USDA Natural Resources Conservation Service

Ecological site F124XY003OH
Mixed Limestone Rich Upland

Last updated: 9/26/2024
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): 124X–Western Allegheny Plateau

Major Land Resource Area (MLRA): 124—Western Allegheny Plateau (USDA-NRCS, 2006)
MLRA 124, Western Allegheny Plateau extends from and includes western PA just north of Pittsburgh through southeastern OH to and includes northeastern KY. This area is primarily in the Kanawha Section of the Appalachian Province of the Appalachian Highlands. This MLRA is on an unglaciated dissected plateau with narrow level valley floors, rolling ridgetops, and hilly to steep slopes with dendritic stream drainages. A notable exception is the broad, Teays Valley, and other glacio-fluvial and glacio-lacustrine features attributed to nearby Pleistocene glaciation. Elevation ranges from 660 to 1310 feet (200 to 400 meters). The geology is predominantly cyclic beds of sandstone, siltstone, clay, shale and coal of Pennsylvanian age. Soils are dominated by Udalfs, Udults, and Ochcrepts with a mesic temperature regime in combination with five parent materials, residuum, colluvium, alluvium, eolian, and extra-glacial material of glacio-fluvial and glaciolacustrine mesic materials. The climate is predominately a humid continental to temperate, with 940 to 1145 millimeters (37 to 45 inches) of precipitation. Average annual temperature is 8 to 13 degree C (46 to 56 degrees F) with a freeze-free period averaging 185 days. Much of the areas is either forest or in farms, principally for hay and pasture, with fruits and vegetables grown locally. Coal and gas extraction are important industries in the northern part of the MLRA.

Classification relationships

USDA-NRCS (USDA 2006):
Land Resource Region (LRR): N—East and Central Farming and Forest Region
Major Land Resource Area (MLRA): 124—Western Allegheny Plateau

USDA-FS (Cleland et al. 2007):
Province: 221 - Eastern Broadleaf Province
Section: 221E - Southern Unglaciated Allegheny Plateau
Subsection: 221Ea - Pittsburgh Low Plateau
221Eb - Teays Plateau
221Ee - Unglaciated Muskingam Plains
221Ef - Western Hocking Plateau
221Eg - Lower Scotio River Plateau
221En - Kinniconick and Licking Knobs
Section: 221H - North Cumberland Plateau (in Part)
Subsection: 221Hb - Kinniconick and Licking Knobs
221He - Miami - Scioto Plain - Tipton Till Plain

Ecological site concept

Within the dissected plateau of the unglaciated Western Allegheny Plateau, the Mixed Limestone Rich Upland ecological site is set in upland landscapes derived from limestone occupying summits, hillslopes and cliffs. Most

sites are moderately well-drained to well-drained. Representative soils include: Brooke, Caneyville, Elba, Hagerstown, Vandergrift. Reference plant communities may include: Chinquapin Oak Limestone Woodland, and Appalachian Sugar Maple - Chinquapin Oak Limestone Forest.

Associated sites

F124XY005OH	**Mixed Limestone Rich Sideslope** Mixed Limestone Rich Sideslope ecological site is often adjacent to and downslope of Mixed Limestone Rich Upland.

Table 1. Dominant plant species

Tree	(1) *Acer saccharum*
Shrub	(1) *Cercis canadensis*
Herbaceous	(1) *Aquilegia canadensis*

Physiographic features

Due to the unglaciated nature of this highly dissected plateau, much of the appearance of the landscapes is directly related to the underlying geology and erosional processes. The Mixed Limestone Rich Upland ecological site is derived from limestone and calcareous shale. Within the typical upland landscape of hills and plateaus, the Mixed Limestone Rich Upland ecological site occupies the calcareous summits, and upper hillslopes, and cliffs. Slope and aspect are variable.

Table 2. Representative physiographic features

Landforms	(1) Plateau > Hillslope (2) Hills > Ridge
Runoff class	Medium to very high
Elevation	259–399 m
Slope	2–30%
Water table depth	38–53 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The regional climate of the unglaciated Western Allegheny Plateau is predominately a humid continental climate grading at the extreme southwestern corner a to humid temperate climate with hot summers and cool winters (Beck et al., 2018; Bailey, 2014). However, the local climate is highly influenced by the dissected terrain, where climatic variations may be greater at the local scale, e.g., cooler temperatures and shorter growing season at higher elevations and more northerly latitudes. Winter precipitation is mostly snow.

