Ecological site F147XY002PA
Mixed Sedimentary Upland

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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 (USDA 2006). 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.

Classification relationships

This ecological site is found in Major Land Resource Area 147- Northern Appalachian Ridges and Valleys. MLRA 147 is located within Land Resource Region S - Northern Atlantic Slope Diversified Farming Region (USDA 2006), and in United States Forest Service ecoregion M221A – 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 (USEPA 2013). The Mixed Sedimentary Upland ecological site occurs within 67b, Northern Shale Valleys, and 67d, Northern Dissected Ridges of EPA Ecoregion IV (Woods et. al. 1996).

Ecological site concept

Mixed Sedimentary Uplands ecological sites occur throughout MLRA 147 on noncalcareous to acidic sedimentary geology primarily composed of shales, siltstones, and fine-grained sandstones. This ecological site occurs on sideslopes and some summits where depth to bedrock is greater than 40 inches (101 cm) and soils are predominantly well drained. These forests are defined by the Northeastern Interior Dry-Mesic Oak Forest System (CES202.592), one of the matrix forest systems in the northeastern and north-central U.S. (NatureServe 2009; Landfire 2010). Occurring in dry-mesic settings, they are typically closed-canopy forests, though there may be areas of patchy-canopy woodlands. Oak species characteristic of dry-mesic conditions like *Quercus rubra* (Northern red oak), *Quercus alba* (White oak), *Quercus velutina* (Black oak), and *Quercus coccinea* (Scarlet oak) and Carya spp. (hickory) are dominant in mature stands. *Castanea dentata* (American chestnut) was a prominent tree before chestnut blight eradicated it as a canopy constituent. *Acer rubrum* (red maple), *Betula lenta* (Sweet

birch), *Fagus grandifolia* (American beech), and Betula alleghaniensis (Yellow birch), may be common associates; *Acer saccharum* (Sugar maple) is occasional. Soils are mostly acidic and relatively infertile but not strongly xeric. Local areas of calcareous bedrock, or colluvial pockets, may support forests typical of richer soils. This ecological site is highly variable due to the history of disturbance, the heterogeneous geology, and the subtle micro climate differences due to aspect and position on the landscape. This ecological site will most likely be split as field work investigations continue.

Associated sites

F147XY008PA	**Shallow Mixed Sedimentary Upland** Shallow to Moderately Drained Acid Mixed Sedimentary Upland

Similar sites

F147XY004PA	**Sandstone Upland** Sandstone Upland

Table 1. Dominant plant species

Tree	(1) *Quercus alba* (2) *Quercus prinus*
Shrub	(1) *Cornus florida*
Herbaceous	(1) *Vaccinium pallidum*

Physiographic features

The Mixed Sedimentary Upland ecological site occurs in uplands on noncalcareous to acidic mixed sedimentary geology primarily composed of shales, siltstones, and fine-grained sandstones. Typical landscapes are rolling hills in narrow valleys. The ecological site can be found on the entire hill from top to bottom, but generally occupies the sideslope and upper footslope positions, and less commonly toeslopes or shoulders. This site differs from the Shallow Mixed Sedimentary Uplands in that depth to bedrock is greater, occurring below 40 inches (51 cm) which allows for greater rooting depth for trees and more available moisture.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Fan (3) Mountain slope
Runoff class	Very low to very high
Elevation	55–1,158 m
Slope	0–55%
Water table depth	71–152 cm
Aspect	W, N, E

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 11 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)	132-144 days
Freeze-free period (characteristic range)	169-180 days
Precipitation total (characteristic range)	940-1,092 mm
Frost-free period (actual range)	119-147 days
Freeze-free period (actual range)	153-184 days
Precipitation total (actual range)	914-1,118 mm
Frost-free period (average)	137 days
Freeze-free period (average)	172 days
Precipitation total (average)	991 mm

