USDA Natural Resources Conservation Service

Ecological site F147XY015PA
Frigid Mixed Sedimentary Upland

Accessed: 05/08/2024

General information

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

MLRA notes

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

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

Elevation in MLRA 147 generally ranges from 330 to 985 feet (100 to 300 meters) in the valleys and from 1,310 to 2,625 feet (400 to 800 meters) on the ridges and mountains. It is as high as 2,955 feet (900 meters) on some mountain crests and is nearly 4,430 feet (1,350 meters) on a few isolated, linear mountain ridges. Local relief in the valleys is about 15 to 165 feet (5 to 50 meters). The ridges rise about 660 feet (200 meters) above the adjoining valleys. (USDA, 2006).

Classification relationships

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

Ecological site concept

The Frigid Mixed Sedimentary Uplands is currently mapped in only three counties in MLRA 147: Highland County and Bath County in Virginia, and Pocahontas County in West Virginia. These areas are high elevation mountain slopes, summits, shoulders, and drainage ways ranging from approximately 3000 to 4300 feet (914 to 1311m). The parent material is residuum and colluvium formed in acidic and noncalcareous sandstone, shale and siltstone. Depth to bedrock or a root restrictive layer is less than 30 inches (76 cm) and the seasonal high water table occurs within 18 to 42 inches (46 to 107cm) of the soil surface. Higher elevations, cooler temperatures, and exposed ridge crests and slopes distinguishes this ecological site from other sandstone and mixed sedimentary uplands.

In general, oaks dominate this ecological site, most commonly *Quercus rubra* (northern red oak) and *Quercus alba* (white oak), with the individuals often stunted or wind-flagged. *Castanea dentata* (American chestnut) sprouts are

also common, but the importance of chestnut in these forests has been dramatically reduced by a fungal parasite which caused chestnut blight. Tree associates in the canopy and subcanopy can include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Betula lenta* (sweet birch), *Prunus serotina* (black cherry), Tsuga canadensis (eastern hemlock), *Quercus velutina* (black oak), and Quercus prinus (chestnut oak), which is mostly restricted to elevations lower than those at which this type prevails. *Ilex montana* (mountain holly) and *Rhododendron prinophyllum* (early azalea) are characteristic shrubs. An uncommon variant of this community type, usually occupying sharply convex landforms with soils shallow to bedrock, contains a dense shrub layer composed largely of *Kalmia latifolia* (Mountain laurel).

Table 1. Dominant plant species

Tree	(1) *Quercus rubra* (2) *Quercus alba*
Shrub	(1) *Ilex montana*
Herbaceous	(1) *Dennstaedtia punctilobula* (2) *Lysimachia quadrifolia*

Physiographic features

The Frigid Mixed Sedimentary Upland ecological site is found on high elevation mountain slopes, summits, shoulders, and drainage ways in the southwestern section of MLRA 147, the Northern Appalachian Ridges and Valleys. Elevation ranges from approximately 3000 to 4300 feet (914 to 1311 m). The parent material is residuum and colluvium formed in acidic and noncalcareous sandstone, shale and siltstone. Depth to bedrock or a root restrictive layer is less than 30 inches (76cm). Most sites on upper and middle slopes and summits are well to excessively well drained, but lower slopes may be moderately well drained with a seasonal high water table between 18 to 42 inches (46 to 107 cm) due to the presence of a dense subsoil layer called a fragipan. The fragipan limits the downward growth of tree roots and impedes the drainage of water.

This ecological site is not subjected to flooding or ponding. Slopes can be moderate to very steep. Terrain is typically mountainous.

Table 2. Representative physiographic features

Landforms	(1) Mountain (2) Hill (3) Cove
Flooding frequency	None
Ponding frequency	None
Elevation	884–1,311 m
Slope	8–80%
Water table depth	46–107 cm
Aspect	N

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 1 weather station in 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 (average)	123 days
Freeze-free period (average)	130 days
Precipitation total (average)	1,143 mm