Climate change is occurring, and the resiliency of any ecological site will depend upon the direct and indirect effects upon component species and shifting atmospheric and soil conditions.

Because these are less common, these ecological sites, dry upland calcareous forests, woodlands and glades are at a moderate-high vulnerability risk to climate change with some impacts considered neutral-negative. Large gap disturbances from greater storm events, drier summer and fall conditions, and a potential increase in fire frequency, may favor this ecosystem. However, greater frequency and high intensity fires may result in loss of eastern red cedar. Furthermore, increased competition and displacement by invasive plants is projected (Butler et al., 2015).

Table 3. Representative climatic features

Frost-free period (characteristic range)	122-142 days
Freeze-free period (characteristic range)	156-178 days

Precipitation total (characteristic range)	1,016-1,118 mm
Frost-free period (actual range)	115-148 days
Freeze-free period (actual range)	148-184 days
Precipitation total (actual range)	965-1,168 mm
Frost-free period (average)	132 days
Freeze-free period (average)	167 days
Precipitation total (average)	1,067 mm

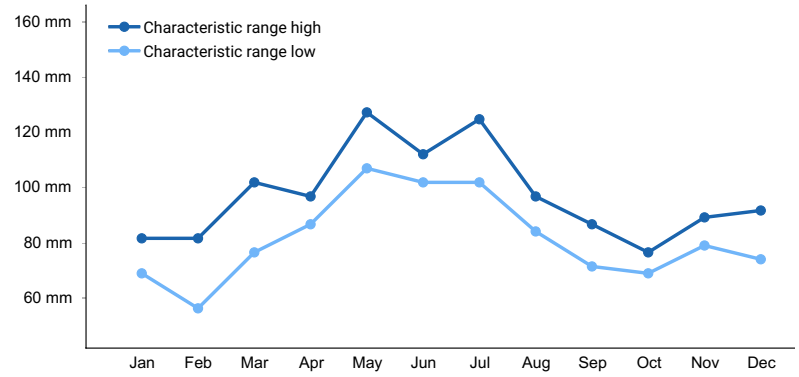


Figure 1. Monthly precipitation range

