

Ecological site F115XB006MO Loamy Protected Backslope Forest

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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.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 115X–Central Mississippi Valley Wooded Slopes

This MLRA is characterized by deeply dissected, loess-covered hills bordering well defined valleys of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers and their tributaries. It is used to produce cash crops and livestock. About one-third of the area is forested, mostly on the steeper slopes. This area is in Illinois (50 percent), Missouri (36 percent), Indiana (13 percent), and Iowa (1 percent) in two separate areas. It makes up about 25,084 square miles (64,967 square kilometers).

Most of this area is in the Till Plains section and the Dissected Till Plains section of the Central Lowland province of the Interior Plains. The Springfield-Salem plateaus section of the Ozarks Plateaus province of the Interior Highlands occurs along the Missouri River and the Mississippi River south of the confluence with the Missouri River. The nearly level to very steep uplands are dissected by both large and small tributaries of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers. The Ohio River flows along the southernmost boundary of this area in Indiana. Well defined valleys with broad flood plains and numerous stream terraces are along the major streams and rivers. The flood plains along the smaller streams are narrow. Broad summits are nearly level to undulating. Karst topography is common in some parts along the Missouri and Mississippi Rivers and their tributaries. Well-developed karst areas have hundreds of sinkholes, caves, springs, and losing streams. In the St. Louis area, many of the karst features have been obliterated by urban development.

Elevation ranges from 90 feet (20 meters) on the southernmost flood plains to 1,030 feet (320 meters) on the highest ridges. Local relief is mainly 10 to 50 feet (3 to 15 meters) but can be 50 to 150 feet (15 to 45 meters) in the steep, deeply dissected hills bordering rivers and streams. The bluffs along the major rivers are generally 200 to 350 feet (60 to 105 meters) above the valley floor.

The uplands in this MLRA are covered almost entirely with Peoria Loess. The loess can be more than 7 feet (2 meters) thick on stable summits. On the steeper slopes, it is thin or does not occur. In Illinois, the loess is underlain mostly by Illinoian-age till that commonly contains a paleosol. Pre-Illinoian-age till is in parts of this MLRA in Iowa and Missouri and to a minor extent in the western part of Illinois. Wisconsin-age outwash, alluvial deposits, and sandy eolian material are on some of the stream terraces and on dunes along the major tributaries. The loess and glacial deposits are underlain by several bedrock systems. Pennsylvanian and Mississippian bedrock are the most extensive. To a lesser extent are Silurian, Devonian, Cretaceous, and Ordovician bedrock. Karst areas have formed where limestone is near the surface, mostly in the southern part of the MLRA along the Mississippi River and some of its major tributaries. Bedrock outcrops are common on the bluffs along the Mississippi, Ohio, and Wabash Rivers and their major tributaries and at the base of some steep slopes along minor streams and drainageways.

The annual precipitation ranges from 35 to 49 inches (880 to 1,250 millimeters) with a mean of 41 inches (1,050 millimeters). The annual temperature ranges from 48 to 58 degrees F (8.6 to 14.3 degrees C) with a mean of 54 degrees F (12.3 degrees C). The freeze-free period ranges from 150 to 220 days with a mean of 195 days.

Soils The dominant soil orders are Alfisols and, to a lesser extent, Entisols and Mollisols. The soils in the area have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed or smectitic mineralogy. They are shallow to very deep, excessively drained to poorly drained, and loamy, silty, or clayey.

The soils on uplands in this area support natural hardwoods. Oak, hickory, and sugar maple are the dominant species. Big bluestem, little bluestem, and scattered oak and eastern redcedar grow on some sites. The soils on flood plains support mixed forest vegetation, mainly American elm, eastern cottonwood, river birch, green ash, silver maple, sweetgum, American sycamore, pin oak, pecan, and willow. Sedge and grass meadows and scattered trees are on some low-lying sites. (United States Department of Agriculture, Natural Resources Conservation Service, 2022)

LRU notes

The Central Mississippi Valley Wooded Slopes, Western Part consists of deeply dissected, loess-covered hills bordering the Missouri and Mississippi Rivers as well as floodplains and terraces of these rivers. The Northern boundary runs along the South Fabius River valley separating it from the broad rounded interfluvies of the northern till plain. A major physiographic feature within the LRU (Land Resource Unit) includes the Lincoln Hills region. The Lincoln Hills extend along the Mississippi River in Missouri, starting about 40 miles (64 kilometers) northwest of St. Louis and extending north to Hannibal. The Lincoln Hills partially escaped the most recent glaciation in the region during the Pleistocene. In geology and biology, they resemble the rugged and forested hills of the Ozark Highlands (MLRA 116A) more than the rolling plains of northern Missouri. The underlying limestone bedrock has formed bluffs, glades, caves, springs, and sinkholes. Elevation ranges from about 420 feet (128 meters) along the Mississippi River near Cape Girardeau, Missouri to about 830 feet (253 meters) near Clarksville along the Mississippi River upstream from St. Louis. High ridges near Hillsboro, Missouri can reach over 1,000 feet (305 meters). Underlying bedrock is mainly Ordovician-aged dolomite and sandstone, with Mississippian-aged limestone north of the Missouri River. Loess caps both stream and glacial outwash terraces along the major rivers along with Pre-Illinoian till near the edges of the area.