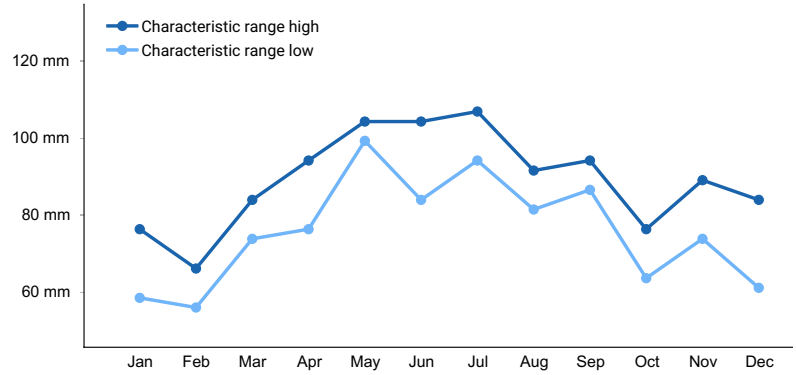


Figure 1. Monthly precipitation range

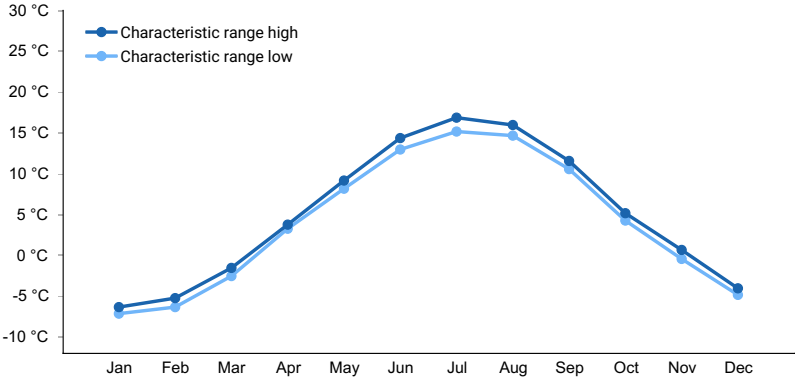


Figure 2. Monthly minimum temperature range

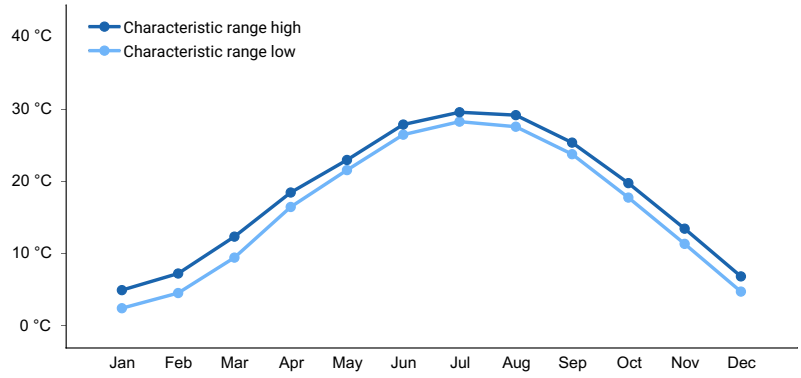


Figure 3. Monthly maximum temperature range

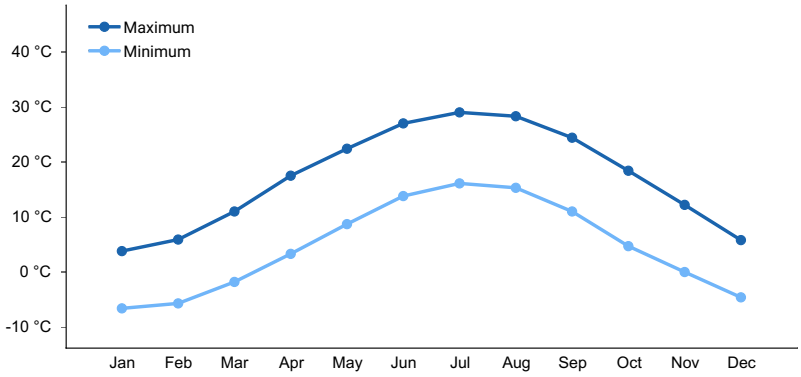


Figure 4. Monthly average minimum and maximum temperature

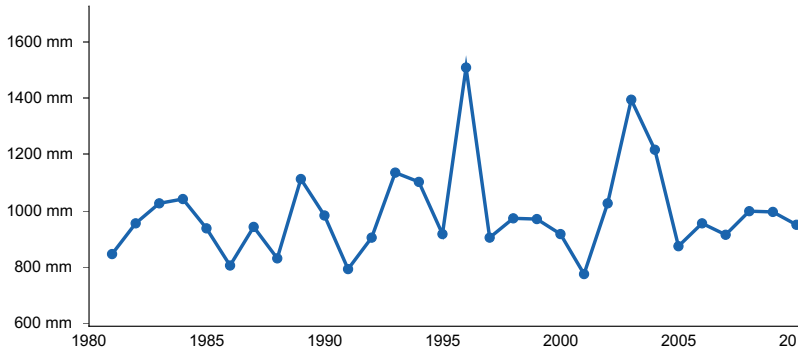


Figure 5. Annual precipitation pattern

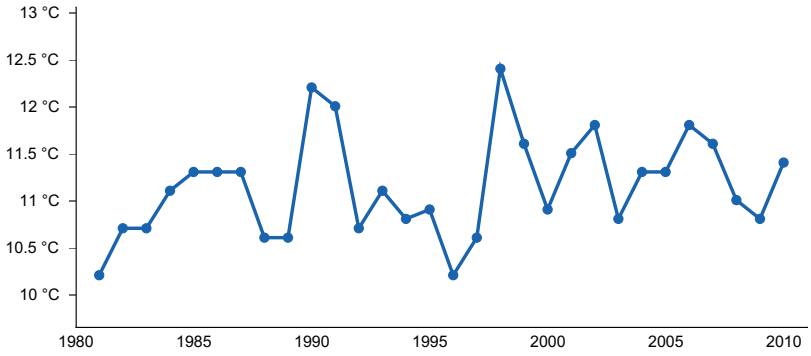


Figure 6. Annual average temperature pattern

Climate stations used

- (1) HANCOCK [USC00184030], Hancock, MD
- (2) STATE COLLEGE [USC00368449], State College, PA
- (3) GATHRIGHT DAM [USC00443310], Covington, VA

- (4) BEAR GAP [USC00360457], Coal Township, PA
- (5) EVERETT [USC00362721], Everett, PA
- (6) DALE ENTERPRISE [USC00442208], Dayton, VA
- (7) LEBANON 2 W [USC00364896], Lebanon, PA
- (8) HOT SPRINGS [USC00444128], Hot Springs, VA
- (9) ROMNEY 1 SW [USC00467730], Romney, WV
- (10) EDINBURG [USC00442663], Edinburg, VA
- (11) MATHIAS [USC00465739], Lost City, WV

Influencing water features

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

Soil features