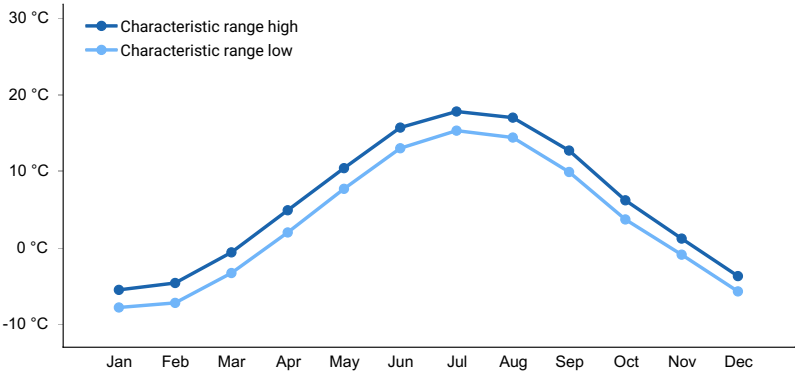


Figure 2. Monthly minimum temperature range

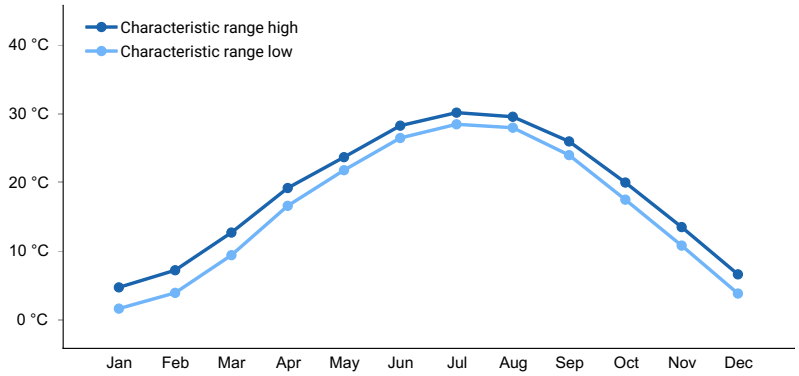


Figure 3. Monthly maximum temperature range

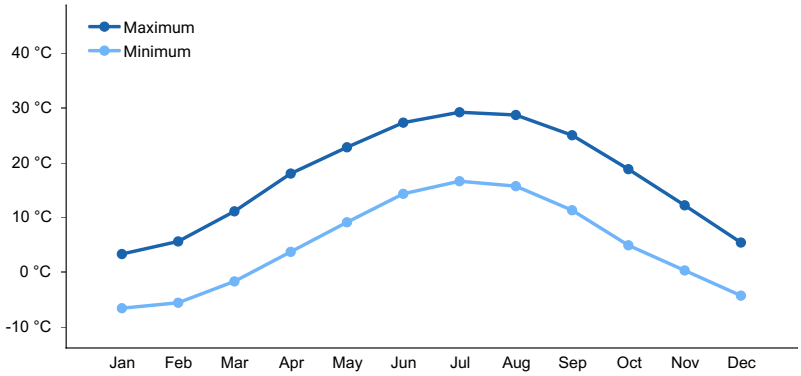


Figure 4. Monthly average minimum and maximum temperature

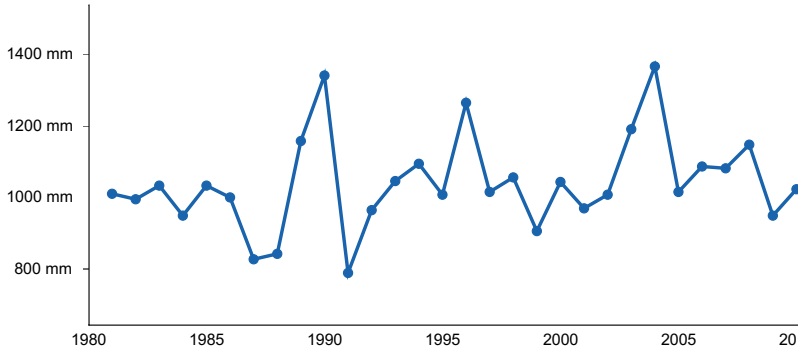


Figure 5. Annual precipitation pattern

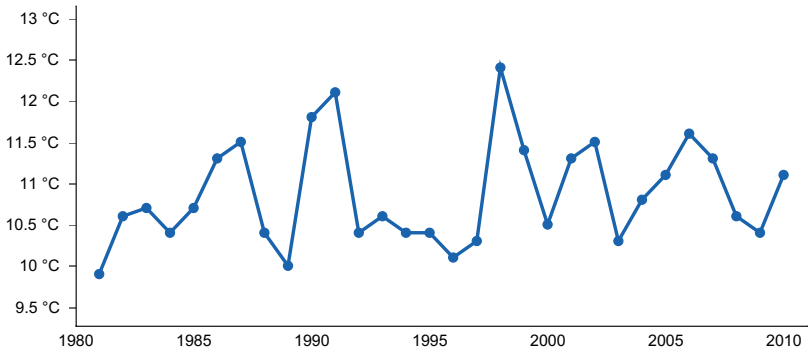


Figure 6. Annual average temperature pattern

Climate stations used

- (1) PUTNEYVILLE 2 SE DAM [USC00367229], Dayton, PA
- (2) FORD CITY 4 S DAM [USC00362942], Ford City, PA
- (3) BUTLER 2 SW [USC00361139], Butler, PA
- (4) DENISON WTR WKS [USC00332160], Dennison, OH
- (5) NEW PHILADELPHIA FLD [USW00004852], New Philadelphia, OH
- (6) MILLERSBURG [USC00335297], Millersburg, OH
- (7) DANVILLE 2 W [USC00332044], Danville, OH
- (8) COSHOCTON AG RSCH STN [USC00331905], Fresno, OH
- (9) COSHOCTON WPC PLT [USC00331890], Coshocton, OH
- (10) ZANESVILLE MUNI AP [USW00093824], Zanesville, OH
- (11) PHILO 3 SW [USC00336600], Philo, OH
- (12) NEW LEXINGTON 2 NW [USC00335857], New Lexington, OH
- (13) LOGAN [USC00334672], Logan, OH
- (14) JACKSON 3 NW [USC00334004], Jackson, OH
- (15) WAVERLY [USC00338830], Waverly, OH
- (16) PORTSMOUTH-SCIOTOVILLE [USC00336781], South Shore, OH

