USDA Natural Resources Conservation Service

Ecological site F147XY006PA
Mixed Limestone Lower Slope

Last updated: 9/27/2024
Accessed: 05/13/2025

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

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

Major Land Resource Area 147 is in the Middle section of the Valley and Ridge Province of the Appalachian Highlands. Characteristic features include folded and faulted parallel ridges and valleys that are carved out of anticlines, synclines, and thrust blocks. The variability of weathering 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 Great Valley is a salient feature of the eastern portion and runs the entire length of the MLRA where it is called the Shenandoah Valley in the south. The western side of the MLRA is dominantly hilly to very steep and is rougher and much steeper than the rolling hills to the east. Parts of the northernmost section of the MLRA were subjected to pre-Illinoian glaciation (>770,000 years ago). Anthracite coal underlies some areas in the north and has been mined since the 1700's.

Elevation in MLRA 147 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. (USDA, 2006).

Classification relationships

This ecological site is found in Major Land Resource Area 147- Northern Appalachian Ridges and Valleys, 148. MLRA 147 is located within Land Resource Region S - Northern Atlantic Slope Diversified Farming Region (USDA 2006), and in United States Forest Service ecoregion M221 – Central Appalachian Broadleaf Forest-Coniferous Forest-Meadow Province (Bailey, 1995). In addition, MLRA 147 falls within area #67 of EPA Ecoregion Level III – the Ridge and Valley (US EPA 2013). The Mixed Limestone Lower Slope ecological site occurs within 67a and 67b of EPA Ecoregion IV - Northern Limestone/Dolomite Valleys, and Northern Shale Valleys respectively (Woods et. al., 1996).

Ecological site concept

The Mixed Limestone Lower Slope ecological sites occur throughout MLRA 147 on lower slopes of hills within valleys on soil material derived from a mixture of limestone, calcareous shale, or mixed limestone and sedimentary geologies. These sites occur less commonly in mountains. They occupy positions on midslopes, footslopes, toeslopes, benches, depressions, drainageways, swales, fans, valley floors, and valley sides. Slopes are generally moderately to gently sloping and can be concave, planar, or slightly convex. Depth to bedrock is greater than 40 inches (100 cm) and most sites are moderately well to somewhat poorly drained with the seasonal high water table occurring between 10 to 48 inches (25 to 122cm). Dense subsurface soil layers called fragipans are characteristic of these landscapes. Fragipans impede the downward growth of tree roots and also prevent rapid drainage of water. Generally these sites are not subject to flooding or ponding. They have favorable moisture conditions for plant

growth.

The majority of these areas are cleared for agricultural production. Existing woodland and forest generally contain *Acer saccharum* (Sugar maple) and Tilia Americana (American basswood) as the dominant canopy tree species. Fraxinus Americana (White ash) is frequent but not necessarily abundant. *Acer rubrum* (Red maple), *Fagus grandifolia* (American beech), and *Prunus serotina* (Black cherry) are typical associates. These mid to lower slope ecological sites are rich relative to the acidic shale and sandstone uplands, and contain more moisture compared to the Limestone uplands.

Associated sites

F147XY003PA	**Mixed Limestone Upland** Mixed Limestone Upland

Table 1. Dominant plant species

Tree	(1) *Acer saccharum* (2) *Tilia americana*
Shrub	(1) *Acer pensylvanicum*
Herbaceous	(1) *Caulophyllum thalictroides*

Physiographic features

The Mixed Limestone Lower Slope ecological sites are found in hills and valleys associated with limestone, calcareous shale, or mixed limestone and sedimentary geologies. These sites occur less commonly in mountains. On the landscape they occupy positions on footslopes, toeslopes, benches, depressions, drainageways, swales, fans, valley floors, and valley sides. The parent material is predominantly colluvium but also residuum and old glacial till derived from calcareous shale, limestone, cherty limestone, dolomite, siltstone, sandstone, and in some places from metasedimentary rocks like marble, mica schists, phyllite, and quartzite. Karst valleys are characteristic of many of these landscapes. Where the ecological sites occupy glacial till, the till is pre-Illinoian and most likely >770,000 years old.