Classification relationships

Major Land Resource Area (MLRA) (USDA-NRCS, 2022):
115X–Central Mississippi Valley Wooded Slopes

Terrestrial Natural Community Type in Missouri (Nelson, 2010):
The reference state for this ecological site is most similar to a Dry-Mesic Chert Forest.

Missouri Department of Conservation Forest and Woodland Communities (MDC, 2006):
The reference state for this ecological site is most similar to a White Oak Forest.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is most similar to a *Quercus alba* / *Cornus florida* Unglaciaded Forest (CEGL002066).

Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002):
This ecological site occurs primarily in Land Type Associations of the following Subsections:
Inner Ozark Border
Outer Ozark Border
Mississippi River Hills

Ecological site concept

Loamy Protected Backslope Forests occupy the northerly and easterly aspects of steep, dissected slopes, and are mapped in complex with the Loamy Exposed Backslope Woodland ecological site. These ecological sites are in the uplands mainly in the Missouri River watershed, but are not adjacent to the Missouri River floodplain. Loess Upland

and Loamy Upland ecological sites are typically upslope. Areas of woodland/glade ecological sites are commonly associated with these sites. Soils are very deep, and typically have coarse fragments with depth. The reference plant community is forest dominated by northern red oak, white oak, white ash and sugar maple, with a well-developed understory and a rich herbaceous ground flora.

Associated sites

F115XB005MO	Loamy Upland Woodland Loamy Upland sites are often upslope.
F115XB011MO	Chert Protected Backslope Forest Chert Protected Backslope Forests are downslope from this ecological site on northerly and easterly aspects.
F115XB048MO	Chert Exposed Backslope Woodland Chert Exposed Backslope Woodlands are downslope from this ecological site on southerly and westerly aspects.
R115XB009MO	Shallow Limestone/Dolomite Upland Glade/Woodland Shallow Limestone/Dolomite Glade sites are often associated with this site.

Similar sites

F115XB044MO	Loamy Exposed Backslope Woodland Loamy Exposed Backslope Woodlands are mapped in a complex with this ecological site but are on southerly and westerly aspects.
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Table 1. Dominant plant species

Tree	(1) <i>Quercus rubra</i> (2) <i>Quercus alba</i>
Shrub	(1) <i>Asimina triloba</i> (2) <i>Ulmus rubra</i>
Herbaceous	(1) <i>Laportea canadensis</i> (2) <i>Erigenia bulbosa</i>

Physiographic features

This site is on upland backslopes, with slopes of 15 to 50 percent. It is on protected aspects (north, northeast, and east), which receive significantly less solar radiation than the exposed aspects. The site generates runoff to adjacent, downslope ecological sites. This site does not flood.

The accompanying figure (adapted from Baker, 1998) shows the typical landscape position of this ecological site, and landscape relationships among the major ecological sites in the uplands. The site is within the area labeled “2”, on northerly and easterly exposures. Loamy Upland sites (labeled “1”) are often upslope, and Chert Backslope sites (labeled “3”) are often downslope. In other areas, Shallow Limestone/Dolomite Glade sites are associated with this site.

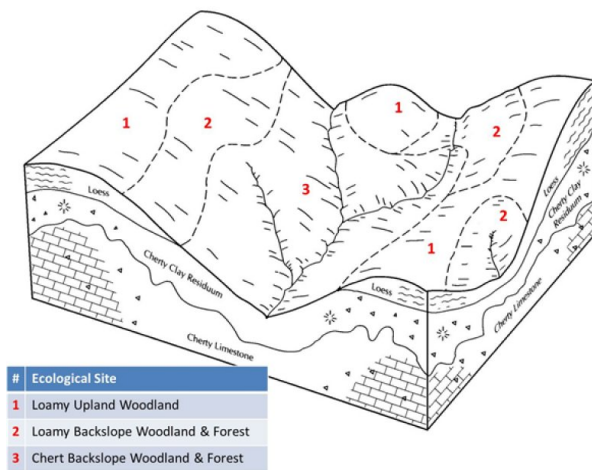


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Hill
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	350–1,020 ft
Slope	15–50%
Water table depth	20–60 in
Aspect	NW, N, NE, E

Climatic features

The Central Mississippi Valley Wooded Slopes, Western Part has a continental type of climate marked by strong seasonality. In winter, dry-cold air masses, unchallenged by any topographic barriers, periodically swing south from the northern plains and Canada. If they invade reasonably humid air, snowfall and rainfall result. In summer, moist, warm air masses, equally unchallenged by topographic barriers, swing north from the Gulf of Mexico and can produce abundant amounts of rain, either by fronts or by convectional processes. In some summers, high pressure stagnates over the region, creating extended droughty periods. Spring and fall are transitional seasons when abrupt changes in temperature and precipitation may occur due to successive, fast-moving fronts separating contrasting air masses.

