwood palustrine forest community and a wet maple-ash community. They occur in seasonally inundated depression and some floodplains of smaller tributaries in flat-bottomed valleys and in old alluvial terraces throughout the northern and southern extents of the Ridge and Valley region. The actual historic reference forests may no longer exist due to a high degree of human disturbance since the time of European colonization.

Community 1.1
Pin Oak-Swamp White Oak/Brome like sedge-Squarrose sedge Forest

Figure 10. Reference phase, Purdy silt loam, Plowden, Y. 06/26/2014

Figure 11. Pin Oak in reference community, Purdy silt loam, Plowden, JC. 09/02/2014

This oak phase has a moderate canopy cover of about 70% but can range from as little as

45% to as high as 80%. In some sites the understory was quite open while in others shrubs and herbs formed a dense thicket. Beaver activity was noted in and around some areas. Most of these forests have been cleared at one time. Many stands of trees seemed of fairly even age, however, a few had swamp white oaks that were quite large 26 to 30 inch dbh as compared to 15.5 inches for the next widest tree, shagbark hickory (Carya Ovata). Although not always one of the dominant members of the over story, red maple (*Acer rubrum*) and green ash (*Fraxinus pennsylvanica*) occurred in nearly all of the sites. Shagbark hickory was the next tree species with the highest frequency of occurrence. Multiflora rose (*Rosa multiflora*) was a common invasive in the shrub layer. Other tree species that were infrequently observed, usually in small areas of better drainage within the site, included sycamore (*Platanus occidentalis*), eastern white pine (*Pinus strobus*), pitch pine (*Pinus rigida*), eastern hemlock (Tsuga Canadensis), red pine (*Pinus resinosa*), and white oak (*Quercus alba*). The National Vegetation Classification lists this as the Northern Piedmont/Central Appalachian Pin Oak Floodplain Swamp (CEGL006497).

Table 5. Ground cover

Tree foliar cover	0.1-0.9%
Shrub/vine/liana foliar cover	0.1-0.4%
Grass/grasslike foliar cover	0.0-2.7%
Forb foliar cover	0.0-0.2%
Non-vascular plants	0-20%
Biological crusts	0%
Litter	73-94%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0-1%
Bare ground	0.0-0.5%

Table 6. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	73-94%

Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 7. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	0-0%
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	0-1%
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	0-1%
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	0-1%
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	0-1%
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	10-20 per acre
Tree snag count** (hard***)	0-10 per acre

*** Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.**

**** >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.**

***** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.**

Table 8. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	0%	0%	0%	0-3%
>0.5 <= 1	0-1%	2-5%	0-64%	1-15%
>1 <= 2	0-15%	0-2%	0-25%	0-2%
>2 <= 4.5	0-1%	0-37%	0%	0%
>4.5 <= 13	0-10%	0-12%	0%	0%
>13 <= 40	1-20%	0-15%	0%	0%
>40 <= 80	0-88%	0%	0%	0%
>80 <= 120	0-64%	0%	0%	0%
>120	0%	0%	0%	0%

Community 1.2
Red Maple-Green Ash/Northern Spicebush/Small-Spike False Nettle

Figure 12. Maple-Ash phase, Plowden, Y. 06/04/2014

This phase may be a result of natural succession from phase 1.1, or it may occur as a result of a different hydrologic regime that includes longer periods of inundation and/or a higher frequency of flooding than the oak community. American elm (Ulmus Americana) is part of the canopy, but not a dominant. American hornbeam (*Carpinus caroliniana*) and black gum (*Nyssa sylvatica*) are part of the understory. Overall canopy cover is about 60%. This swamp forest is part of the Northern Piedmont/Central Appalachian Maple-Ash Swamp Forest. It can also occupy poorly drained backswamps, sloughs, abandoned oxbows, and depressions of large-stream and river floodplains. The National Vegetation Classification System lists this association as the Northern Piedmont/Central Appalachian Maple-Ash Swamp Forest (CEGL006548).

