Ecological site F147XY004PA
Sandstone Upland

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Accessed: 09/16/2026

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) and 67b, Northern Sandstone Ridges of EPA Ecoregion IV (Woods et. al., 1996). Parts of this ecological site fall within 67d, the Northern Dissected Ridges and Knobs, and 67b, Northern Shale Valleys.

Ecological site concept

The Sandstone Upland ecological sites occur throughout MLRA 147 primarily on sandstone ridgetops and mid to upper slopes. Depth to bedrock is generally 40 to 60 inches (100 to 152 cm) but can be shallower than 20 inches (50 cm) in the most convex areas. Soils are relatively infertile sandy loams to loamy sands with numerous rock fragments. Water infiltrates easily. Areas can be well drained to excessively well drained. The soil pH ranges from 4.0 to 5.5. Compared to the sandstone and shale foothills, these higher elevation ridges have coarser soil textures, are generally more acidic, have less moisture holding capacity, and can be quite stony and full of boulders. The forests are dominated by xeric (dry) Quercus species (oaks) in the canopy with an understory dominated by heath species like Vaccineum spp. (blueberry), Gaylussacia spp. (huckleberry), and Kalmia latifolia (mountain laurel). In some places the understory can be quite dense. The convex summits and ridgetops generally have sparser canopy cover, smaller trees, and more stones on the surface. Below the summits, the upper slopes will have thicker canopy cover, depth to bedrock is usually greater than on the convex ridgetops, but the soil surface may still have many rock fragments.

Similar sites

F147XY002PA	**Mixed Sedimentary Upland** Deep Acid Sedimentary Upland

Table 1. Dominant plant species

Tree	(1) *Quercus montana* (2) *Quercus coccinea*
Shrub	(1) *Kalmia latifolia* (2) *Vaccinium pallidum*
Herbaceous	Not specified

Physiographic features

The Sandstone Upland ecological sites are found within the Northern Appalachian Ridges and Valleys region on ridge tops and upper and middle slopes of mountains and hills that are underlain by medium to coarse textured sandstone bedrock. Other types of bedrock associated with this ecological site are conglomerate, quartzite, shale and siltstone. The underlying geology is acidic although occasional outcroppings of calcareous rock do occur. This ecological site is not subjected to flooding or ponding. Depth to bedrock can range from 22 to over 80 inches (56 to 203 cm), with the shallower sites occupying shoulder and convex ridgetop positions. Typically these sites contain many sandstone fragments. In some areas, boulders are common and can cover most of surface area. Elevation can range from 245 to 3000 feet (75 to 914m) although sandstone uplands are most commonly associated with elevations around 1300 feet (close to 400m). Most slopes are steep, but plateaus and ridge tops generally are level to gently sloping.

Table 2. Representative physiographic features

Landforms	(1) Mountain (2) Mountain slope (3) Hill
Runoff class	Very low to very high
Elevation	80 – 910 m
Slope	0 – 80 %
Water table depth	150 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 7 weather stations throughout MLRA 147 at elevations near and 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)	130-140 days
Freeze-free period (characteristic range)	160-180 days
Precipitation total (characteristic range)	990-1,120 mm
Frost-free period (actual range)	120-140 days
Freeze-free period (actual range)	150-180 days
Precipitation total (actual range)	940-1,140 mm
Frost-free period (average)	130 days
Freeze-free period (average)	170 days
Precipitation total (average)	1,020 mm

- (1) BEAR GAP [USC00360457], Coal Township, PA
- (2) STATE COLLEGE [USC00368449], State College, PA
- (3) EVERETT [USC00362721], Everett, PA
- (4) MUSTOE 1 SW [USC00445880], Monterey, VA
- (5) CACAPON ST PRK # 2 [USC00461324], Great Cacapon, WV
- (6) KEYSER 2 SSW [USC00464840], Keyser, WV
- (7) WARDENSVILLE RM FARM [USC00469281], Wardensville, WV

Influencing water features

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

Soil features

The representative soil series associated with the Sandstone Upland ecological site are: Wallen, Schaffenaker, Pocono, Oriskany, Massanutten, Lily, Lehew, Leetonia, Hazleton, Fleetwood, Edgemont, Drall, Dekalb, Covegap, Clymer, Arendtsville, and Alticrest. They are derived primarily from sandstone, orthoquartzite, quartzite, and conglomerate, but may include areas of shale and siltstone. They are well drained to excessively well drained, and often contain greater than 50 percent rock fragments by volume within the soil profile. Surface textures are sandy loams and loams. Sandstone rock fragments are common on the soil surface. Some areas have boulders. Most of these soils are residual meaning they have formed from the weathering of bedrock in place. Some soils may be colluvial in nature, resulting from the mass movement and subsequent deposition of material downslope. Soils data was obtained from the Natural Resources and Conservation Service (NRCS) National Soils Information System database (USDA 2015).