Representative soil series associated with this site are: Zepp, Wharton, Vanderlip, Ungers, Trappist, Tilsit, Sideling, Shouns, Shelocta, Rushtown, Rayne, Pennval, Murrill, Meckesville, Macove, Laidig, Kedron, Jefferson, Hustontown, Hartleton, Evendale, Escatawba, Ernest, Drifton, Cookport, Comly, Clearbrook, Buchanan, Blairton, Blackthorn, Bedington, and Albrights. These soils have weathered from mixed geologies of acidic shales, sandstones, siltstones, and less commonly limestone or calcareous rocks. The soils are mostly derived from material that has moved from upper slopes to lower positions, called colluvium. In some cases, the soils have developed from bedrock that has weathered in place. 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 well drained with the seasonal high water table usually occurring between 17 to greater than 40 inches (43 to 102cm) depth. The ecological site may include areas where the water table can be within 6 to 18 inches (15 to 46cm) of the soil surface during the wettest times of the year, due to the presence of a fragipan which is a dense subsoil layer typically found in lower slope soils in the Valley and Ridge province. These fragipans impede the drainage of water. Depth to bedrock is usually greater than 60 inches (152 cm), but can be shallower in some areas where bedrock outcrops are closer to the surface.

Surface textures range from silt loam, loam, sandy loam, loamy sand, and silty clay loam. Ranges of some soil chemical and physical properties are listed below.