The Central Mississippi Valley Wooded Slopes, Western Part experiences regional differences in climates, but these differences do not have obvious geographic boundaries. Regional climates grade inconspicuously into each other. The basic gradient for most climatic characteristics is along a line diagonally crossing the MLRA from northwest to southeast. Both mean annual temperature and precipitation exhibit gradients along this line.

The average annual precipitation in most of this area is 38 to 48 inches. The average annual temperature is 53 to 57 degrees F. Mean January minimum temperature follows the northwest-to-southeast gradient. However, mean July maximum temperature shows hardly any geographic variation in the MLRA. Mean July maximum temperatures have a range of only two or three degrees across the area.

Mean annual precipitation varies along the same gradient as temperature. Seasonal climatic variations are more complex. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages three to four times greater than January precipitation. Most of the rainfall occurs as high-intensity, convective thunderstorms in summer. Snowfall is common in winter.

During years when precipitation is normal, moisture is stored in the soil profile during the winter and early spring, when evaporation and transpiration are low. During the summer months the loss of water by evaporation and

transpiration is high, and if rainfall fails to occur at frequent intervals, drought will result. Drought directly affects plant and animal life by limiting water supplies, especially at times of high temperatures and high evaporation rates.

Superimposed upon the basic MLRA climatic patterns are local topographic influences that create topoclimatic, or microclimatic variations. In regions of appreciable relief, for example, air drainage at nighttime may produce temperatures several degrees lower in valley bottoms than on side slopes. At critical times during the year, this phenomenon may produce later spring or earlier fall freezes in valley bottoms. Higher daytime temperatures of bare rock surfaces and higher reflectivity of these unvegetated surfaces create characteristic glade and cliff ecological sites. Slope orientation is an important topographic influence on climate. Summits and south-and-west-facing slopes are regularly warmer and drier than adjacent north- and-east-facing slopes. Finally, the climate within a canopied forest ecological site is measurably different from the climate of the more open grassland or savanna ecological sites.

Source: University of Missouri Climate Center - <http://climate.missouri.edu/climate.php>; Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, United States

Department of Agriculture Handbook 296 - <http://soils.usda.gov/survey/geography/mlra/>

Table 3. Representative climatic features

Frost-free period (characteristic range)	158-165 days
Freeze-free period (characteristic range)	190-201 days
Precipitation total (characteristic range)	44-47 in
Frost-free period (actual range)	153-166 days
Freeze-free period (actual range)	189-203 days
Precipitation total (actual range)	43-49 in
Frost-free period (average)	161 days
Freeze-free period (average)	196 days
Precipitation total (average)	46 in

Climate stations used

- (1) JACKSON [USC00234226], Jackson, MO
- (2) BOONVILLE [USC00230817], Boonville, MO
- (3) JEFFERSON CITY WTP [USC00234271], Jefferson City, MO
- (4) UNION [USC00238515], Union, MO

Influencing water features

The water features of this upland ecological site include evapotranspiration, surface runoff, and drainage. Each water balance component fluctuates to varying extents from year-to-year. Evapotranspiration remains the most constant. Precipitation and drainage are highly variable between years. Seasonal variability differs for each water component. Precipitation generally occurs as single day events. Evapotranspiration is lowest in the winter and peaks in the summer. Water stored as ice and snow decreases drainage and surface runoff rates throughout the winter and increases these fluxes in the spring. The surface runoff pulse is greatly influenced by extreme events. Conversion to cropland or other high intensities land uses tends to increase runoff, but also decreases evapotranspiration. Depending on the situation, this might increase groundwater discharge, and decrease baseflow in receiving streams (Vano 2005).

Soil features

These soils have no major rooting restriction. The soils were formed under woodland vegetation, and have thin, light-colored surface horizons. Parent material is loess over slope alluvium and residuum weathered from either limestone and dolomite, or from sandstone. The soils have silt loam surface horizons. Subsoils are silty clay loam in

the upper part, and are very gravelly and cobbly silty clay loam, clay loam to clay in the underlying slope alluvium and residuum. Soils with sandstone residuum have more sand in the subsoil. These soils are not affected by seasonal wetness. A few soils have a bedrock contact below 40 inches. Soil series associated with this site include Baxter, Bluelick, Bucklick, Crider, Holstein, Minnith, Rocheport, Useful, Weingarten, Wellston, Westmore, and Wrengart.

The accompanying picture of the Bluelick series shows loess over reddish brown clayey residuum, underlain by very cobbly clay. Roots can be seen in the picture throughout the soil profile. Picture from Baker (1998).