Most sites are moderately well to somewhat poorly drained with the seasonal high water table occurring between 10 to 48 inches (25 to 122 cm). Dense subsurface soil layers called fragipans are characteristic of these landscapes. Fragipan impede the downward growth of tree roots and also prevent rapid drainage of water. Generally these sites are not subject to flooding or ponding. They have favorable moisture conditions for plant growth.

Table 2. Representative physiographic features

Landforms	(1) Valley (2) Hill (3) Swale
Runoff class	Low to very high
Elevation	27–579 m
Slope	0–25%
Water table depth	25–122 cm
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 8 weather stations throughout MLRA 147 in proximity to this ecological site. 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)	135-148 days
Freeze-free period (characteristic range)	170-189 days
Precipitation total (characteristic range)	940-1,092 mm
Frost-free period (actual range)	124-156 days
Freeze-free period (actual range)	156-189 days
Precipitation total (actual range)	914-1,143 mm
Frost-free period (average)	142 days
Freeze-free period (average)	178 days
Precipitation total (average)	1,016 mm

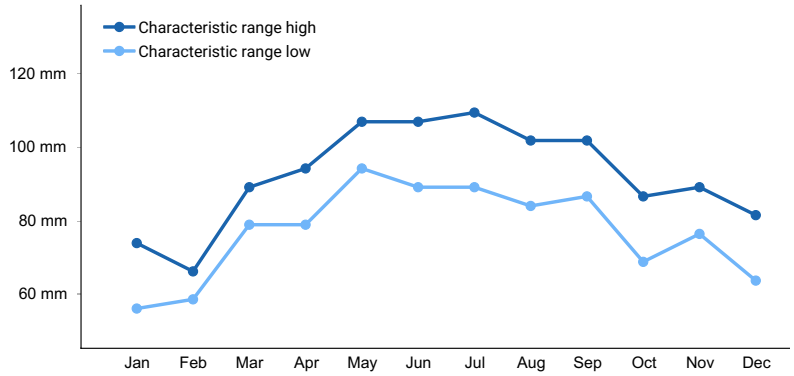


Figure 1. Monthly precipitation range

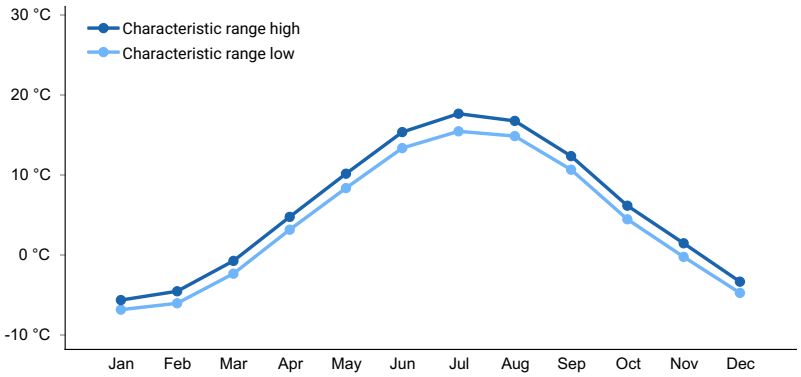


Figure 2. Monthly minimum temperature range

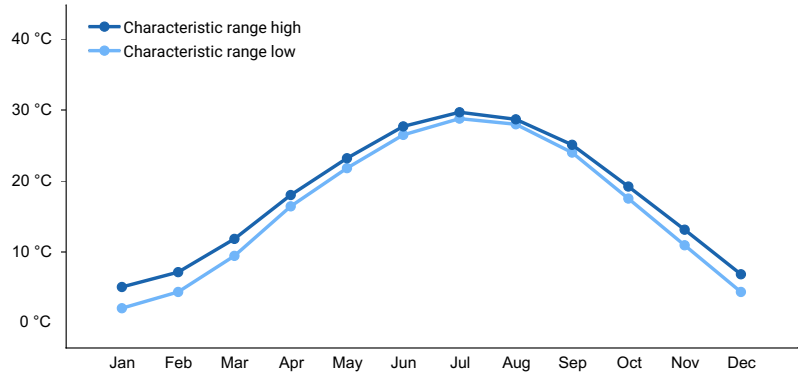


Figure 3. Monthly maximum temperature range

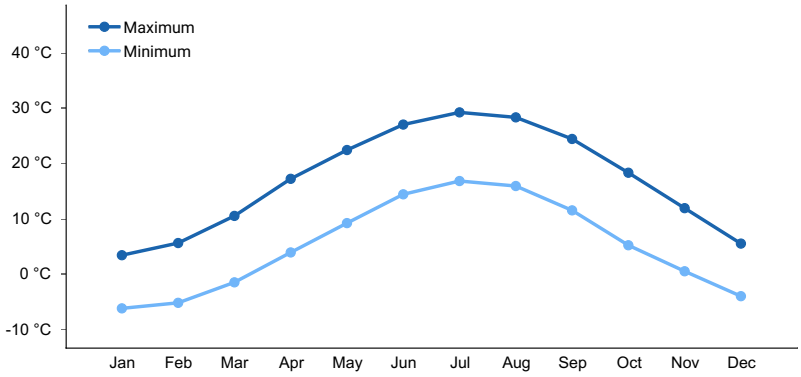


Figure 4. Monthly average minimum and maximum temperature