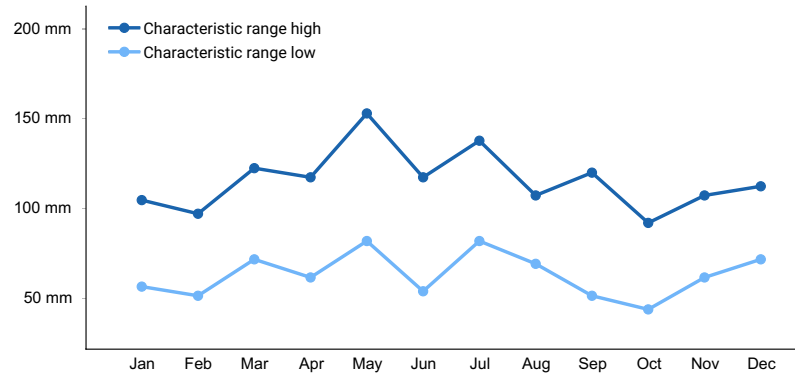


Figure 1. Monthly precipitation range

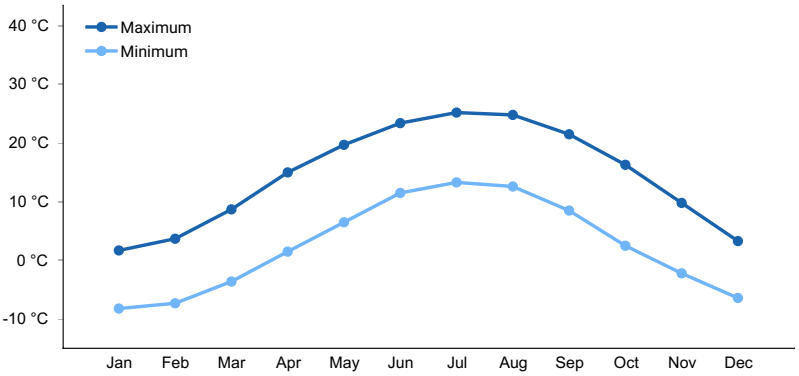


Figure 2. Monthly average minimum and maximum temperature

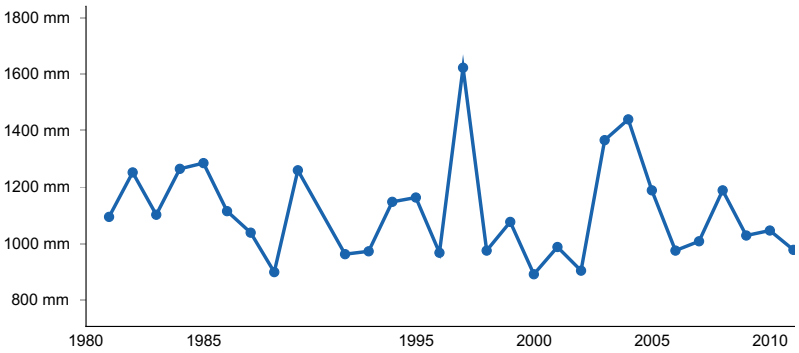


Figure 3. Annual precipitation pattern

Climate stations used

- (1) BARTOW 1S [USC00460509], Arbovale, WV

Influencing water features

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

Soil features

The soil series associated with this site are: Snowdog, Paddyknob, Mandy, and Madsheep. They formed from mixed geologies of sandstone, shale, and siltstone. Most of these soils formed through the weathering of rock in place. Soils on the lower slopes, coves, and drainage ways developed from material that moved from upper to lower slope positions. Bedrock is generally less than 30 inches (76cm) from the surface and the soils are well drained to excessively well drained. Lower slope landscape positions may be moderately well drained due to the presence of a dense subsoil layer called a fragipan which impedes the drainage of water. Soil pH is relatively low ranging from 4.2 to 4.6. Surface textures are loam and silt loam, subsurface textures are loamy, with rock fragment content that can range from 0 to 65% by volume. Soils data was obtained from the Natural Resources and Conservation Service (NRCS) National Soils Information System database (USDA 2015).

These soils formed at elevations generally over 3000 feet (914 m) and have frigid temperature regimes. In general, a soil with a frigid temperature regime has an average annual temperature that is lower than 46.4° F (8°C) and the difference between average summer and average winter soil temperatures is more than 42.8°F (6°C) (Soil Survey Staff 1999). Soil temperature is measured at 20 inches depth (50cm). In contrast, most soils in the Northern Ridge and Valley region have an average soil temperature that is greater than or equal to 46.4° F (8°C). Soil temperature regime has implications for the kind of vegetation that is present. The higher elevation and cooler temperatures allows for the presence of plant species and communities more typical of the northern United States.