Table 9. Ground cover

Tree foliar cover	0.1-2.0%
Shrub/vine/liana foliar cover	0.0-0.1%
Grass/grasslike foliar cover	0.0-0.1%
Forb foliar cover	0.0-0.1%
Non-vascular plants	0.0-2.3%
Biological crusts	0%
Litter	75-95%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%

Water	0.0-0.5%
Bare ground	0-5%

Table 10. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	75-95%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 11. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	0-1% N*
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	0-1% N*
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	0-1% N*
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	0-3% N*
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	0% N*
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	0-20 per acre
Tree snag count** (hard***)	

*** Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.**

**** >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.**

***** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.**

Table 12. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	0%	0%	0%	0-3%
>0.5 <= 1	0%	0-2%	0-8%	3-8%
>1 <= 2	0-15%	0%	0%	0%
>2 <= 4.5	0%	0-8%	0%	0%
>4.5 <= 13	0%	0-12%	0%	0%
>13 <= 40	20-95%	0-15%	0%	0%
>40 <= 80	0-64%	0%	0%	0%
>80 <= 120	0%	0%	0%	0%
>120	0%	0%	0%	0%

Pathway 1.1A
Community 1.1 to 1.2

Pin Oak-Swamp White Oak/Brome like sedge-Squarrose sedge Forest

Red Maple-Green Ash/Northern Spicebush/Small-Spike False Nettle

The relationship between the Pin Oak-Swamp White Oak phase and the Red Maple-Green Ash phase is unclear. Natural succession may play a role in a shift from oak communities to ones dominated by maple, ash, and elm. As oak forests mature, the shade tolerant understory species like maple and ash are able to outcompete the shade-intolerant oak seedlings which eventually die and are unavailable to regenerate. The Maple-Ash phase may therefore be a natural successional phase that results with the absence of other disturbances that open the canopy like clearing or fire. Or, it may be a community that exists separately on this landform in areas that receive more frequent flooding and/or longer periods of inundation due to differences in micro-topography that affect the hydrology.

Pathway 1.2A
Community 1.2 to 1.1

Red Maple-Green Ash/Northern Spicebush/Small-Spike False Nettle

Pin Oak-Swamp White Oak/Brome like sedge-Squarrose sedge Forest

The ecological relationship between the Maple-Ash phase and the Pin Oak-Swamp White Oak phase is not clear. However, where an oak seedbank or root system exists, oak production can be encouraged through opening of the canopy. This can be done by selective removal of the non-oak over story in conjunction with management of the understory to promote oak seedling advancement. Where few oak seedlings exist, acorns or root stock may have to be planted.

State 2
Invaded State

This community is similar to the reference community 1.1 but includes the significant invasion of Nepalese browntop (*Microstegium vimineum*), greater than 60% cover, which if left uncontrolled can form a continuous groundcover thereby suppressing the germination and growth of other plant species. It can replace other ground vegetation in three years. Nepalese browntop grows well in shady, moist areas, and is most frequently found on floodplains and mesic forests where it takes advantage of sun flecks on the forest floor. It is often in association with other nonnatives including garlic mustard (*Alliaria petiolata*), Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), and Japanese barberry (*Berberis thunbergii*). Roads and waterways appear to be the primary corridor for expansion of Nepalese browntop. It tends to favor more open sites with little or no leaf litter, a common characteristic of disturbed forests. Some insects eat Nepalese browntop, but deer do not, nor do livestock. It can provide cover for mice, but may reduce suitable cover and habitat quality for turtles.

Community 2.1
Pin Oak-Swamp White Oak/Nepalese browntop Forest

Figure 13. invaded state, Purdy silt loam, Plowden, JC. 09/02/2014

Figure 14. Nepalese browntop ground cover, Purdy silt loam, Plowden, JC 09/02/2014

This community is similar to the reference community 1.1 but includes the significant invasion of Nepalese browntop (*Microstegium vimineum*.