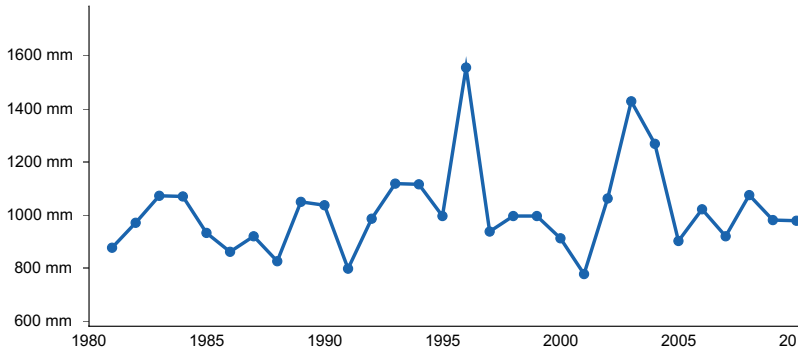


Figure 5. Annual precipitation pattern

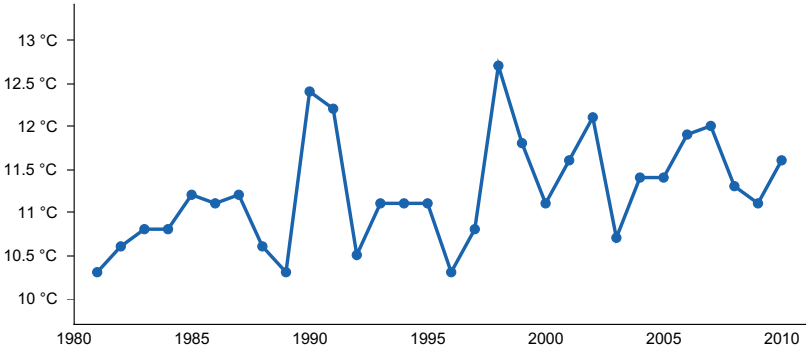


Figure 6. Annual average temperature pattern

Climate stations used

- (1) LEWISBURG [USC00364976], Lewisburg, PA
- (2) STATE COLLEGE [USC00368449], State College, PA
- (3) WINCHESTER 7 SE [USC00449186], Winchester, VA

- (4) CHAMBERSBURG 1 ESE [USC00361354], Chambersburg, PA
- (5) HAMBURG [USC00363632], Hamburg, PA
- (6) EVERETT [USC00362721], Everett, PA
- (7) DALE ENTERPRISE [USC00442208], Dayton, VA
- (8) FRANKLIN 2 NE [USC00463215], Franklin, WV

Influencing water features

This ecological site is not influenced by wetland or riparian water features.

Soil features

The representative soil series associated with this site are: Wiltshire, Watson, Tumbling, Slabtown, Poorhouse, Penlaw, Nixa, Nicholson, Natalie, Kreamer, Guernsey, Clarksburg, and Alvira. They have weathered from mixed geologies of calcareous shale, limestone, cherty limestone, dolomite, siltstone, sandstone, and in some places from metasedimentary rocks including marble, mica schists, phyllite, and quartzite. The soils are mostly derived from colluvium, which is material that has moved from upper slopes to lower positions. In some cases, the soils have developed from bedrock that has weathered in place, and less commonly from pre-Illinoian glacial till (>770,000 years before present). Soils data was obtained from the Natural Resources and Conservation Service (NRCS) National Soils Information System database (USDA 2015).