Figure 9. Bluelick series

Table 4. Representative soil features

Parent material	(1) Loess (2) Residuum–limestone and dolomite
Surface texture	(1) Silt loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Very slow to moderately slow
Soil depth	40–72 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	6–8 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	4.5–7.3
Subsurface fragment volume <=3" (Depth not specified)	20–35%
Subsurface fragment volume >3" (Depth not specified)	0–40%

Ecological dynamics

Information contained in this section was developed using historical data, professional experience, field reviews, and scientific studies. 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 reference plant community is a forest dominated by an overstory of northern red oak, white oak, white ash and occasional sugar maple. The canopy is tall (75 to 90 feet) and well developed (80 to 100 percent closure) and the understory well developed and with great structural diversity. In the most mesic landscape positions, shade tolerant and moisture loving species, such as basswood, Kentucky coffeetree, and bitternut hickory would have been in greater abundance.

While fire-prone prairies, savannas and open woodlands surround this region, Loamy Protected Backslope Forests historically occurred in the most protected landscape positions on lower, steep slopes in the deeper valleys furthest from the prairie uplands. While the upland prairies and savannas may have had a fire frequency of 1 to 3 years, Loamy Protected Backslope Forests would have burned less frequently (estimated 10 to 25 years) and with lower intensity. Periodic fires would have removed some of the shade tolerant understory, but it would have quickly recovered.

Loamy Protected Backslope Forests would have also been subjected to occasional disturbances from wind and ice, as well as grazing by large native herbivores, such as bison, elk, and white-tailed deer. Wind and ice would have periodically opened the canopy up by knocking over trees or breaking substantial branches off canopy trees. Such canopy disturbances allowed more light to reach the ground and favored reproduction of the dominant oak species. Grazing by native large herbivores would have kept understory conditions more open, also creating conditions more favorable to oak reproduction.

Today, these communities have been cleared and converted to pasture, or have undergone repeated timber harvest and domestic grazing. Most existing occurrences have a younger (50 to 80 years) canopy layer whose composition has been altered by timber harvesting practices. An increase in hickories over historic conditions is common. In addition, in the absence of fire, the canopy, sub-canopy and woody understory layers are better developed. The absence of periodic fire has allowed more shade-tolerant tree species, such as sugar maple, white ash, or hickory to increase in abundance.

Uncontrolled domestic grazing has diminished the diversity and cover of woodland ground flora species, and has introduced weedy species such as gooseberry, buckbrush, poison ivy and Virginia creeper created a more open understory and increased soil compaction and soil erosion.

Loamy Protected Backslope Forests are productive timber sites. Carefully planned single tree selection or the creation of small group openings can help regenerate more desirable oak species and increase vigor on the residual trees. Clear-cutting does occur and results in dense, even-aged stands of primarily oak. This may be most beneficial for existing stands whose composition has been highly altered by past management practices. However, without some thinning of the dense stands, the ground flora diversity can be shaded out and productivity of the stand may suffer.

Oak regeneration is typically problematic. Sugar maple, red elm, ironwood, hickories, grapes, pawpaw and spicebush are often dominant competitors in the understory. Maintenance of the oak component will require disturbances that will impair the cool, moist, shaded conditions, so trade-offs will have to be made carefully.

Prescribed fire can play a beneficial but limited role in the management of this ecological site. The higher productivity of these sites makes it more challenging than on other forest sites in the region. Protected aspect forests did evolve with some fire, but their composition often reflects more closed, forested conditions, with fewer woodland ground flora species that can respond to fire. Consequently, while having protected aspects in a burn unit is acceptable, targeting them solely for woodland restoration is not advisable.

A State and Transition Diagram model is depicted in Figure 1. Detailed descriptions of each state, transition, plant

community, and pathway follow the model. This model is based on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases.