- (17) WARNOCK2 [USC00158432], Greenup, KY
- (18) GRAYSON 2 E [USC00153389], Grayson, KY
- (19) OLIVE HILL 5NE [USC00156012], Olive Hill, KY
- (20) GRAYSON 3 SW [USC00153391], Grayson, KY
- (21) GIMLET 9N [USC00153230], Olive Hill, KY
- (22) CAVE RUN LAKE [USC00152791], Morehead, KY
- (23) ASHLAND [USC00150254], South Point, KY

Influencing water features

Water features are not typically associated with this ecological site.

Wetland description

N/A

Soil features

Representative soils include: Brooke, Caneyville, Elba, Hagerstown, Vandergrift. Most sites are moderately well-drained to well-drained.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone, sandstone, and shale
Surface texture	(1) Clay
Drainage class	Moderately well drained to well drained
Permeability class	Very slow to moderately slow
Depth to restrictive layer	58–193 cm
Soil depth	58–183 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	10.16–17.78 cm
Soil reaction (1:1 water) (Depth not specified)	4.5–8.5
Subsurface fragment volume <=3" (Depth not specified)	4–35%
Subsurface fragment volume >3" (Depth not specified)	1–25%

Ecological dynamics

[Caveat: The vegetation information contained in this section is only provisional, based on concepts, not yet validated with field work.*]

The vegetation groupings described in this section are based on the terrestrial ecological system classification and vegetation associations developed by NatureServe (Comer et al., 2003). Terrestrial ecological SYSTEMS are specifically defined as a group of plant community types called 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 terrain and 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 and recognized by the US National

Vegetation Classification (FDGC, 2008; USNVC, 2017). Each association will be named by the diagnostic and often dominant species that occupy the different height strata (represented by tree, shrub, and herb layers). Within the NatureServe Explorer database, ecological systems are numbered by a community Ecological System Code (CES) and individual vegetation associations are assigned an identification number called a Community Element Global Code (CEGL).

Additional and more localized vegetation information can be provided by the various State Heritage Programs. Additional insights to the vegetation were provided by Plant Communities of Ohio: A Preliminary Classification (Anderson, 1982) and Terrestrial and Palustrine Plant Communities of Pennsylvania, 2nd Edition (Zimmerman et al., 2012).

Due to a long history of human activity, the reference condition more accurately reflects the current naturalized, minimally-managed state rather than the historic, pre-European settlement condition. Derived from limestone and calcareous shale, the Mixed Limestone Rich Upland ecological site occupies calcareous summits, upper slopes, and cliffs. The vegetation of the Mixed Limestone Rich Upland ecological site is quite varied but dominated by Chinquapin oak- sugar maple or Chinquapin oak-eastern red cedar. Within the Reference State, plant communities are part of the Central Appalachian Alkaline Glade and Woodland (CES202.602) and may transition to Central Appalachian Dry Oak-Pine Forest system (CES202.591) (NatureServe 2020). Besides the mature plant community-types listed, other spontaneous, successional plant community-types may exist following natural disturbances.