The soils that underlie this ecological site are predominantly moderately well to somewhat poorly drained with the seasonal high water table usually occurring between 10 to 48 inches (25 to 122 cm) below the surface during the wettest times of the year. Dense subsurface soil layers called fragipans are characteristic of soils in this landscape. Fragipans impede the downward growth of tree roots and the downward movement of water.

Surface texture is mostly silt loam, loam and fine sandy loam. Most soils have a clay increase in the subsoil with textures of silty clay loam, clay loam, silt loam, and loam.

Table 4. Representative soil features

Parent material	(1) Colluvium–limestone (2) Residuum–limestone and shale (3) Till–sandstone and shale
Surface texture	(1) Channery silt loam (2) Gravelly loam (3) Fine sandy loam
Family particle size	(1) Loamy
Drainage class	Somewhat poorly drained to well drained
Permeability class	Slow to moderate
Soil depth	152–216 cm
Surface fragment cover <=3"	0–7%
Surface fragment cover >3"	2–7%
Available water capacity (0-101.6cm)	10.67–17.02 cm
Soil reaction (1:1 water) (0-101.6cm)	4.6–6.5
Subsurface fragment volume <=3" (Depth not specified)	0–50%
Subsurface fragment volume >3" (Depth not specified)	0–11%

Ecological dynamics

The vegetation groupings described in this section are based on the terrestrial ecological system classification and

vegetation associations developed by NatureServe (Comer 2003) and the Natural Heritage Programs of Pennsylvania (Zimmerman et al. 2012), Virginia (Fleming et al. 2013), West Virginia (WVDNR 2014), and Maryland (Harrison 2004). Terrestrial ecological systems are specifically defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients. They are intended to provide a classification unit that is readily mappable, often from remote imagery, and readily identifiable by conservation and resource managers in the field. A given system will typically manifest itself in a landscape at intermediate geographic scales of tens to thousands of hectares and will persist for 50 or more years. A vegetation association is a plant community that is much more specific to a given soil, geology, landform, climate, hydrology, and disturbance history. It is the basic unit for vegetation classification. Each association will be named by the dominant species that occupy the different strata (tree, sapling, shrub, and herb). Within the NatureServe database, individual vegetation associations are assigned an identification number called a Community Element Global Code (CEGL).

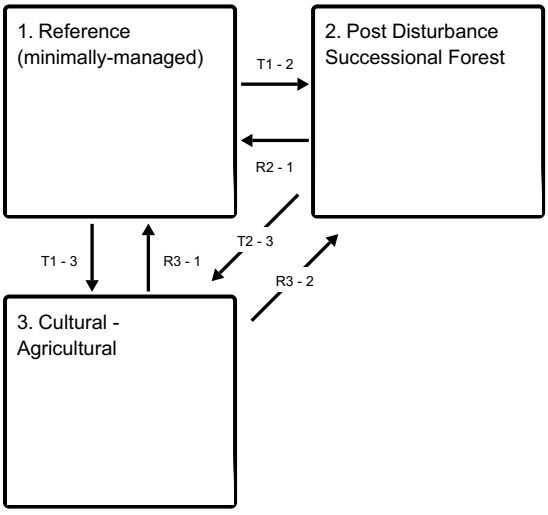
The Mixed Limestone Lower Slope Ecological Site is located in the Ridge and Valley region of the Appalachian Highlands, an area that has undergone extensive human disturbance since pre and post-European settlement times (Braun, 1950). The topography and landscape position ranges from slightly convex to concave middle and lower slope positions, predominantly on colluvial material weathered from limestone, dolomite, calcareous siltstone, sandstone, and shales and in some places from metasedimentary rocks including marble, mica schists, phyllite, and quartzite. In some cases, the soils have developed from bedrock that has weathered in place, and less commonly from pre-Illinoian glacial till (>770,000 years before present).