State and transition model

Loamy Protected Backslope Forest, F115BY006MO

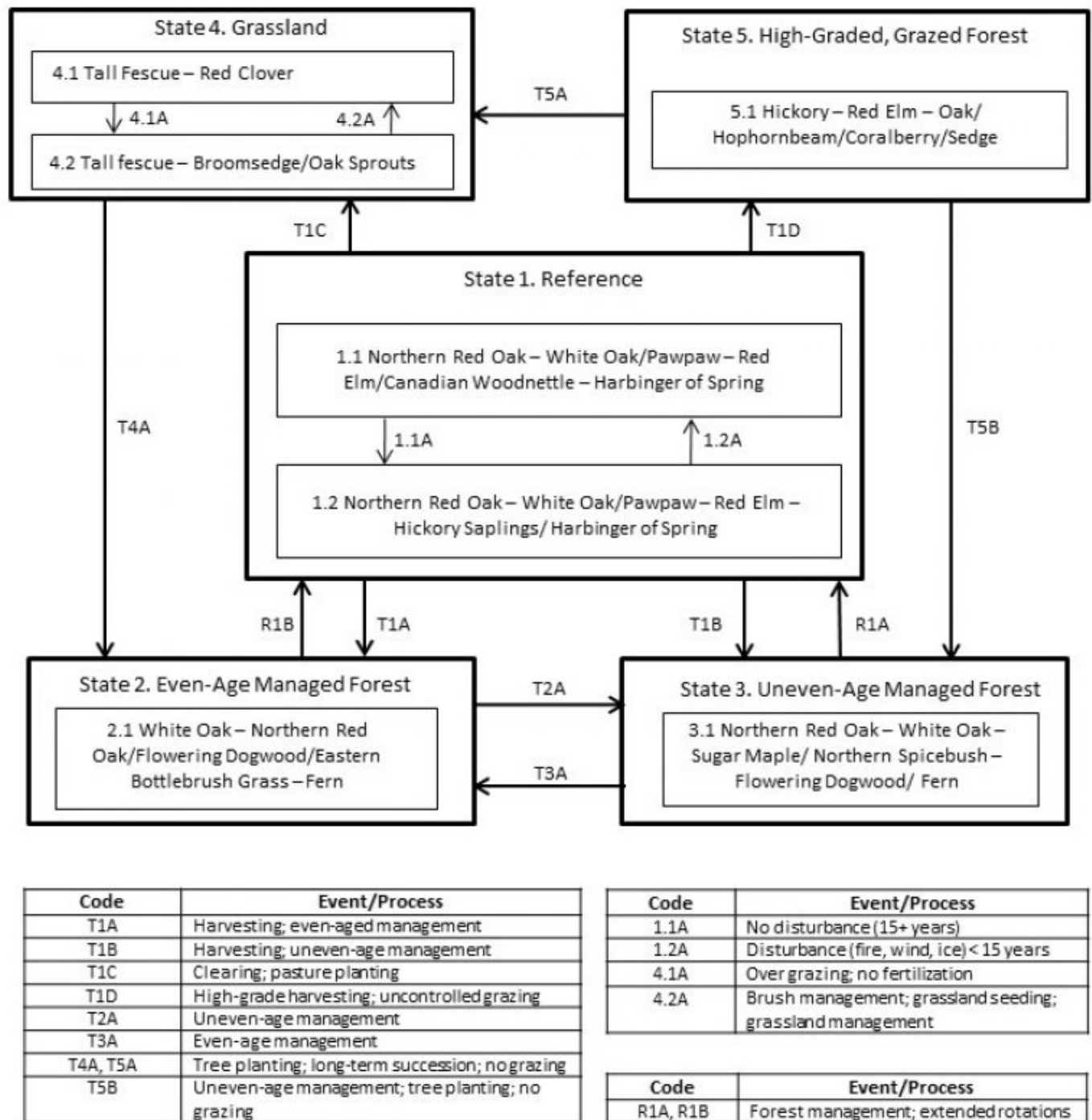


Figure 10. State and transition diagram for this ecological site

State 1

Reference

The reference state was dominated by northern red oak associated with white oak and other mixed hardwoods. Maximum tree age was likely 150 to 300 years. Periodic disturbances from fire, wind or ice maintained the dominance of white oak by opening up the canopy and allowing more light for white oak reproduction. Long disturbance-free periods allowed an increase in more shade tolerant species such as northern red oak and sugar maple. Two community phases are recognized in this state, with shifts between phases based on disturbance frequency. The reference state can be found in scattered locations throughout the MLRA. Some sites have been converted to grassland (State 4). Others have been subject to repeated, high-graded timber harvests coupled with uncontrolled domestic livestock grazing (State 5). Fire suppression throughout the region has resulted in increased canopy density, which has affected the abundance and diversity of ground flora. Many reference sites have been effectively managed for timber harvesting, resulting in either even-age (State 2) or uneven-age (State 3) managed forests depending upon the removal intensity and the species selection.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- pawpaw (*Asimina triloba*), tree
- slippery elm (*Ulmus rubra*), tree
- Canadian woodnettle (*Laportea canadensis*), other herbaceous
- harbinger of spring (*Erigenia bulbosa*), other herbaceous

Community 1.1

Northern Red Oak – White Oak/Pawpaw – Red Elm/Canadian Woodnettle – Harbinger of Spring

This phase is a forest dominated by an overstory of red oak, white oak, white ash and occasional sugar maple. The canopy and understory are well developed with great structural and species diversity. This phase experienced some periodic burning (estimated 10 to 25 years) but with low intensity.

Forest overstory. The Overstory Species list is based on field surveys and commonly occurring species listed in Nelson (2010).

Forest understory. The Understory Species list is based on field surveys and commonly occurring species listed in Nelson (2010).

Community 1.2

Northern Red Oak – White Oak/Pawpaw – Red Elm - Hickory Saplings/Harbinger of Spring

Long disturbance-free periods allowed an increase in more shade tolerant species such as northern red oak and sugar maple with increased canopy density, which has affected the abundance and diversity of ground flora.