Depth to bedrock is as shallow as 22 inches (56 cm) in the most convex landscapes, usually on the shoulders of hills. Generally, depth to bedrock is greater than 60 inches (152 cm), although rock fragment content will increase with depth.

These soils are typically sandy and acidic with available water capacity ranging from 1.4 to 5.5 inches (3.5 to 14 cm). Permeability is rapid.

Table 4. Representative soil features

Parent material	(1) Residuum – sandstone (2) Colluvium – conglomerate
Surface texture	(1) Channery sandy loam (2) Very channery loam (3) Very stony
Family particle size	(1) Loamy
Drainage class	Well drained to excessively drained
Permeability class	Rapid
Soil depth	60 – 220 cm
Surface fragment cover <=3"	0 – 60 %
Surface fragment cover >3"	0 – 60 %
Available water capacity (0-101.6cm)	3.56 – 13.97 cm
Soil reaction (1:1 water) (0-101.6cm)	0 – 5.3
Subsurface fragment volume <=3" (Depth not specified)	0 – 60 %
Subsurface fragment volume >3" (Depth not specified)	0 – 70 %

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, herb). Within the NatureServe database, individual vegetation associations are assigned an identification number called a Community Element Global Code (CEGL).

The Sandstone Uplands 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 range from convex sandstone ridgetops to steep upper slopes on acidic sandstone, and conglomerate rock. Depth to bedrock is generally 40 to 60 inches (100 to 152 cm) but can be shallower than 20 inches (50 cm) in the most convex areas. Soils are relatively infertile sandy loams to loamy sands with numerous rock fragments. Water infiltrates easily. These sites tend to create dry, xeric conditions with moderate to low forest productivity.

The reference state is a combination of several vegetation associations within the Central Appalachian Dry Oak-Pine Forest System (CES202.591) as defined by NatureServe (NatureServe 2009) but can be broadly described as a dry oak and heath community. The well-drained soils and exposure create dry conditions. The forest is mostly closed-canopy but may include patches of more open woodlands. It is dominated by a variable mixture of dry-site oak and pine species, most typically Quercus prinus (Chestnut oak), Pinus virginiana (Virginia pine), Pinus rigida (Pitch pine), and Pinus strobus (White pine), but sometimes Quercus alba (White oak) and/or Quercus coccinea (Scarlet oak). The system may include areas of oak forest, pine forest (usually small), and mixed oak-pine forest. Vaccinium pallidum (Lowbush blueberry), Vaccinium stamineum (Deerberry), Vaccinium angustofolium (Low sweet blueberry), Gaylussacia baccata (Black huckleberry), and Kalmia latifolia (Mountain laurel) were commonly observed in the understory during field reconnaissance of this ecological site within the Ridge and Valley region.

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, honeysuckle, and garlic mustard. Despite these factors, oak forests in the sandstone upland areas, seem to be maintaining their dominance. Large oak roots are able to survive in xeric uplands and can resprout multiple times, thus enabling these landscapes to continually reproduce and accumulate oak seedlings. This accumulation of reproduction results from the combined effects of periodic seed production, the relatively large food reserves in acorns that sustain seedlings through the first year, the high sprouting capacity of seedlings, drought tolerance and the ability of seedlings to persist under at least moderate shade. In the eastern United States, the accumulation of oak reproduction generally increases with decreasing site quality and over story density (Johnson 2009). In parts of Pennsylvania, however, within the Sandstone Uplands, Betula lenta (Sweet birch) was dominating the understory, preventing the establishment of oak seedlings.

Cropped fields or pasture do exist on this ecological site as alternative states, although due to the amount of surface stones, the steepness of the sideslopes and ridgetops, and the relative infertility of the soils, the Sandstone Uplands are for the most part unsuitable for agriculture, and are dominated by forests. Most areas have a history of repeated logging. Very convex ridgetops and sideslopes occasionally are dominated by a grassy bald or savannah-like state. The ecological mechanisms that create this state are unclear, although it may be due to a combination of logging disturbance, fire, and exposed south-facing slope aspect.

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 6. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 7. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 8. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

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

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	09/16/2026

Approved by	
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:**