These ecological sites occur within areas defined by the Northeastern Interior Dry-Mesic Oak Forest System (CES202.592), however, the current forest, which is not dominated by oak, is most often associated with the Laurentian-Acadian Northern Hardwoods Forest (CES201.564 (NatureServe 2009; Landfire 2013). Agriculture is the main land use of this ecological site and a long history of disturbance makes it difficult to determine the true composition of the original reference forest community. Existing woodland and forest generally contain *Acer saccharum* (sugar maple) and Tilia Americana (American basswood) as the dominant canopy tree species. Fraxinus Americana (White ash) is frequent but not necessarily abundant. *Acer rubrum* (red maple), *Fagus grandifolia* (American beech), and *Prunus serotina* (Black cherry) are typical associates. These mid to lower slope ecological sites are rich relative to the acidic shale and sandstone uplands, and contain more moisture compared to the Limestone uplands.

A ruderal tuliptree community exists as a successional alternate state on abandoned farmland and townsites, old clearcuts, burned areas and places where the canopy was removed or heavily disturbed. These woodland/forests tend to be heavily colonized by invasive species such as *Microstegium vimineum* (Nepalese browntop), Alliaria petiola (Garlic mustard), *Rosa multiflora* (Multiflora rose), Berberis japonica (Japanese barberry), various Lonicera (Honeysuckle), and Rubus (Blackberry).

State and transition model

Ecosystem states



State 1 submodel, plant communities

1.1. Acer saccharum – Tilia Americana/Acer pensylvanicum/Caulophyllum thalictroides Forest

State 2 submodel, plant communities

2.1. Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin) Ruderal Forest

State 3 submodel, plant communities

3.1. Row Crops or Pasture

State 1
Reference (minimally-managed)

Agriculture is the dominant land use for the Mixed Limestone Lower Slope ecological site. The history of human disturbance makes it difficult to determine the true reference forest state. The *Acer saccharum* (Sugar maple) and Tilia Americana (American Basswood) vegetation association may in reality reflect the current naturalized, minimally managed state rather than the historic, pre-European settlement condition. The information presented is representative of very complex vegetation communities. Key indicator plants, animals and ecological processes are described to help inform land management decisions. The plant associations listed are not intended to cover every situation nor the full range of conditions and species as they will differ across the Ridge and Valley region because of the naturally occurring variability in weather, soils, and slope aspect.

Community 1.1
Acer saccharum – Tilia Americana/Acer pensylvanicum/Caulophyllum thalictroides Forest

The Sugar Maple - American Basswood / Striped Maple / Blue Cohosh Forest, also known as the Transitional Northern Sugar Maple - Ash Rich Mesic Forest (CEGL006637 - NatureServe 2015) occurs on nutrient-rich, mesic or wet-mesic settings on sloped to rolling terrain and slope bottoms, where colluvium collects. The sites are somewhat poorly drained to well-drained and can have a water table within 16 to greater than 79 inches (40 to 200 cm) below the surface. Small, <2.5 acre (<1 ha), seep areas that may occur within these forests have soils that are usually saturated. This forest community has a well-developed tree canopy composed of deciduous species. Shrubs are scattered, but the herbaceous stratum is generally extensive. Bryoids are only a minor component of the ground layer, which is predominantly nitrogen-rich sugar maple leaves. *Acer saccharum* (Sugar maple) and *Tilia americana* (American basswood) are the dominant trees; *Fraxinus americana* (White ash) is frequent but not necessarily abundant. *Ostrya virginiana* (Hophornbeam) is very common as a small tree. *Acer rubrum* (red maple), *Fagus grandifolia* (American beech), and *Prunus serotina* (Black cherry) are typical associates, in small amounts. *Ulmus rubra* (Slippery elm) and *Juglans cinerea* (Butternut) are occasional, *Magnolia acuminata* (Cucumber tree) infrequent. Shrubs that may be found in this community include *Cornus alternifolia* (Alternateleaf dogwood), *Hamamelis virginiana* (American witch hazel), and Lonicera Canadensis (American fly honeysuckle). The ground flora, including many spring ephemerals, is diverse and consists primarily of nutrient- and light-requiring species. Many of these flower and fruit early in the spring before the tree canopy has fully leafed out. Fern richness is often high. Various sedges are present.