Pathway P1.1A

Community 1.1 to 1.2

This pathway is a gradual transition that results from extended, disturbance-free periods.

Pathway P1.2A

Community 1.2 to 1.1

This pathway is a transition that results from extended, disturbance periods returning, such as native fires, wind, and ice storms.

State 2

Even-Age Managed Forest

This forest tends to be rather dense with an even-aged overstory and an under developed understory and ground

flora. Thinning can increase overall tree vigor and improve understory diversity. Continual managed timber harvesting, depending on the practices used and age classes removed, will either maintain this state, or convert the site to uneven-age (State 3) forests. This state can be restored to a reference state by modifying or eliminating timber harvests, extending rotations, incorporating selective thinning, and re-introducing limited prescribed fire.

Dominant plant species

- white oak (*Quercus alba*), tree
- northern red oak (*Quercus rubra*), tree
- flowering dogwood (*Cornus florida*), tree
- eastern bottlebrush grass (*Elymus hystrix*), grass
- Christmas fern (*Polystichum acrostichoides*), other herbaceous
- northern maidenhair (*Adiantum pedatum*), other herbaceous

Community 2.1

White Oak - Northern Red Oak /Flowering Dogwood/Bottlebrush Grass - Fern



Figure 11. A Loamy Protected Backslope Forest on private land in Boone County, Missouri

This is an even-aged forest management phase. Logging activities are removing higher volumes of white oak causing a decrease in white oak in the canopy and an increase in northern red oak. Large group, shelterwood or clearcut harvests create a more uniform age class structure throughout the canopy layer while also opening up the understory and allowing more sunlight to reach the forest floor.

State 3

Uneven-Age Managed Forest

An uneven-age managed forest can resemble the reference state. The primary difference is tree age, most being only 50 to 90 years old. Composition is also likely altered from the reference state depending on tree selection during harvests and disturbance activities. Without a regular 15 to 20 year harvest re-entry into these stands, they will slowly increase in more shade tolerant species such as sugar maple and white oak will become less dominant.

This state can be restored to a reference state by modifying timber harvests, extending rotations, incorporating selective thinning, and re-introducing limited prescribed fire.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- sugar maple (*Acer saccharum*), tree
- flowering dogwood (*Cornus florida*), tree
- northern spicebush (*Lindera benzoin*), shrub
- Christmas fern (*Polystichum acrostichoides*), other herbaceous
- northern maidenhair (*Adiantum pedatum*), other herbaceous

Community 3.1

Northern Red Oak – White Oak – Sugar Maple/ Spicebush – Flowering Dogwood/ Fern

This is an uneven-aged forest management phase. Selective logging activities are removing higher volumes of white oak causing a decrease in white oak in the canopy and an increase in northern red oak and sugar maple. Densities numbers, especially more shade tolerant species, are increasing at the lower size-class levels.

State 4

Grassland

Conversion of forests to planted, non-native cool season grasses and legumes has been common. Without proper grassland management these ecological sites are challenging to maintain in a healthy, productive state. With over grazing and cessation of active pasture management, tall fescue, white clover and multi-flora rose will increase in density.

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- red clover (*Trifolium pratense*), other herbaceous

Community 4.1

Tall Fescue - Red Clover

This phase is well-managed grassland, composed of non-native cool season grasses and legumes. Grazing and haying is occurring. The effects of long-term liming on soil pH, and calcium and magnesium content, is most evident in this phase. Studies show that these soils have higher pH and higher base status in soil horizons as much as two feet below the surface, relative to poorly managed grassland and to woodland communities (where liming is not practiced).

Community 4.2

Tall fescue - Broomsedge/Oak Sprouts

This phase is the result of over use, poor grassland and grazing management and lack of adequate nutrient application. Oak sprouts, oak saplings, and invasive species are increasing as a result of poor management.

Pathway P4.1A

Community 4.1 to 4.2

This pathway is the result of over grazing and lack of proper grassland management.

Pathway P4.2A

Community 4.2 to 4.1

This pathway is the result of brush management, grassland reseeding and proper grassland management.

State 5

High-Graded/Grazed Forest

Reference or managed forested states subjected to repeated, high-grading timber harvests and uncontrolled cattle grazing transition to this degraded state. This state exhibits an over-abundance of hickory and other less economically desirable tree species and weedy understory species such as buckbrush, gooseberry, poison ivy and multi-flora rose. The vegetation offers little nutritional value for cattle, and excessive livestock stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff. Browsing by goats using good rotational management can open up the shrub layer, eliminate many of the weedy species and increase both native herbaceous vegetation and may induce regeneration of oak and hickory species. Cessation of active logging and exclusion of livestock from sites in this state will create an idle phase that experiences an increase in black cherry and Ohio buckeye in the understory layer. Transition back to either an even-age managed or uneven-age managed forest will require dynamic and sustained forest stand improvements, cessation of grazing, and selective thinning of overstory and understory canopies.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- sugar maple (*Acer saccharum*), tree
- flowering dogwood (*Cornus florida*), tree
- northern spicebush (*Lindera benzoin*), shrub
- Christmas fern (*Polystichum acrostichoides*), other herbaceous
- northern maidenhair (*Adiantum pedatum*), other herbaceous

Community 5.1

Hickory – Red Elm – Oak/ Hophornbeam/Buckbrush/Sedge

This phase is the result of repeated, high-grading timber harvests and uncontrolled cattle grazing.