Table 4. Representative soil features

Parent material	(1) Residuum–sandstone and shale (2) Colluvium–sandstone and siltstone
Surface texture	(1) Channery loam (2) Very channery silt loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Very slow to rapid
Soil depth	46–94 cm
Surface fragment cover <=3"	0–2%
Surface fragment cover >3"	0–2%
Available water capacity (0-101.6cm)	5.33–15.24 cm
Soil reaction (1:1 water) (0-101.6cm)	4.2–4.6
Subsurface fragment volume <=3" (Depth not specified)	5–0%
Subsurface fragment volume >3" (Depth not specified)	15–65%

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 Virginia (Fleming et al. 2013) and West Virginia (WVDNR 2014). Terrestrial ecological systems are specifically defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients. They are intended to provide a classification unit that is

readily mappable, often from remote imagery, and readily identifiable by conservation and resource managers in the field. A given system will typically manifest itself in a landscape at intermediate geographic scales of tens to thousands of hectares and will persist for 50 or more years. A vegetation association is a plant community that is much more specific to a given soil, geology, landform, climate, hydrology, and disturbance history. It is the basic unit for vegetation classification. Each association will be named by the dominant species that occupy the different strata (tree, sapling, shrub, and herb). Within the NatureServe database, individual vegetation associations are assigned an identification number called a Community Element Global Code (CEGL).

The Frigid 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 is found on high elevation mountain slopes, summits, shoulders, and drainage ways in the southwestern section of the region.

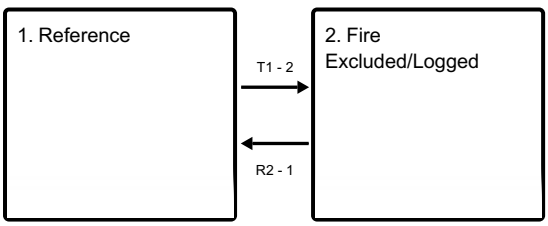
The reference plant community is part of the Central and Southern Appalachian Montane Oak Forest System (CES202.596) as defined by NatureServe (NatureServe 2009; Landfire 2010). This generally oak-dominated system is found in the central and southern Appalachian Mountains. The high-elevation deciduous forests occur on exposed sites, including ridge crests and south- to west-facing slopes, mostly between 3000 to 4500 feet (915 and 1372 m) elevation, less commonly ranging up to 5500 feet (1680 m). In most areas attributed to this system, the soils are thin, weathered, nutrient-poor, low in organic matter, and acidic. The forests are dominated by Quercus spp. (oak), most commonly *Quercus rubra* (Northern red oak) and *Quercus alba* (White oak), with the individuals often stunted or wind-flagged. *Castanea dentata* (American chestnut) sprouts are also common, but the importance of chestnut in these forests has been dramatically altered by chestnut blight. *Ilex montana* (Mountain holly) and *Rhododendron prinophyllum* (Early azalea) are characteristic shrubs. An uncommon variant of this community type, usually occupying sharply convex landforms with soils shallow to bedrock, contains a dense shrub layer composed largely of *Kalmia latifolia* (Mountain laurel).

Most stands likely experience frequent high winds and ice damage. The composition and structure of nearly all examples of this community type in Virginia have been altered by logging in the late 19th and early 20th centuries and by the loss of American chestnut as an important component in the 1930s. Fire dynamics in these high elevation areas are not well-known, although 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). Due to high elevation, steepness, and rockiness, this ecological site is not conducive to agriculture.

The information presented is representative of very complex vegetation communities. Key indicator plants and ecological processes are described to help inform land management decisions. Plant communities will differ across the major land resource region 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.

State and transition model

Ecosystem states



State 1 submodel, plant communities

1.1. Quercus rubra - (Quercus alba) / Ilex montana / Dennstaedtia punctilobula Forest

State 2 submodel, plant communities

2.1. Quercus spp. – Carya spp. Ruderal Forest

State 1
Reference

The reference forest state is most likely a combination of several vegetation communities within the Central and Southern Appalachian Montane Oak Forest as defined by NatureServe (NatureServe 2009). Above 3000 feet (914m) the vegetation remains dominated by oak, particularly northern red oak and white oak, but individuals may be stunted or wind-flagged. At one time, American chestnut may have been a prominent species, but its importance has been dramatically reduced by chestnut blight. Due to the heterogeneity of this provisional ecological unit, they are not intended to cover every situation nor the full range of conditions and species.

Community 1.1
Quercus rubra - (Quercus alba) / Ilex montana / Dennstaedtia punctilobula Forest