State 2
Post Disturbance Successional Forest

Community 2.1
Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin) Ruderal Forest

The Tuliptree / (Eastern Redbud) / (Northern Spicebush) Ruderal Forest, also known as the Ruderal tuliptree Forest (Rich type) (CEGL007220 - NatureServe 2015) is distinguished from other upland communities dominated by *Liriodendron tulipifera* by the presence of species associated with soils with moderately high base saturation levels (rich soils). Species found in stands attributable to this type may be fairly diverse and result in a varied composition. In addition to *Liriodendron tulipifera* (Tuliptree), other canopy species may include *Liquidambar styraciflua* (Sweetgum), *Acer saccharum* (Sugar maple), *Aesculus flava* (Yellow buckeye), *Platanus occidentalis* (American sycamore), *Quercus rubra* (Northern red oak), *Acer rubrum* (Red maple), *Robinia pseudoacacia* (Black locust), *Juglans nigra* (Black walnut), *Halesia tetraptera* (Mountain silverbell), Fraxinus Americana (White ash), *Fagus grandifolia* (American beech), *Magnolia acuminata* (Cucumber tree), *Ulmus rubra* (Slippery elm), *Quercus imbricaria* (Shingle imbricaria), *Quercus muehlenbergii* (Chinkapin oak), and *Carya ovata* (Shagbark hickory). Species often found in the subcanopy include *Acer saccharum* (Sugar maple), Cercis Canadensis (Eastern redbud), *Ulmus alata* (Winged elm), Fraxinus Americana (White ash), *Morus rubra* (Red mulberry), and *Cornus florida* (Flowering dogwood). Shrubs include saplings of the subcanopy and canopy species, as well as *Lindera benzoin* (Spicebush), *Symphoricarpos orbiculatus* (Coralberry), *Asimina triloba* (Pawpaw), *Staphylea trifolia* (American bladdernut), *Acer negundo* (*Acer negundo*), and *Juniperus virginiana* (Eastern red cedar). Exotic shrubs, including *Rosa multiflora* (Multiflora rose), *Rubus phoenicolasius* (Wine raspberry), and *Lonicera japonica* (Japanese honeysuckle), are present at some sites. Herb-layer species include the exotics *Microstegium vimineum* (Nepalese browntop), *Alliaria petiolata* (Garlic mustard), and *Veronica hederifolia* (Ivyleaf speedwell), as well as *Toxicodendron radicans* (Poison ivy), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax tamnoides* (Bristly greenbrier), Actaea racemose (Black bugbane), *Caulophyllum thalictroides* (Blue cohosh), Laportea Canadensis (Canadian woodnettle), *Impatiens pallida* (Pale touch-me-not), *Hydrophyllum canadense* (Bluntleaf waterleaf), *Adiantum pedatum* (Northern maidenhair), *Polygonatum pubescens* (Hairy Solomon's seal), *Verbesina alternifolia* (Wingstem), *Amphicarpaea bracteata* (American hogpeanut), and *Polystichum acrostichoides* (Christmas fern).

State 3
Cultural - Agricultural

Community 3.1
Row Crops or Pasture

The agricultural state is planted either to row crops like corn and soybeans, or in managed pastures of non-native forages. Non-native grasses may include cool season species such as *Schedonorus arundinaceus* (Tall fescue), Phleum pretense (Timothy) and *Dactylis glomerata* (Orchardgrass). Other species included *Sorghum halepense* (Johnsongrass), Setaria spp. (Foxtails), Panicum spp. (Panic grass), Amaranthus spp. (Amaranth), *Taraxacum officinale* (Common dandelion), and *Cirsium arvense* (Canada thistle). Surface fragments, low organic matter content and soil acidity make agriculture harder to maintain in a healthy, productive state on this ecological site.

Transition T1 - 2
State 1 to 2

Historically logged and cleared; possibly plowed, pastured, and grazed. Long term succession; no longer grazed.

Transition T1 - 3
State 1 to 3

Clearcutting; tillage; conversion to agricultural land; fertilizer and lime application; active management.