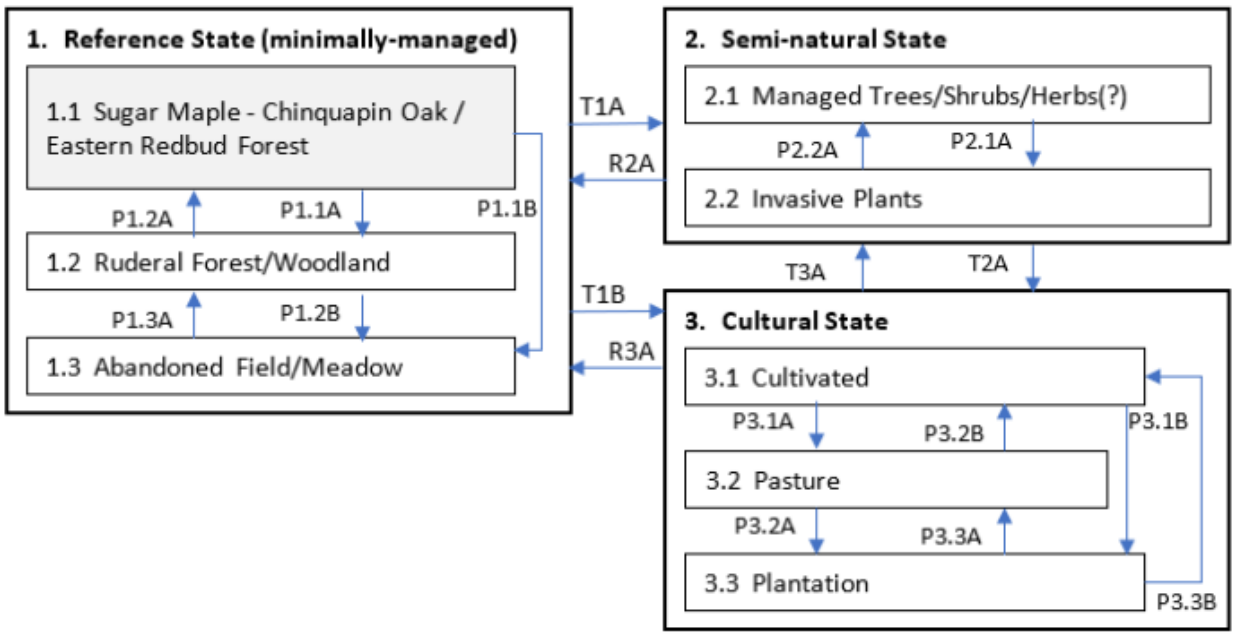
Agents-of-change within any ecological site include both natural and anthropogenic sources. Large gap disturbances from greater storm events, drier summer and fall conditions, and a potential increase in fire frequency, may favor this ecosystem. (Lafon et al., 2017, NatureServe, 2020). However, greater frequency and high intensity fires may result in loss of eastern red cedar. Conversely, fire suppression, a changing climate, and natural forest succession effect mesophication, a trend toward more shade tolerant species, e.g., white ash, sugar maple, red maple, American beech. (Nowacki et al., 2008). However, site conditions do influence the degree of mesophication. Mesophication is more subdued on more xeric, exposed summits and southwest upper slopes. Furthermore, increased competition and displacement by invasive plants is projected (Butler et al., 2015). Invasive and incursive plants can directly affect forest ecosystems in many ways; through direct competition for resources, alter fire or hydrologic conditions and affect species diversity. Insect pests and diseases such as the Gypsy moth, oak decline and armillaria root rot can cause reduced productivity and mortality in target oak species (Butler et al., 2015). Within the unglaciated, Western Alleghany Plateau, most of the hills remain forested (especially to the south), with agriculture and residential development concentrated in the valleys, though some exceptions occur. Surface mining for coal affects land and water to varying degrees (Ohio Div. of Wildlife, 2015; USDA-NRCS, 2006).

Other ecological states, a Semi-natural State and a Cultural State are recognized. The Semi-natural State would expect plant communities where ecological processes primarily operate with some conditioning by land management, e.g., managed forests, or plant communities that are an artifact of land management e.g., predominately invasive plants. The Cultural State is a completely converted or transformed state; heavily or completely conditioned by land management, e.g., cultivated lands, pasture/haylands, vineyards, and plantations, etc. Generally, the form of vegetation in the Semi-natural State or the Cultural State is not able to be specified until field work is conducted.

[*Caveat] The vegetation information presented is representative of complex plant communities. Key indicator plants 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 geography. The reference plant community is not necessarily the management goal. The drafts of species lists are merely 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.