Table 4. Representative soil features

Parent material	(1) Residuum–acid shale (2) Colluvium–shale and siltstone
Surface texture	(1) Channery silt loam (2) Very channery loam (3) Very stony sandy loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to excessively drained
Permeability class	Very slow to rapid
Soil depth	43–249 cm
Surface fragment cover <=3"	0–70%
Surface fragment cover >3"	0–70%
Available water capacity (0-101.6cm)	5.08–18.29 cm
Soil reaction (1:1 water) (0-101.6cm)	4.5–5.6
Subsurface fragment volume <=3" (Depth not specified)	2–68%

Subsurface fragment volume >3" (Depth not specified)	0–75%

Ecological dynamics

Information contained in this section was adapted from several sources, including the Landfire Biophysical Settings layer (Landfire 2010), NatureServe's Community Element Global System (CEGL) descriptions of vegetation (NatureServe 2009; NatureServe 2015), and the Natural Heritage Programs of Pennsylvania (Zimmerman et al. 2012), Virginia (Fleming et al. 2013), West Virginia (WVDNR 2014), and Maryland (Harrison 2004). 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. Plant communities will differ across the MLRA because of the naturally occurring variability in weather, soils, and aspect. The reference plant community is not necessarily the management goal. 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.

The Mixed Sedimentary Upland 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). This ecological site occurs in uplands on noncalcareous to acidic mixed sedimentary geology primarily composed of shales, siltstones, and fine-grained sandstones. Typical landscapes are rolling hills in narrow valleys. The ecological site can be found on the entire hill from top to bottom, but generally occupies the sideslope and upper footslope positions, and less commonly toeslopes or shoulders.

The reference state is a combination of several vegetation associations within the Northeastern Interior Dry-Mesic Oak Forest System (CES202.592), and Central Appalachian Dry Oak-Pine Forest System (CES202.591) as defined by NatureServe (NatureServe 2009). In general, the dominant species are oak and hickory, but these areas can also have overstories of tulip poplar, pine, and/or hemlock. Where soils are drier, heath shrubs like *Vaccinium pallidum* (Blue Ridge blueberry) may dominate the herb layer. With more moisture, *Amphicarpaea bracteata* (American hogpeanut), *Dennstaedtia punctilobula* (Eastern hayscented fern), Eurybia divaricate(White wood aster) and *Polystichum acrostichoides* (Christmas fern) may be patchy to moderately dense.

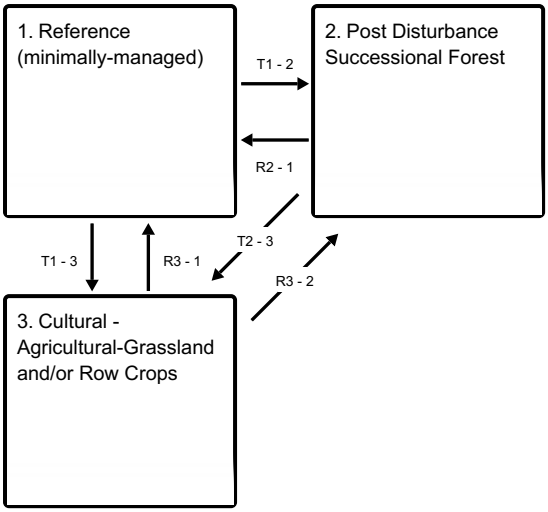
The hemlock woolly adelgid (Adelges tsugae) is causing close to 100% mortality of hemlocks in some areas of this ecological site. Field reconnaissance in 2016 confirmed significant opening of the canopy due to hemlock die off. The insect will most likely cause canopy hemlocks to be replaced by other trees. Many dead Chestnut oak have also been observed throughout the region. The tree damage may have been caused by gypsy moth (Lymantria dispar), which prefers chestnut oaks and white oaks over other tree species (Burns 1990).

Windthrow, fire, and ice storms are natural disturbances in these habitats. Oak forests historically have been maintained by periodic fire. Fire suppression since the early 20th century in the eastern United States is believed to be leading to the overall replacement of oaks with fire-sensitive, non-oak species like maples, beeches, birches, tulip poplars, and black cherry (Brose et. al. 2008). Oak forest regeneration is also hindered by heavy deer browsing (Latham et. al. 2005). Deer will selectively consume many native species including oak seedlings and acorns over less palatable species like hay-scented fern and several non-native species including Japanese barberry, Eurasian species of honeysuckle, and garlic mustard.