Restoration pathway R2 - 1
State 2 to 1

Remove understory, plant native seeds and seedlings, eliminate and manage nonnative species, implement a

prescribed fire plan. Return to the reference or post logged minimally managed state may require a very long term series of costly management options and stages. Many species may need to be planted or seeded to restore the system. Herbivory can be a problem as well as competition from faster growing species. Depending on the existing seed bank and the proximity of a mature forest from which to recruit seeds, ruderal forests may regain a mixed forest stand. Nevertheless, sites that have been cleared and tilled have significant soil disturbance which may include compaction, erosion, loss of native soil structure, loss of soil organic matter, disruption of soil microorganisms, all which affect the soil's nutrient availability and water holding capacity (Duiker and Myers, 2005). These characteristics favor recolonization by plant species that have wind dispersed seeds (verses those that propagate through underground roots called rhizomes, or which have heavy seeds that stay near the parent tree), are shade intolerant, have rapid to moderate growth rates, and drought tolerance (Dyer, 2010). Aggressive control of nonnative species and invasive species will be ongoing. The following conservation practices from the Natural Resources Conservation Service Field Office Technical Guide can be used for restoration efforts (FOTG-USDA): Brush Management-314; Critical Area Planting-342; Early Successional Habitat Development-647; Fence-382; Forest Stand Improvement-666; Herbaceous Weed Control-315; Tree/Shrub site Preparation-490; Upland Wildlife habitat management-645.

Conservation practices

Brush Management
Critical Area Planting
Fence
Tree/Shrub Site Preparation
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Forest Stand Improvement
Herbaceous Weed Control

Transition T2 - 3
State 2 to 3

Clearcutting; tillage; conversion to agricultural land; fertilizer and lime application; active management.

Restoration pathway R3 - 1
State 3 to 1

Cease agricultural management, exclude grazing, plant native seeds and seedlings, eliminate and manage nonnative and aggressive species, implement prescribed fire plan. Return to the reference or post logged minimally managed state may require a very long term series of costly management options and stages. Many species may need to be planted or seeded to restore the system. Herbivory can be a problem as well as competition from faster growing species. Depending on the existing seed bank and the proximity of a mature forest from which to recruit seeds, ruderal forests may regain a mixed forest stand. Nevertheless, sites that have been cleared and tilled have significant soil disturbance which may include compaction, erosion, loss of native soil structure, loss of soil organic matter, disruption of soil microorganisms, all which affect the soil's nutrient availability and water holding capacity (Duiker and Myers, 2005). These characteristics favor recolonization by plant species that have wind dispersed seeds (verses those that propagate through underground roots called rhizomes, or which have heavy seeds that stay near the parent tree), are shade intolerant, have rapid to moderate growth rates, and drought tolerance (Dyer, 2010). Aggressive control of nonnative species and invasive species will be ongoing. The following conservation practices from the Natural Resources Conservation Service Field Office Technical Guide can be used for restoration efforts (FOTG-USDA): Brush Management-314; Critical Area Planting-342; Early Successional Habitat Development-647; Fence-382; Forest Stand Improvement-666; Herbaceous Weed Control-315; Tree/Shrub site Preparation-490; Upland Wildlife habitat management-645.

Conservation practices

Brush Management

Critical Area Planting
Fence
Tree/Shrub Site Preparation
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Forest Stand Improvement
Herbaceous Weed Control

Restoration pathway R3 - 2
State 3 to 2

Cease agricultural management, exclude grazing, and allow long term succession.

Additional community tables

Inventory data references

Site Development and Testing Plan
Future work is needed, as described in a future project plan, to validate the information presented in this provisional ecological site description. Future work includes field sampling, data collection and analysis by qualified vegetation ecologists and soil scientists. As warranted, annual reviews of the project plan can be conducted by the Ecological Site Technical Team. A final field review, peer review, quality control, and quality assurance reviews of the ESD are necessary to approve a final document.

Other references

Bailey, Robert G. 1995. Description of the ecoregions of the United States 2d ed. Rev. and expanded (1st ed. 1980). Misc. Publ. No. 1391 (rev.), Washington, DC: USDA Forest Service. 108p. with separate map at 1:7,500,000.

Braun, E. Lucy. 1950. Deciduous Forests of Eastern North America. Philadelphia and Toronto: The Blakiston Company.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K., Snow, and J.Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington,Virginia.

Daily, Paul. 1971. Climate of Pennsylvania, in Climatography of the United States No. 60-36, Climates of the States. Washington, DC: U.S. Government Printing Office.

Duiker, S. W. and J.C. Myers, 2005. Better Soils with the NoTill System, A Publication to Hellp Farmers Understand the Effect of No-Till Systems of the Soil. USDA Natural Resources Conservation Service.