State 3
Grassland

This state results from conversion of forests and woodlands to agricultural uses, primarily pasture. Tall fescue (Festuca arundinacea) is a common planted species. Rushes (Juncus spp.), sedges (Carex spp.) and other hydrophytic herbaceous plants are present in varying amounts depending on the effectiveness of drainage ditches. In some areas, parallel bedding is a feature of this state where the surface of the land has been elevated into a series of broad, low ridges separated by shallow, parallel channels in order to improve drainage. Some parallel bedding may have existed since early settlement as these features could have been constructed with a horse and moldboard plow (personal communication with Soil Scientist and landowners). If the drainage is no longer maintained, the ditches may quickly transition to the old field phase.

Community 3.1
Tall fescue Pasture

Figure 15. Pasture phase, Purdy silt loam, Plowden, Y. 09/15/2014

In this phase, tall fescue (Festuca arundinacea) is a common planted species as well as timothy (Phleum pretense), and orchard grass (*Dactylis glomerata*). Other common nonnative species include great plantain (*Plantago major*), narrowleaf plantain (Plantago laneolata), red clover (Trifolium pretense), white clover (*Trifolium repens*), and common dandelion (*Taraxacum officinale*). Rushes (Juncus spp.), sedges (Carex spp.) and other hydrophytic herbaceous plants are present in varying amounts depending on the effectiveness of drainage ditches. Some of these include: slenderleaf false foxglove (*Agalinis tenuifolia*), bluejoint (*Calamagrostis canadensis*), false nut sedge (*Cyperus strigosus*), common boneset (*Eupatorium perfoliatum*), common bedstraw (Galium palestre), water horehound (*Lycopus americanus*), marsh pepperweed (Persicaria hydropiper), purple stem aster (*Symphyotrichum puniceum*), blue vervain (Verbena hastate), and New York ironweed (*Vernonia noveboracensis*). Return to the reference state from this state may require a very long term series of costly management options and stages. Many species may need to be eventually planted or reseeded to restore the system.

Community 3.2
Sedge-Rush old field

Figure 16. Sedge-Rush old field phase, Purdy silt loam, Plowden, Y. 09/14/2014

Pasture converts to this phase when drainage ditches are no longer maintained and management becomes limited to mowing once a year or every few years with no additional inputs of fertilizer or seed. The wetland hydrology eventually returns, but well drained microtopography may remain resulting in a mosaic of predominantly hydrophytic vegetation but with nonhydrophytic vegetation as well such as late goldenrod (Solidago altissima), fuller’s teasel (*Dipsacus fullonum*), and carolina horsenettle (*Solanum carolinense*), and a mix of grass species. Sedges seem to dominate, a common identifiable species observed is fox sedge (*Carex vulpinoidea*). Easily identifiable rush species include lamp rush (Juncus effuses), and path rush (*Juncus tenuis*). Other herbaceous species may include yellow nutsedge (*Cyperus esculentus*), deer tongue (*Dichanthelium clandestinum*), needle spike rush (Eleochous acicularis), common boneset (*Eupatorium perfoliatum*) common marsh bedstraw (*Galium palustre*), northern water horehound (*Lycopus uniflorus*), allegheny monkeyflower (*Mimulus ringens*), golden groundsel (*Packera aurea*), goldenrod species (Solidago spp), blue verbena (*Verbena hastata*), and New York ironweed (*Vernonia noveboracensis*).

Pathway 3.1A
Community 3.1 to 3.2

Tall fescue Pasture **Sedge-Rush old field**

Natural succession and the cessation of maintenance of drainage ditches will allow this phase to convert to the non-managed or minimally managed old field phase. Mowing as infrequently as once a year will prevent shrubs and trees from becoming established.

Pathway 3.2A
Community 3.2 to 3.1

Sedge-Rush old field **Tall fescue Pasture**

This non-managed plant community phase may transition to a managed phase with human-related inputs such as fertilizer, lime, and reseeding with non-native grass and forb mixtures.

Transition T1A
State 1 to 2

Invasion of Nepalese browntop along disturbance pathways.

Transition T1B
State 1 to 3

This transition is the result of clearing of forest for agriculture.