State and transition model

124XY003 – Mixed Limestone Rich Upland



Transition	*Drivers/practices*
T1A	Forest mgmt., Disturbance
T1B, T2A	Disturbance/cutting/clearing, Brush removal
R2A, R3A	Restoration & Mgmt, Forest Stand Improvement, Early Successional Habitat Development, Upland Wildlife Mgmt, Invasive spp. Control, Plant establishment
T3A	Abandonment, Plant establishment, Forest mgmt.
P2.1A	Disturbance, Invasive species establishment
P2.2A	Invasive spp. Control, Forest mgmt..
P1.3A, P1.2A	Abandonment, succession
P3.1A, P3.2A, P3.3A, P3.1B, P3.2B, P3.3B	Changing agricultural phases
P1.1A, P1.1B, P1.2B	Disturbance, Early Successional Habitat Development

State 1
Reference State (minimally-managed)

As a result of a 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. Notice transition pathways are not always designated between some of the communities in the reference state because the differences in vegetation are more controlled by landscape position, rather than disturbances or management, or that the relationships are not understood. In addition, undisclosed successional plant community-types following disturbance may be included as community phases. Within the reference state, the plant communities are quite variable and include: • *Acer saccharum* - *Quercus muehlenbergii* / *Cercis canadensis* Forest (CEGL006017) (Translated Name: Sugar Maple - Chinquapin Oak / Eastern Redbud Forest) [Common Name: Appalachian Sugar Maple - Chinquapin Oak Limestone Forest] Or relate to more exposed southwest aspects: • *Quercus muehlenbergii* - *Juniperus virginiana* / *Schizachyrium scoparium* - *Manfreda virginica* Wooded Grassland (CEGL005131) (Translated Name: Chinquapin Oak - Eastern Red-cedar / Little Bluestem - False Aloe Wooded Grassland)

[Common Name: Central Limestone Glade] Other plant communities present may include: • *Quercus muehlenbergii - Cercis canadensis* / *Packera obovata - Lithospermum canescens* Woodland (CEGL006231) (Translated Name: Chinquapin Oak - Eastern Redbud / Roundleaf Ragwort - Hoary Puccoon Woodland) [Common Name: Chinquapin Oak Limestone Woodland] • *Quercus marilandica* - (*Juniperus virginiana*) / *Schizachyrium scoparium - Danthonia spicata* Wooded Grassland (CEGL002428) (Translated Name: Blackjack Oak - (Eastern Red-cedar) / Little Bluestem - Poverty Oatgrass Wooded Grassland) [Common Name: Central Shale Glade] • *Thuja occidentalis* / *Carex eburnea - Pellaea atropurpurea* Cliff Woodland (CEGL002596) (Translated Name: Northern White-cedar / Bristleleaf Sedge - Purple Cliffbrake Cliff Woodland) [Common Name: Appalachian Northern White-cedar Cliff Woodland] (Source: NatureServe 2020)

Community 1.1
Sugar Maple - Chinquapin Oak / Eastern Redbud Forest

• *Acer saccharum - Quercus muehlenbergii* / *Cercis canadensis* Forest (CEGL006017) (Translated Name: Sugar Maple - Chinquapin Oak / Eastern Redbud Forest) [Common Name: Appalachian Sugar Maple - Chinquapin Oak Limestone Forest] Closed-canopy stands are dominated by sugar maple (*Acer saccharum*), chinquapin oak (*Quercus muehlenbergii*), white ash (*Fraxinus americana*), and hophornbeam (*Ostrya virginiana*). Other trees include white oak (*Quercus alba*), American basswood (*Tilia americana*), black maple (*Acer nigrum*), slippery elm (*Ulmus rubra*), yellow buckeye (*Aesculus flava*), common hackberry (*Celtis occidentalis*), red Hickory (*Carya ovalis*), bitternut hickory (*Carya cordiformis*), and shagbark hickory (*Carya ovata*). Chestnut oak (*Quercus montana* [= Quercus prinus]) might also be found. More open and drier sites might have more diverse subcanopy and shrub layer containing flowering dogwood (*Cornus florida*), eastern redbud (*Cercis canadensis*), American hornbeam (*Carpinus caroliniana*), northern spicebush (*Lindera benzoin*), American witchhazel (*Hamamelis virginiana*), Carolina rose (*Rosa carolina*), fragrant sumac (*Rhus aromatica*), blackhaw (*Viburnum prunifolium*), downy arrowwood (*Viburnum rafinesqueanum*), rusty blackhaw (*Viburnum rufidulum*), and common pricklynash (*Zanthoxylum americanum*). The variably-developed herb layer may contain poverty oatgrass (*Danthonia spicata*), eastern bottlebrush grass (*Elymus hystrix*), sideoats grama (*Bouteloua curtipendula*), white snakeroot (*Ageratina altissima* [= Eupatorium rugosum]), plantain-leaved pussytoes (*Antennaria plantaginifolia*), red columbine (*Aquilegia canadensis*), smooth rockcress (*Arabis laevigata*), fourleaf milkweed (*Asclepias quadrifolia*), western blue virginsbower (*Clematis occidentalis*), longleaf summer bluet (*Houstonia longifolia* [= Houstonia tenuifolia]), climbing false buckwheat (*Polygonum scandens*), Canadian blacksnakeroot (*Sanicula canadensis*), early saxifrage (*Saxifraga virginiensis*), and roundleaf ragwort (*Packera obovata* [= Senecio obovatus]). Additional plants include ebony spleenwort (*Asplenium platyneuron*), rattlesnake fern (*Botrychium virginianum*), eastern woodland sedge (*Carex blanda*), black baeberry (*Actaea racemosa* [= Cimicifuga racemose]), fragrant bedstraw (*Galium triflorum*), eastern greenviolet (*Hybanthus concolor*), feathery false Solomon's-seal (*Maianthemum racemosum*), smooth Solomon’s seal (*Polygonatum biflorum*), whiteflower leafcup (*Polymnia canadensis*), hooked buttercup (*Ranunculus recurvatus*), bloodroot (*Sanguinaria canadensis*) and occasionally, rock muhly (*Muhlenbergia sobolifera*). (Source: NatureServe 2020 [accessed April 2020], USNVC 2019 [accessed April 2020]).