Dyer, James, M. 2010. Land-use legacies in a central Appalachian forest differential response of trees and herbs to to historic agricultural practices. Applied Vegetation Science 13:195-206.

Fleming, G.P., K.D. Patterson, K. Taverna, and P.P. Coulling. 2013. The natural communities of Virginia: classification of ecological community groups. Second approximation. Version 2.6. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

FOTG-Field Office Technical Guide, Section IV-Practice Standards and Specifications, USDA, Natural Resources Conservation Service, https://efotg.sc.egov.usda.gov/

Harrison, J.W. 2004. Classification of vegetation communities of Maryland: First iteration. NatureServe and Maryland Natural Heritage Program, Wildlife and Heritage Service, Maryland Department of Natural Resources.

Annapolis, MD.

LANDFIRE: LANDFIRE Biophysical Settings. (2010, January 01 - last update). U.S. Department of Interior, Geological Survey. [Online]. Available: http://landfire.cr.usgs.gov/viewer/ [2015, June 5].

NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 06 February 2009.

NatureServe 2015. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://explorer.natureserve.org. (Accessed: November-December 2015).

NatureServe 2017. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://explorer.natureserve.org. (Accessed: December 2017).

PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu, created February 26, 2013.

United States Department of Agriculture, Natural Resources Conservation Service, National Water and Climate Center, http://www.wcc.nrcs.usda.gov, Accessed February 2015.

United States Department of Agriculture, Natural Resources Conservation Service, 2006. Land Resource Regions and Major land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296, 669p.

United States Department of Agriculture, Natural Resources Conservation Service, 2015. National Soils Information System.

United States Environmental Protection Agency, 2013, Level III ecoregions of the continental United States: Corvallis, Oregon, U.S. EPA-National health and Environmental Effects Research Laboratory, map scale 1:7,500,000, http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm.

Woods, A.J., J.O. Omernik, D.D. Brown, C.W. Kiilsgaard. 1996. Level IV Ecoregions of EPA Region 3. US Environmental Protection Agency National Health and Environmental Effects Research Laboratory, Corvallis, Oregon. Map scale 1:250,000.

WVDNR [West Virginia Division of Natural Resources]. 2014. Plots2-WV database of community ecology plots. West Virginia Natural Heritage Program, WVDNR, Elkins, WV.

Zimmerman, E., T. Davis, G. Podniesinski, M. Furedi, J. McPherson, S. Seymour, B. Eichelberger, N. Dewar, J. Wagner, and J. Fike (editors). 2012. Terrestrial and Palustrine Plant Communities of Pennsylvania, 2nd Edition. Pennsylvania Natural Heritage Program, Pennsylvania Department of Conservation and Natural Resources, Harrisburg, Pennsylvania.

Approval

Nels Barrett, 9/27/2024

Acknowledgments

This current draft provisional ecological site (PES) report is a generalized description of landform, climate, physiography, soils and associated vegetation. Future work is needed to validate this information and further refine the report into an ecological site description (ESD). An ESD will include detailed plant floristic inventory data on the reference state and most commonly occurring alternate states, interpretations for different land use, site productivity data, as well as descriptions of the ecological dynamics. Development of ESDs will require field data collection of soils and vegetation and subsequent data analysis. Production of ESDs will begin after draft provisional ecological site reports have been completed for most soil survey areas. The target completion date for PES is 2020, therefore the development of ESDs will not start until 2021. ESD development prioritization will be based on national priorities, state priorities, soil survey regional priorities, and funding and staffing limitations.

The following people assisted with the development of this provisional ecological site report:

Yuri Plowden, Ecological Site Specialist, NRCS, Mill Hall, PA
Aron Sattler, 6-MIL Soil Survey Project Leader, NRCS, Mill Hall, PA
Mike McDevitt, Soil Scientist, NRCS, Mill Hall, PA
Nels Barrett, Ph.D, Regional Ecological Site Specialist, NRCS, Amherst, MA
Ephraim Zimmerman, Ecological Assessment Manager, Western PA Conservancy, Pittsburgh, PA
Don Flegel, Resource Soil Scientist, NRCS, Harrisonburg, VA
Kevin Godsey, Ecological Site Specialist, NRCS, Springfield, MO

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	05/13/2025
Approved by	Nels Barrett
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:

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

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

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

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:**

17. **Perennial plant reproductive capability:**