Restoration pathway R2A
State 2 to 1

Restoration of a Nepalese browntop (*Microstegium vimineum*) invaded forest requires repeated annual efforts to prevent flowering and seed set until the seed bank is exhausted. This may take at least 3 years. Invaded road sides can serve as seed banks, so control of Nepalese browntop growth in these areas is important as well. It spreads vegetatively through stolons during the growing season. It flowers in late summer with seeds maturing until fall frosts and plant death which could occur as late as December. Therefore, hand-pulling or herbicide treatments must be done before the plant sets seed. Mowing in late summer before seed set is effective, but mowing too soon allows the plant to recover. Nepalese browntop seeds can be carried into an area by flooding, therefore areas that are inundated yearly must receive treatments indefinitely (Fryer 2011).

Conservation practices

Wetland Wildlife Habitat Management
Wetland Enhancement
Invasive Plant Species Control

Transition T2A
State 2 to 3

This transition is the result of clearing of forest for agriculture.

Restoration pathway R3A
State 3 to 1

Return to the reference state from this state may require a very long term series of costly management options and stages. Many species may need to be eventually planted or reseeded to restore the system. If using acorns, direct seeding must be done fairly heavily. Herbivory can be a problem as well as competition from faster growing species. At a minimum, allowing the original wetland hydrology to return would result in natural succession of a hydrophytic plant community. Depending on the existing seed bank and the proximity of a mature forest from which to recruit seeds, old fields may regain a mixed forest stand.

Additional community tables

Table 13. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
green ash	FRPE	*Fraxinus pennsylvanica*	Native	16–56	8–60	5.6–7.1	–
shagbark hickory	CAOV2	*Carya ovata*	Native	6–50	2–40	2.3–19	–
swamp white oak	QUBI	*Quercus bicolor*	Native	30–66	5–40	26–30	–
pin oak	QUPA2	*Quercus palustris*	Native	33–66	8–40	5.5–13	–
red maple	ACRU	*Acer rubrum*	Native	10–50	5–8	2.5–4.2	–
American elm	ULAM	*Ulmus americana*	Native	12–33	1–2	2.5–3	–

Table 14. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
brome-like sedge	CABR14	*Carex bromoides*	Native	0.3–1.6	0–15
greater bladder sedge	CAIN12	*Carex intumescens*	Native	0.3–1.6	0–8
blunt broom sedge	CATR7	*Carex tribuloides*	Native	0–0.7	0–3
graceful sedge	CAGR2	*Carex gracillima*	Native	0.3–1.6	0–1.5
awlfruit sedge	CAST5	*Carex stipata*	Native	0–1	0–1
squarrose sedge	CASQ2	*Carex squarrosa*	Native	0–0.7	0–1
hop sedge	CALU4	*Carex lupulina*	Native	0–1	0–1
fringed sedge	CACR6	*Carex crinita*	Native	0–2	0–1
star sedge	CAEC	*Carex echinata*	Native	0.3–1.3	0–0.8
bearded shorthusk	BRER2	*Brachyelytrum erectum*	Native	0.3–1.7	0–0.1
Forb/Herb					
halberdleaf tearthumb	POAR6	*Polygonum arifolium*	Native	0.5–1	0–5
creeping jenny	LYNU	*Lysimachia nummularia*	Introduced	0–0.3	0–5
stinging nettle	URDI	*Urtica dioica*	Unknown	0.2–1	0–5