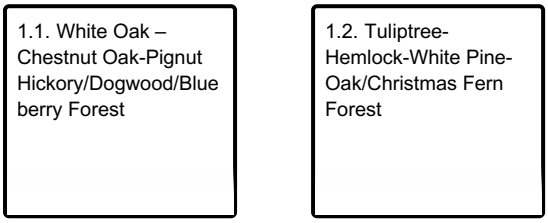
Much of this site has been subjected to heavy disturbance either through repeated logging and/or agriculture. The resulting alternate state is a successional forest often dominated by *Acer rubrum* (red maple), *Liriodendron tulipifera* (Tuliptree), *Betula lenta* (Sweet birch), some oak species and an assortment of herbaceous and nonnative species. Cropped fields or pasture do exist on this ecological site as alternative states, although many areas have a considerable amount of surface stones which would have hindered agricultural production.

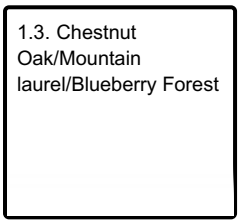
State and transition model

Ecosystem states

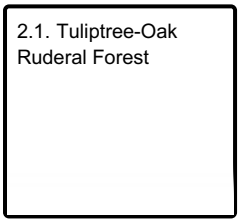


State 1 submodel, plant communities

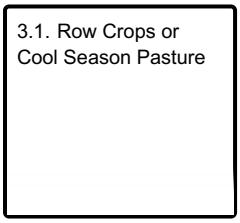




State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference (minimally-managed)

The reference state is a combination of several vegetation associations within the Northeastern Interior Dry-Mesic Oak Forest System (CES202.592), and Central Appalachian Dry Oak-Pine Forest System (CES202.591) as defined by NatureServe (NatureServe 2009). Due to the long history of human activity, the associations listed below may in reality reflect the current naturalized, minimally managed state rather than the historic, pre-European settlement condition. These areas will have oak and hickory species characteristic of dry to mesic conditions as well as mesophytic (moisture loving) hardwood or hemlock-hardwood forests. Due to the heterogeneity and the

broadness of this provisional ecological unit, the vegetation associations listed are not intended to cover every situation nor the full range of conditions and species. There are no transition pathways designated between the communities in the reference state because the differences in vegetation are more controlled by landscape position, aspect, and variations in inherent site properties than management or disturbance.

Community 1.1
White Oak – Chestnut Oak-Pignut Hickory/Dogwood/Blueberry Forest

Quercus alba-Quercus prinus-*Carya glabra*/*Cornus florida*/*Vaccinium pallidum* Forest The White oak-Chestnut Oak-Pignut Hickory/Flowering Dogwood/Blue Ridge Blueberry Forest, also known as the Central Appalachian Acidic Oak-Hickory Forest (CEGL008515, NatureServe 2017) is associated with substrates weathered from shale, sandstone, and other sedimentary and metasedimentary rocks. The characteristic vegetation of this type is an open oak-hickory or oak-hickory-pine forest dominated by oaks, particularly Quercus prinus (Chestnut oak) and *Quercus alba* (White oak), with high cover of Carya spp.(Hickory), especially *Carya glabra* (Pignut hickory). *Quercus velutina* (Black oak), *Quercus rubra* (Red oak), Carya alba (Mockernut hickory), *Pinus virginiana* (Virginia pine), and *Pinus strobus* (Eastern white pine) are also important, sometimes codominant trees. Stands in which *Quercus alba* (White oak) greatly dominates are also common. Total canopy cover is usually in the range of 60-80%, and dominant canopy trees typically do not much exceed, and in some situations do not reach, 66 feet (20 m) in height. Minor canopy associates include *Carya ovalis* (Red hickory), *Pinus echinata* (Shortleaf pine), *Quercus coccinea* (Scarlet oak), and *Quercus stellata* (Post oak). Young representatives of most canopy species are common in the understory, along with *Cornus florida* (Flowering dogwood) and *Amelanchier arborea* (Common serviceberry). Generally, there is a moderate to sparse representation of ericaceous (heath family) shrubs in this community type. However, on gentle ridge crests, where litter and humus tend to accumulate, *Vaccinium pallidum* (Blue Ridge blueberry) may dominate the herb layer in low colonies. On the more extensive steep, convex slopes, where litter accumulations are thin and patchy, ericads are sparse and herbaceous richness tends to be moderately high, although total herb cover can be quite sparse.