Transition T1A

State 1 to 2

This transition typically results from even-aged management, younger canopy ages, and harvesting.

Transition T1B

State 1 to 3

This transition typically results from uneven-age forest management practices, such as single tree or group selection harvest and fire suppression.

Transition T1D

State 1 to 5

This transition is the result of high-grade harvesting and uncontrolled domestic livestock grazing.

Restoration pathway R1B

State 2 to 1

This restoration transition generally requires extended rotations that allow mature trees to exceed ages of about 100 years along with prescribed fire.

Transition T2A

State 2 to 3

This transition typically results from uneven-age management .

Restoration pathway R1A
State 3 to 1

This restoration transition generally requires extended rotations that allow mature trees to exceed ages of about 100 years along with prescribed fire.

Transition T3A
State 3 to 2

This transition typically results from active even-age forest management.

Transition T4A
State 4 to 2

This transition typically results with tree planting, long-term succession, and no grazing.

Transition T5B
State 5 to 3

This transition typically results with uneven-age forest management, tree planting and livestock exclusion

Transition T5A
State 5 to 4

This transition is the result of clearing and conversion to non-native cool season grassland.

Additional community tables

Table 5. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
white oak	QUAL	<i>Quercus alba</i>	Native	–	30–50	–	–
northern red oak	QURU	<i>Quercus rubra</i>	Native	–	30–50	–	–
shagbark hickory	CAOV2	<i>Carya ovata</i>	Native	–	20–30	–	–
sugar maple	ACSA3	<i>Acer saccharum</i>	Native	–	5–20	–	–
slippery elm	ULRU	<i>Ulmus rubra</i>	Native	–	10–20	–	–
American basswood	TIAM	<i>Tilia americana</i>	Native	–	5–10	–	–
bitternut hickory	CACO15	<i>Carya cordiformis</i>	Native	–	5–10	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Forb/Herb					
Virginia springbeauty	CLVI3	<i>Claytonia virginica</i>	Native	—	20–40
mayapple	POPE	<i>Podophyllum peltatum</i>	Native	—	20–30
toadshade	TRSE2	<i>Trillium sessile</i>	Native	—	20–30
harbinger of spring	ERBU	<i>Erigenia bulbosa</i>	Native	—	20–30
wild blue phlox	PHDI5	<i>Phlox divaricata</i>	Native	—	10–20
white fawnlily	ERAL9	<i>Erythronium albidum</i>	Native	—	10–20
hepatica	HENO2	<i>Hepatica nobilis</i>	Native	—	10–20
goldenseal	HYCA	<i>Hydrastis canadensis</i>	Native	—	10–20
feathery false lily of the valley	MARA7	<i>Maianthemum racemosum</i>	Native	—	10–20
largeflower bellwort	UVGR	<i>Uvularia grandiflora</i>	Native	—	10–20
Canadian woodnettle	LACA3	<i>Laportea canadensis</i>	Native	—	10–20
Virginia snakeroot	ARSE3	<i>Aristolochia serpentaria</i>	Native	—	10–20
green dragon	ARDR3	<i>Arisaema dracontium</i>	Native	—	5–10
lesser yellow lady's slipper	CYPAP4	<i>Cypripedium parviflorum var. parviflorum</i>	Native	—	0–5
Fern/fern ally					
Christmas fern	POAC4	<i>Polystichum acrostichoides</i>	Native	—	5–20
northern maidenhair	ADPE	<i>Adiantum pedatum</i>	Native	—	5–20
Shrub/Subshrub					
American hazelnut	COAM3	<i>Corylus americana</i>	Native	—	10–30
fragrant sumac	RHAR4	<i>Rhus aromatica</i>	Native	—	5–20
northern spicebush	LIBE3	<i>Lindera benzoin</i>	Native	—	10–20
Tree					
hophornbeam	OSVI	<i>Ostrya virginiana</i>	Native	—	10–20
pawpaw	ASTR	<i>Asimina triloba</i>	Native	—	10–20
American bladdernut	STTR	<i>Staphylea trifolia</i>	Native	—	10–20
flowering dogwood	COFL2	<i>Cornus florida</i>	Native	—	10–20
Vine/Liana					
Virginia creeper	PAQU2	<i>Parthenocissus quinquefolia</i>	Native	—	10–20
summer grape	VIAE	<i>Vitis aestivalis</i>	Native	—	10–20

Animal community

Wildlife (MDC 2006):

Wild turkey, white-tailed deer, and eastern gray squirrel depend on hard and soft mast food sources and are typical upland game species of this type.