stinging nettle	URDI	*Urtica dioica*	Unknown	0.2–1	0–3
white avens	GECA7	*Geum canadense*	Native	0.2–1	0–1.5
jewelweed	IMCA	*Impatiens capensis*	Native	0.2–0.6	0–1
marsh blue violet	VICU	*Viola cucullata*	Native	0–0.5	0–1
northern spicebush	LIBE3	*Lindera benzoin*	Native	0.5–1	0–1
common marsh bedstraw	GAPA3	*Galium palustre*	Native	0.2–0.8	0–1
dotted smartweed	POPUP4	*Polygonum punctatum var. punctatum*	Native	0.5–1	0–1
smooth Solomon's seal	POBI2	*Polygonatum biflorum*	Native	0.3–0.8	0–0.8
wild yam	DIVI4	*Dioscorea villosa*	Native	0.2–0.4	0–0.1
mayapple	POPE	*Podophyllum peltatum*	Native	0.7–0.8	0–0.1
paleyellow iris	IRPS	*Iris pseudacorus*	Introduced	0.3–1.3	0–0.1
Canadian clearweed	PIPU2	*Pilea pumila*	Native	0.3–1.3	0–0.1
jumpseed	POVI2	*Polygonum virginianum*	Native	0.6–1.1	0–0.1
garlic mustard	ALPE4	*Alliaria petiolata*	Introduced	0.3–1	0–0.1
smallspike false nettle	BOCY	*Boehmeria cylindrica*	Native	0.3–1.3	0–0.1
swamp white oak	QUBI	*Quercus bicolor*	Native	0.3–0.7	0–0.1
American water horehound	LYAM	*Lycopus americanus*	Native	0.2–0.8	0–0.1
Shrub/Subshrub					
multiflora rose	ROMU	*Rosa multiflora*	Introduced	0.5–1.7	0–1.5
northern spicebush	LIBE3	*Lindera benzoin*	Native	2–5	0–1
autumn olive	ELUM	*Elaeagnus umbellata*	Introduced	2–6	0–0.8
silky dogwood	COAM2	*Cornus amomum*	Native	0.5–1.6	0–0.1
nannyberry	VILE	*Viburnum lentago*	Native	2–4	0–0.1
common winterberry	ILVE	*Ilex verticillata*	Native	0.5–3	0–0.1
Tree					
green ash	FRPE	*Fraxinus pennsylvanica*	Native	1.5–	1–25

				16	
American hornbeam	CACA18	*Carpinus caroliniana*	Native	1.5–15	1–4
American elm	ULAM	*Ulmus americana*	Native	2–6	0–1
red maple	ACRU	*Acer rubrum*	Native	0.5–1	0–1
Vine/Liana					
eastern poison ivy	TORA2	*Toxicodendron radicans*	Native	0.2–1	0–4

Table 15. Community 1.2 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
red maple	ACRU	*Acer rubrum*	Native	10–50	10–60	2.5–17.6	–
green ash	FRPE	*Fraxinus pennsylvanica*	Native	35–50	4–45	8.6–10.6	–
blackgum	NYSY	*Nyssa sylvatica*	Native	16–39	5–20	6.8–13	–
American elm	ULAM	*Ulmus americana*	Native	15–25	0–10	5.5–7.7	–

Table 16. Community 1.2 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
Nepalese browntop	MIVI	*Microstegium vimineum*	Introduced	0–0.2	0–3
squarrose sedge	CASQ2	*Carex squarrosa*	Native	0–0.8	0–2
fowl mannagrass	GLST	*Glyceria striata*	Native	0–1	0–2
sedge	CAREX	*Carex*	Native	0–0.8	0–1
Forb/Herb					
smallspike false nettle	BOCY	*Boehmeria cylindrica*	Native	0.1–0.7	0–1
jewelweed	IMCA	*Impatiens capensis*	Native	0.1–0.7	0–1
common cinquefoil	POSI2	*Potentilla simplex*	Native	0–0.5	0–1
goldenrod	SOLID	*Solidago*	Native	0.2–8	0–1
creeping jenny	LYNU	*Lysimachia nummularia*	Introduced	0–0.3	0–0.1
common marsh bedstraw	GAPA3	*Galium palustre*	Native	0–0.7	0–0.1