Community 1.2
Successional forest/shrublands

(to be developed)

Community 1.3
Sucessional/[Abandoned] Field/Meadow

to be developed

Pathway P1.1A
Community 1.1 to 1.2

disturbance

Pathway P1.3A
Community 1.2 to 1.1

vegetation development/succession

Pathway P1.3C
Community 1.2 to 1.3

Pathway P1.4A
Community 1.3 to 1.2

Abandonment, succession

State 2
Semi-natural State

The Semi-natural State would expect plant communities where ecological processes are primarily operating with some land conditioning in the past or present, e.g., managed forests, or plant communities that are an artifact of land management e.g., predominately invasive plants.

Community 2.1
Managed Forest/Woodland

(to be developed)

Community 2.2
Invasive Plants

(to be developed)

Pathway P2.1A
Community 2.1 to 2.2

invasive plant establishment, vegetation development/succession

Pathway P2.2A
Community 2.2 to 2.1

invasive plant management, forest management

Conservation practices

Forest Stand Improvement
Invasive Plant Species Control

State 3
Cultural State

The Cultural State would expect the ecological site to be very strongly conditioned by land management, i.e., transformed/converted to cultivated, pasture, or plantation.

Community 3.1
Cultivated

(to be developed)

Community 3.2
Pasture

(to be developed)

Community 3.3
Plantation

(to be developed)

Transition T1A
State 1 to 2

forest management, disturbance, invasive plant establishment

Conservation practices

Forest Stand Improvement

Transition T1B
State 1 to 3

cutting, land clearing, plant establishment

Conservation practices

Land Clearing

Restoration pathway R2A
State 2 to 1

plant removal, plant establishment, successional management

Conservation practices

Restoration and Management of Natural Ecosystems
Native Plant Community Restoration and Management
Invasive Plant Species Control

Transition T2A
State 2 to 3

cutting, land clearing, plant establishment

Conservation practices

Land Clearing

Restoration pathway R3A
State 3 to 1

plant removal, plant establishment, successional management

Conservation practices

Restoration and Management of Natural Ecosystems
Native Plant Community Restoration and Management
Invasive Plant Species Control

Restoration pathway R3B
State 3 to 2

forest management, disturbance, invasive plant establishment

Conservation practices

Restoration and Management of Natural Ecosystems
Native Plant Community Restoration and Management

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

Anderson, D. M. 1982. Plant Communities of Ohio: A Preliminary Classification. Division of Natural Areas and Preserves, Ohio Department of Natural Resources, Columbus, OH (https://www.lm.doe.gov/cercla/documents/fernald_docs/cat/112509.pdf).