Birds associated with this ecological site include Worm-eating warbler, Whip-poor-will, Great Crested Flycatcher, Ovenbird, Pileated Woodpecker, Wood Thrush, Red-eyed Vireo, Northern Parula, Louisiana Waterthrush (near streams), and Broad-winged Hawk.

Reptile and amphibian species associated with mature forests include: ringed salamander, spotted salamander, marbled salamander, central newt, long-tailed salamander, dark-sided salamander, southern red-backed salamander, three-toed box turtle, western worm snake, western earth snake, and American toad.

Other information

Forestry (NRCS 2002, 2014):

Management: Field measured site index values range from 53 to 76 for oak. Timber management opportunities are good. Create group openings of at least 2 acres. Large clearcuts should be minimized if possible to reduce impacts on wildlife and aesthetics. Uneven-aged management using single tree selection or small group selection cuttings of ½ to 1 acre are other options that can be used if clear cutting is not desired or warranted. Using prescribed fire as a management tool could have a negative impact on timber quality, may not be fitting, or should be used with caution on a particular site if timber management is the primary objective.

Limitations: No major equipment restrictions or limitations exist. Erosion is a hazard when slopes exceed 15 percent. On steep slopes greater than 35 percent, traction problems increase and equipment use is not recommended.

Inventory data references

Potential Reference Sites: Loamy Protected Backslope Forest

Plot DABOCA_JK12 – Wrengart soil

Located in Daniel Boone CA, Warren County, MO

Latitude: 38.783534

Longitude: -91.37662851

Plot DOROSP02 - Bucklick soil

Located in Don Robinson SP, Jefferson County, MO

Latitude: 38.39356

Longitude: -90.704197

Plot GRCASP_KS03 - Holstein soil

Located in Graham Cave SP, Montgomery County, MO

Latitude: 38.904757

Longitude: -91.572512

Plot LILOCA_JK18 – Wrengart soil

Located in Little Lost Creek CA, Warren County, MO

Latitude: 38.76862

Longitude: -91.26983

Other references

Baker, John L. 1998. Soil Survey of Cooper County, Missouri. U.S. Dept. of Agric. Natural Resources Conservation Service.

Batek, M.J., A.J. Rebertus, W.A. Schroeder, T.L. Haithcoat, E. Compas, and R.P. Guyette. 1999. Reconstruction of early nineteenth-century vegetation and fire regimes in the Missouri Ozarks. *Journal of Biogeography* 26:397-412.

Frost, C., 1996. Pre-settlement Fire Frequency Regimes of the United States: A First Approximation. Pages 70-81, *Proceedings of the 20nd Tall Timbers Fire Ecology Conference: Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescription*. Tall Timbers Research Station, Tallahassee, FL.

Harlan, J.D., T.A. Nigh and W.A. Schroeder. 2001. The Missouri original General Land Office survey notes project. University of Missouri, Columbia.

Ladd, D. 1991. Reexamination of the role of fire in Missouri oak woodlands. Pp. 67-80 in G.V. Brown, James K.; Smith, Jane Kapler, eds. 2000. *Wildland fire in ecosystems: effects of fire on flora*. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 p.

MDC, 2006. Missouri Forest and Woodland Community Profiles. Missouri Department of Conservation, Jefferson City, Missouri.

Natural Resources Conservation Service. 2002. Woodland Suitability Groups. Missouri FOTG, Section II, Soil Interpretations and Reports. 30 pgs.

Natural Resources Conservation Service. Site Index Reports. Accessed May 2014.
https://esi.sc.egov.usda.gov/ESI_Forestland/pgFSWelcome.aspx

NatureServe, 2010. Vegetation Associations of Missouri (revised). NatureServe, St. Paul, Minnesota.

Nelson, Paul W. 2010. The Terrestrial Natural Communities of Missouri. Missouri Department of Conservation, Jefferson City, Missouri.

Nigh, Timothy A. and Walter A. Schroeder. 2002. Atlas of Missouri Ecoregions. Missouri Department of Conservation, Jefferson City, Missouri.

University of Missouri Climate Center - <http://climate.missouri.edu/climate.php>; accessed June 2012

United States Department of Agriculture – Natural Resource Conservation Service (USDA-NRCS). 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. 682 pgs.

United States Department of Agriculture, Natural Resources Conservation Service. 2022. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture, Agriculture Handbook 296.

Vano, Julie A. 2005. Land Surface Hydrology in Northern Wisconsin: Influences of climatic variability and land cover. University of Wisconsin-Madison.

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Approval

Suzanne Mayne-Kinney, 12/30/2024

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Missouri Department of Conservation and Missouri Department of Natural Resources personnel provided significant and helpful field and technical support in the development of this ecological site.

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	05/11/2025

Approved by	Suzanne Mayne-Kinney
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:**
-