creeping jenny	LYNU	*Lysimachia nummularia*	Introduced	0–0.3	0–0.1
halberdleaf tearthumb	POAR6	*Polygonum arifolium*	Native	0.2–0.5	0–0.1
Fern/fern ally					
eastern marsh fern	THPA	*Thelypteris palustris*	Native	0.3–1	0–3
sensitive fern	ONSE	*Onoclea sensibilis*	Native	0–0.7	0–0.1
Shrub/Subshrub					
blue huckleberry	GAFR2	*Gaylussacia frondosa*	Native	0.3–2	0–10
roundleaf greenbrier	SMRO	*Smilax rotundifolia*	Unknown	0.3–2	0–5
northern spicebush	LIBE3	*Lindera benzoin*	Native	0.5–5	0–3
honeysuckle	LONIC	*Lonicera*	Introduced	2–5	0–3
multiflora rose	ROMU	*Rosa multiflora*	Introduced	0.4–2	0–0.1
Tree					
red maple	ACRU	*Acer rubrum*	Native	10–15	0–25
blackgum	NYSY	*Nyssa sylvatica*	Native	6.6–15	0–25
blackgum	NYSY	*Nyssa sylvatica*	Native	6.6–15	0–25
American hornbeam	CACA18	*Carpinus caroliniana*	Native	6–12	0–6
northern red oak	QURU	*Quercus rubra*	Native	2–4	0–0.1
Vine/Liana					
eastern poison ivy	TORA2	*Toxicodendron radicans*	Native	0.3–0.7	0–2

Animal community

The Poorly Drained Fine Alluvial Terrace ecological site is important for wildlife species that need wetlands for food and/or habitat for all or part of their life cycles. Ephemeral or vernal pools may form in these areas in the spring becoming almost completely dry at some point during most years. They are virtually free of breeding fish, but attractive habitat for many species of breeding salamanders, turtles, frogs and toads such as the wood frog (Rana sylvatica), spotted salamander (Ambystoma maculatum), marbled salamander (Ambystoma opacum), and Jefferson salamander (Ambystoma jeffersonianum) (Zimmerman et. al 2012; PA Natural Heritage Program 2015). Salamander and frog egg masses provide food for some snake species like the eastern garter snake (Thamnophis sirtalis), and the eastern hognosed snake (Heterodon platyrhinos). Various turtle species may occasionally inhabit these moist areas including wood turtles (Glyptemys insculpta) and box turtles (Terrapene Carolina). Numerous invertebrates are associated with vernal pools including fairy shrimp (Eubranchipus spp.), clam shrimp (Limnadia spp.), water fleas, water beetles, water striders, dragonflies, aquatic earthworms, and flies. Mosquitos lay eggs in these areas, but the larvae often do not survive to adulthood as they are an important food source for many vernal pool wildlife species.

Wetland shrubs, forbes, and grass-like plant species provide a source of food for butterflies. Observed species include, the black dash butterfly (Euphys conspicuous), the viceroy (Limenitis achippus), pearl crescent (Phyciodes tharos), and spicebush swallowtail (Papilio Troilus) (PA Heritage Program, 2005). Pin oak and swamp white oak acorns and hickory nuts are an important food for mallards and wood ducks during their fall migration (Burns and Honkala 1990). Acorns are also an important food for deer, squirrels, turkeys, woodpeckers, and blue jays. Red maple is a highly desirable deer food. A number of game and nongame animals and birds feed on Green ash seeds and black tupelo fruits. Hickory nuts are consumed by squirrels, chipmunks, black bears, gray and red foxes, rabbits, and white-footed mice. Standing dead trees (snags) provide cavities for bats, wood ducks (Aix sponsa), and other cavity nesting species. Small areas of brush can provide food and cover for geese, ducks, muskrat, mink, and a variety of songbirds. Beaver activity was noted at several of the sites.