The Northern Red Oak - (White Oak)/Mountain Holly/Eastern Hay-scented Fern - Whorled Yellow Loosestrife Forest, also known as the Central Appalachian Northern Red Oak Forest (CEGL008506; NatureServe 2017) occurs in stands restricted to elevations above 3000 feet (915m). Most examples are located on gentle to only moderately steep ridge crests and upper slopes. Soils are frequently bouldery and moderately to strongly infertile, with low base status. *Quercus rubra* (Northern red oak) is the principal dominant species in the overstory, with *Quercus alba* (White oak) as a frequent but usually low-cover associate, often in a subcanopy layer. Canopy trees often exhibit stunted growth and sparse cover; the stature of these so-called "red oak orchards" reflects the harsh conditions of frequent wind and destructive ice storms. The abundance of *Castanea dentata* (American chestnut) in the understory suggests its former importance in stands of this type. Other tree associates in the canopy and subcanopy can include *Acer rubrum* (Red maple), *Betula alleghaniensis* (Yellow birch), *Betula lenta* (Sweet birch), *Prunus serotina* (Black cherry), Tsuga Canadensis (Eastern hemlock), and *Quercus velutina*, (Black oak). The shrub layer is generally sparse to patchy; *Acer pensylvanicum* (Striped maple), *Ilex montana* (Mountain holly), *Kalmia latifolia* (Mountain laurel), *Castanea dentata* (American chestnut), and *Hamamelis virginiana* (Witchhazel) are the most frequent species. Other tall shrubs occurring with lower cover and/or frequency include *Ribes rotundifolium* (Appalachian gooseberry), *Rubus allegheniensis* (Allegheny blackberry), *Rhododendron prinophyllum* (Early azalea), *Corylus cornuta* var. cornuta (Beaked hazelnut) and *Prunus virginiana* (Chokecherry). *Vaccinium pallidum* (Blue Ridge blueberry) and *Vaccinium stamineum* (Deerberry) are infrequent low shrubs, but sometimes comprise 10% or more of the herb layer. Herbaceous composition varies considerably and usually features patch-dominance by one or more of the following: *Dennstaedtia punctilobula* (Eastern hayscented fern), *Carex pensylvanica* (Pennsylvania sedge), *Lysimachia quadrifolia* (Whorled yellow loosestrife), and *Deschampsia flexuosa* (Wavy hairgrass), *Calamagrostis porteri* (Porter’s reedgrass) is a patch-dominant grass in a very small percentage of stands. Other characteristic herbs of this community are *Ageratina altissima* (White snakeroot), *Agrostis perennans* (Upland bentgrass), *Amianthium muscitoxicum* (Flypoison), *Aralia nudicaulis* (Wild sarsaparilla), *Asclepias exaltata* (Poke milkweed), *Dioscorea quaternata* , (Fourleaf yam), *Eurybia divaricata* (Aster divaricatus) (White wood aster), *Hieracium paniculatum* (Allegheny hawkweed), *Maianthemum canadense* (Canada mayflower), Pedicularis Canadensis (Canadian lousewort), Potentilla Canadensis (Dwarf cinquefoil), *Prenanthes altissima* (Tall rattlesnake root), *Prenanthes trifoliolata*, (Gall of the earth), *Smilax herbacea* (Smooth carrionflower), *Solidago arguta* var. argute (Atlantic goldenrod), and *Solidago curtisii* (Mountain decumbent goldenrod). Many

additional herbs occur at low cover and constancy.

State 2
Fire Excluded/Logged

Community 2.1
Quercus spp. – Carya spp. Ruderal Forest

The Oak – Hickory Ruderal forest (combination of CEGL associations; NatureServe 2017) is assumed to exist as an alternative state on this landscape based on the history of the Appalachians and field work in oak hickory forests. We assume that the post logging, fire excluded oak – hickory forests are similar to the non-logged reference state with the exception that overall species diversity is less, and trees are even-aged due to logging. Where oaks are present, they are frequently multi-stemmed, resulting from coppicing. The understory of these sites are dominated by fire sensitive species, most notably *Acer rubrum* (Red maple). Pine species are common in successional forests including *Pinus strobus* (Eastern white pine) and *Pinus virginiana* (Virginia pine). Early successional species like *Robinia pseudoacacia* (Black locust), *Liriodendron tulipifera* (Tuliptree), and *Prunus serotina* (Black cherry) may also be present.

Transition T1 - 2
State 1 to 2

Logging followed by natural regeneration. In general, fire suppression allows fire sensitive species like tuliptree, red maple, and birches to out compete oak seedlings in the understory. However, it is not clear what role fire has played in these high elevation and frigid soil sites.

Restoration pathway R2 - 1
State 2 to 1

Control of understory to allow oak seedling recruitment. Prescribed fire may further advance the growth of oaks over fire sensitive species, but it is not clear what role fire has played in these high elevation and frigid soil sites. The following conservation practices from the Natural Resources Conservation Service Field Office Technical Guide could be considered for restoration efforts (FOTG-USDA): Brush Management-314; Forest Stand Improvement-666; Herbaceous Weed Control-315; Upland Wildlife habitat management-645; Prescribed burning-338.

Conservation practices

Brush Management
Prescribed Burning
Upland Wildlife Habitat Management
Forest Stand Improvement
Herbaceous Weed Control

Additional community tables

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Harrisburg, Pennsylvania.

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:

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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	
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:

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:**