Apsley, D., and B.C. McCarthy. 2004. White-tailed deer herbivory on forest regeneration following fire and thinning treatments in southern Ohio mixed oak forests. P. 461–471. In: Yaussy, D.A., D.M. Hix, R.P. Long, and P.C. Goebel (eds.) Proceedings, 14th Central Hardwood Forest Conference, Wooster, OH. 16-19 March 2004. Gen. Tech. Rep. NE-316. USDA Forest Service, Northeastern Research Station, Newtown Square, PA.

Bailey, R. 2014. Ecoregions: the ecosystem geography of the oceans and continents. 2nd ed. New York, NY: Springer-Verlag.

Beck, H.E., N.E. Zimmermann, T.R. McVicar, N. Vergopolan, A. Berg, E.F. Wood. 2018. Present and future Köppen-Geiger climate classification maps at 1-km resolution. Scientific Data 5(1):1-12.

Butler, P.R., L. Iverson, F.R. Thompson, L. Brandt, S. Handler, M. Janowiak, P.D. Shannon, C. Swanston, K. Karriker, J. Bartig, and S. Connolly. 2015. Central Appalachians Forest Ecosystem Vulnerability Assessment and Synthesis: a Report From The Central Appalachians Climate Change Response Framework Project. Gen. Tech. Rep. NRS-146, US Department of Agriculture, Forest Service, Northern Research Station, Newtown Square, PA. (https://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs146.pdf)

Cleland, D.T., J.A. Freeouf, J.E. Keys, G.J. Nowacki, C.A. Carpenter, and W.H. McNab. 2007. Ecological Subregions: Sections and Subsections for the conterminous United States. [Map. presentation scale 1:3,500,000, colored; A.M. Sloan, cartographer] Gen. Tech. Report WO-76D. U.S. Department of Agriculture, Forest Service, Washington, DC. (https://www.fs.fed.us/research/publications/misc/73326-wo-gtr-76d-cleland2007.pdf)

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, and K. Snow. 2003. Ecological Systems of the United States: A Working Classification of US Terrestrial Systems. NatureServe, Arlington, VA. (https://www.natureserve.org/sites/default/files/pcom_2003_ecol_systems_us.pdf).

FGDC (Federal Geographic Data Committee). 2008. National Vegetation Classification Standard, Version 2. VGDC-STD-005-2008 (Version 2). FGDC Vegetation Subcommittee, Reston, Virginia. (https://www.fgdc.gov/standards/projects/vegetation/NVCS_V2_FINAL_2008-02.pdf).

Lafon, C.W., A.T. Naito, H.D. Grissino-Mayer, S.P. Horn, and T.A. Waldrop. 2017. Fire History of the Appalachian Region: a Review and Synthesis. Gen. Tech. Rep. SRS-219., U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, NC. (https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs219.pdf)

NatureServe 2020. NatureServe Explorer: An Online Encyclopedia of Life [web application]. NatureServe, Arlington, VA. Available http://explorer.natureserve.org (Accessed: April 2020).

Nowacki, G.J. and M.D. Abrams. 2008. The demise of fire and “mesophication” of forests in the eastern United States. Bioscience 58(2):123–138.

Ohio Division of Wildlife. 2015. Ohio’s State Wildlife Action Plan. Columbus, Ohio, USA. (https://ohiodnr.gov/static/documents/wildlife/wildlife-management/OH_SWAP_2015.pdf).

Royo, A.A.; D.W. Kramer, K.V. Miller, N.P. Nibbelink, and S.L. Stout. 2017. Spatio-temporal variation in foodscapes modifies deer browsing impact on vegetation. Landscape Ecology 32(2):2281–2295.

Soil Survey Staff-USDA-NRCS [United States Department of Agriculture, Natural Resources Conservation Service] 2016. National Soils Information Service (NASIS Data Model Version 7.3.4) Lincoln, NE. Available description: https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/survey/tools/?cid=nrcs142p2_053552 (Accessed January 2020).

USDA-NRCS [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. (https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051845.pdf).

USNVC [United States National Vegetation Classification]. 2019. United States National Vegetation Classification Database, V2.03. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC. (http://usnvc.org (accessed April 2020).

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, PA.

Contributors

Nels Barret, Ph.D.
Jason Teets

Approval

Greg Schmidt, 9/26/2024

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:**