Hydrological functions

This reference site receives water from precipitation, surface inflow, and some ground water inflow. It loses water to interception, evapotranspiration, surface outflow, and ground water outflow. Both inputs and outputs vary by time of year. This site is considered a forested wetland and has a perched water table that provides multiple hydrologic functions, including the capacity to maintain variations in water storage levels. The variations include depth and duration over the year. The reference site maintains its characteristic water level fluctuations unless it is hydrologically modified. Water table monitoring (from wells) has not been conducted over the long time periods necessary to independently characterize seasonal and inter-annual variations in water level in an unaltered reference state. This site also dampens the effect of excess runoff and floodwater. It helps minimize downslope flooding, filter runoff, protect water quality, maintain cool water temperatures for fish, provide the energy base of the aquatic food chain in the form of fallen leaves, and provide logs that create cover for invertebrates. This community also serves as a buffer for sediment and pollution runoff from adjacent developed lands by slowing the flow of surficial water causing sediment to settle within this wetland.

Recreational uses

These areas may be of interest to hunters, birders, and naturalists. However, due to the wetland hydrology of these sites, most recreational uses are severely limited by the presence of a seasonal high water table that may persist through out the growing season depending on climatic conditions. Because of the combination of the concave or gently sloping shape of the landscape and the very slowly permeable sub soils, these areas are difficult to drain, and would be subject to compaction if disturbance occurred when soils were wet.

Wood products

Species that can tolerate seasonal saturation of soils and occasional inundation are suitable for commercial planting. Some of these include pin oak, swamp white oak, red maple, hickory, sycamore, and eastern white pine.

Extensive tree cutting and operation of heavy equipment on unfrozen ground in these areas can change the drainage characteristics and degrade the wildlife habitat, plant productivity, and diversity values. Following harvest, changes in the properties and distribution of organic matter may have long-term effects on soil fertility and productivity. This in turn may increase evaporative losses of moisture. Harvesting on frozen ground or snow cover and using low-pressure tires are recommended to minimize rutting and disturbance of soil structure and hydrology.

The construction and maintenance of forest roads and mechanical sites should include minimizing soil disturbance during shearing and raking; avoiding excessive soil compaction; arranging windrows to limit erosion and overland flow; preventing disposal or storage of logs or debris in streamside management areas; maintaining the natural contour of the harvesting and planting site; and minimizing impacts to offsite water quality.

Table 17. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
pin oak	*QUPA2*	80	85	57	72	–	–	–	

Inventory data references

Ecological states and phases and the plant species lists were developed utilizing low-intensity reconnaissance followed by selective medium and high-intensity sampling using the Relevé Method; data was then classified by tabular comparison (Mueller-Dombois and Ellenberg 2002). Medium and high intensity evaluation were conducted on 20 x 20 meter plots. Data contained in this document was also derived from analysis of Natural Heritage Inventories and various reference papers and books. Five high intensity inventories were conducted for the forested reference states. Described communities were compared to current NVC classifications and best matches were found.

Data collection included: verification of soil mapping, ocular estimates of cover, development of plant lists for species, transect lines within plots, landscape descriptions, diameter at breast height (dbh) measurements for dominant canopy trees, estimate of overstory basal area using a 10 BAF sub-plot in the center of the high intensity plots, analysis of historic aerial photography, and additional field notes.
Selection of representative sampling sites was determined subjectively by using expert knowledge from soil survey staff as well as identifying potential sites through the use of several GIS layers including soil survey maps, orthophotography, historic aerial

photographs from local NRCS field offices where available, and public lands GIS layers. A mixture of public and private lands were evaluated throughout the MLRA 147 area including sites in Pennsylvania, Virginia, and West Virginia.

Site index data was not gathered on any of the plots, because none of the sites met SI criteria (no sites contained at least 5 trees of a species that were approximately 50 years old and have a site index curve from the NRCS national Register of Site Index Curves). SI data contained within this document were gleaned from existing soil survey information.

Type locality

Location 1: Cumberland County, PA	
Latitude	40° 10′ 19″
Longitude	77° 28′ 53″
General legal description	Pennsylvania State Game Lands

Location 2: Centre County, PA	
Latitude	40° 59′ 58″
Longitude	77° 40′ 46″
General legal description	Bald Eagle State Park

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Approval

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	04/11/2025
Approved by	Greg Schmidt
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater**

than, greater than, and equal to):

Dominant:

Sub-dominant:

Other:

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