Community 1.2
Tuliptree-Hemlock-White Pine-Oak/Christmas Fern Forest

Liriodendron tulipifera – Pinus strobus –Tsuga Canadensis – Quercus (rubra,alba)/*Polystichum acrostichoides* Forest The Tuliptree - Eastern White Pine - Eastern Hemlock - (Northern Red Oak, White Oak) / Christmas Fern Forest, also known as the Central Appalachian Acidic Cove Forest (CEGL006304-NatureServe 2017) occupies habitats that are generally mesic (has moisture) with acidic soils of moderate or intermediate fertility. This association can be found on northern aspects, lower slopes, bottoms of ravines, and cove positions. The overstory is codominated by variable mixtures of *Liriodendron tulipifera* (Tuliptree), *Pinus strobus* (Eastern white pine), Tsuga Canadensis (Eastern hemlock), *Quercus rubra* (Red oak), and *Quercus alba* (White oak). This forest generally has a moderate to strong evergreen component, but *Pinus strobus* (Eastern white pine) varies from widely scattered to codominant, and *Tsuga canadensis* (Eastern hemlock) has been greatly reduced by recent outbreaks of the hemlock woolly adelgid and may be restricted to the understory. Less frequent overstory associates include *Acer rubrum* (Red maple), *Betula lenta* (Sweet birch), Carya spp. (Hickory), *Fagus grandifolia* (American beech), Fraxinus Americana (White ash), *Nyssa sylvatica* (Blackgum), and Quercus prinus (Chestnut oak). Characteristic understory species include *Acer pensylvanicum* (Striped maple), *Amelanchier arborea* (Common serviceberry), *Cornus florida* (Flowering dogwood), *Ostrya virginiana* (Hophornbeam), Oxydendrum arboretum (Sourwood), *Viburnum acerifolium* (Mapleleaf viburnum), Rubus spp. (Blackberry), Corylus Americana (American hazelnut), *Hamamelis virginiana* (American witch hazel), *Hydrangea arborescens* (Wild hydrangea), and *Lindera benzoin* (Spicebush). The herb layer is usually patchy to moderately dense. Frequent patch-dominants include *Amphicarpaea bracteata* (American hogpeanut), *Dennstaedtia punctilobula* (Eastern hayscented fern), Eurybia divaricate (White wood aster) and *Polystichum acrostichoides* (Christmas fern). Other constant but low-cover herbs include *Botrychium virginianum* (Rattlesnake fern), *Desmodium nudiflorum* (Nakedflower ticktrefoil), *Dioscorea quaternata* (Fourleaf yam), *Galium triflorum* (Fragrant bedstraw), *Maianthemum racemosum* ssp. (Feathery false lily of the valley), *Mitchella repens* (Partridgeberry), and *Stellaria pubera* (Star chickweed). Many additional herbs occur at low constancy.

Community 1.3
Chestnut Oak/Mountain laurel/Blueberry Forest

Quercus prinus - (*Quercus coccinea*, *Quercus rubra*) / *Kalmia latifolia* / *Vaccinium pallidum* Forest The Chestnut Oak - (Scarlet Oak, Northern Red Oak) / Mountain Laurel / Blue Ridge Blueberry Forest, also known as the Central Appalachian-Northern Piedmont Chestnut Oak Forest (CEGL006299; NatureServe 2017), can be readily identified by its dry, infertile, sandy loam soils, and quite species-poor vegetation overwhelmingly dominated by Quercus prinus (Chestnut oak) and *Kalmia latifolia* (Mountain laurel) often with *Vaccinium pallidum* (Blue Ridge blueberry). The most characteristic canopy associates are *Quercus coccinea* (Scarlet oak), which varies from sparse to codominant, and *Quercus rubra* (Northern red oak). Minor associates frequently include *Quercus velutina* (Black oak), *Quercus alba* (White oak), *Nyssa sylvatica* (Sourgum), *Sassafras albidum* (Sassafras), and/or *Robinia pseudoacacia* (Black locust). Root sprouts of *Castanea dentata* (American chestnut) are present in some areas. *Acer rubrum* (Red maple) and *Nyssa sylvatica* (Sourgum) are often abundant in the understory tree layers. Tall shrubs include *Kalmia latifolia* (Mountain laurel) (usually dominant), *Viburnum acerifolium* (Mapleleaf viburnum), and *Rhododendron periclymenoides* (Pink azalea). The short-shrub layer is well-developed and includes *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium stamineum* (Deerberry), and *Gaylussacia baccata* (Black huckleberry), any one of which can exhibit patch-dominance. The herb layer generally has sparse cover but sometimes includes scattered individuals of *Aureolaria laevigata* (Entireleaf yellow false foxglove), *Chimaphila maculata* (Striped prince's pine), *Comandra umbellata* (Bastard toadflax), *Cypripedium acaule* (Moccasin flower), *Danthonia spicata* (Poverty oatgrass), *Epigaea repens* (Trailing arbutus), *Gaultheria procumbens* (Eastern teaberry), *Hieracium venosum* (Rattlesnake weed), *Lysimachia quadrifolia* (Whorled yellow loosestrife), *Medeola virginiana* (Indian cucumber), *Monotropa uniflora* (Indianpipe), *Pteridium aquilinum* (Western brackenfern), and/or *Uvularia puberula* (Mountain bellwort).

State 2
Post Disturbance Successional Forest

Community 2.1
Tuliptree-Oak Ruderal Forest

Liriodendron tulipifera - Quercus spp. Ruderal Forest The Tuliptree - Oak species Ruderal Forest (CEGL007221 - NatureServe 2017) is a broadly defined ruderal or successional community that is one of several upland associations dominated by *Liriodendron tulipifera*. These successional forests often follow cropping, clearcut logging, or other severe disturbance, and are successional to mixed oak-hickory forests. Examples are common across large areas of the upland landscape which have previously been disturbed. Species found in stands attributable to this type may include a fairly diverse and varied composition. *Acer rubrum*, Quercus spp. (Oaks), *Betula lenta* (Sweet birch), *Oxydendrum arboreum* (Sourwood), *Acer saccharum* (Sugar maple), and occasionally *Liquidambar styraciflua* (Sweetgum), *Ilex opaca* (American holly), or *Robinia pseudoacacia* (Black locust) may be common in stands of this type. Where oaks are present, they are frequently multi-stemmed, resulting from coppicing. The conifer *Tsuga canadensis* (Eastern hemlock) is abundant in the understories of some stands. Shrub composition is variable but may include *Sambucus nigra* ssp. (Black elderberry), *Rhododendron maximum* (Great laurel), *Hamamelis virginiana* (American witchhazel), and *Vaccinium pallidum* (Blue Ridge Blueberry). Herbs are likewise variable; West Virginia samples feature *Dioscorea quaternata* (Fourleaf yam), *Lysimachia quadrifolia* (Whorled yellow loosestrife), *Maianthemum racemosum* (Feathery false lily of the valley), *Solidago curtisii* (Mountain decumbent goldenrod), *Symphyotrichum prenanthoides* (Crookedstem aster), *Polystichum acrostichoides* (Christmas fern), *Dryopteris intermedia* (Intermediate woodfern), *Arisaema triphyllum* ssp. Triphyllum (Jack in the pulpit), *Packera aurea* (Golden ragwort), *Amphicarpaea bracteata* (American hogpeanut), *Thelypteris noveboracensis* (New York fern), *Lycopodium digitatum* (Fan clubmoss), and *Geranium maculatum* (Spotted geranium).

State 3
Cultural - Agricultural-Grassland and/or Row Crops

Community 3.1
Row Crops or Cool Season Pasture

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; Prescribed burning-338.

Conservation practices

Brush Management
Prescribed Burning
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; Prescribed burning-338.

Conservation practices

Brush Management
Prescribed Burning
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.

Conservation practices

Fence

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.

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Approval

Nels Barrett, 9/27/2024

Acknowledgments

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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	05/12/2025
Approved by	Nels Barrett
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

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

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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):**

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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:**
