USDA Natural Resources
Conservation Service

# Ecological site F115XC007IL
# Loess 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.

## 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, Northern part (Land Resource Unit (LRU) (115XC) encompasses the Wyaconda River Dissected Till Plains, Mississippi River Hills, and Mississippi River Alluvial Plain (Schwegman et al. 1973; Nelson 2010). It spans three states – Illinois (73 percent), Iowa (6 percent), and Missouri (21 percent) – comprising about 13,650 square miles (Figure 1). The elevation ranges from 420 feet above sea level (ASL) along the Mississippi River floodplains to 885 feet on the upland ridges. Local relief varies from 10 to 20 feet but can be as high as 50 to 100 feet along drainageways and streams and the bluffs on the major rivers reaching 250 feet above valley floors. Wisconsin-aged loess covers the uplands, while Illinoian glacial drift lies directly below. The loess and drift deposits are underlain by several bedrock systems, including the Cretaceous, Pennsylvania, Mississippian, Silurian, Devonian, and Ordovician Systems. Wisconsin outwash deposits and sandy eolian material occur along stream terraces of major tributaries (USDA-NRCS 2006).

The vegetation across the region has undergone drastic changes over time. At the end of the last glacial episode – the Wisconsinan glaciation – the evolution of vegetation began with the development of tundra habitats, followed by a phase of spruce and fir forests, and eventually spruce-pine forests. Not until approximately 9,000 years ago did the climate undergo a warming trend which prompted the development of deciduous forests dominated by oak and hickory. As the climate continued to warm and dry, prairies began to develop approximately 8,300 years ago. Another shift in climate that resulted in an increase in moisture prompted the emergence of savanna-like habitats from 8,000 to 5,000 years before present (Taft et al. 2009). During the most recent climatic shifts, forested ecosystems maintained footholds on steep valley sides and wet floodplains. Due to the physiography of the MLRA, forests were the dominant ecosystems and were affected by such natural disturbances as droughts, wind, lightning, and occasional fire (Taft et al. 2009).

## Classification relationships

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

USFS Subregions: Central Dissected Till Plains (251C)Section; Western Mississippi River Hills (251Ce), Mississippi River and Illinois Alluvial Plains (251Cf), Eastern Mississippi River Hills (251Ci), Galesburg Dissected Till Plain (251Cj), and Wyaconda River Dissected Till Plain (251Cm) Subsections (Cleland et al. 2007)

U.S. EPA Level IV Ecoregion: Upper Mississippi River Alluvial Plain (72d), River Hills (72f), and Western Dissected Illinoian Till Plain (72i) (USEPA 2013)

National Vegetation Classification – Ecological Systems: North-Central Interior Dry-Mesic Oak Forest and Woodland (CES202.046) (NatureServe 2018)

National Vegetation Classification – Plant Associations: Quercus alba – Quercus rubra – Carya ovata Glaciated Forest (CEGL002068) (Nature Serve 2018)

Biophysical Settings: North-Central Interior Dry-Mesic Oak Forest and Woodland (BpS 4913100) (LANDFIRE 2009)

Illinois Natural Areas Inventory: Mesic Upland Forest (White and Madany 1978)

Missouri Terrestrial Natural Communities: Dry-mesic loess/glacial till forest, Mesic loess/glacial till forest (Nelson 2010)

## Ecological site concept

Loess Protected Backslope Forests are located within the green areas on the map. They occur on north- and east-facing backslopes. The soils are Alfisols and Entisols that are somewhat poorly to well drained and very deep, formed in loess and loess-covered substrates

The historic pre-European settlement vegetation on this ecological site was dominated by a closed canopy of oaks. Northern red oak (Quercus rubra L.) and shagbark hickory (Carya ovata (Mill.) K. Koch) are the dominant species in the tree canopy, but white oak (Quercus alba L.), sugar maple (*Acer saccharum* Marshall), and American basswood (Tilia americana L.) can also be present (White and Madany 1978). Pawpaw (Asimina triloba (L.) Dunal) is a characteristic shrub and Canadian woodnettle (Laportea canadensis (L.) Weddell) and bluntleaf waterleaf (Hydrophyllum canadense L.) are characteristic herbaceous species of this closed canopy forest. Herbaceous species characteristic of an undisturbed plant community associated with this ecological site include American ginseng (Panax quinquefolius L.) and blue cohosh (Caulophyllum thalictroides (L.) Michx.) (Ladd and Thomas 2015; NatureServe 2018). Fire is the primary disturbance factor that maintains this ecological site, while storm damage and drought are secondary factors (LANDFIRE 2009).

## Associated sites

| | |
|---|---|
| F115XC008IL | **Loess Exposed Backslope Woodland**<br>Loess and loess-covered substrates on south and west-facing backslopes including Atlas, Baylis, Fayette, Hennepin, Hickory, Keswick, Menfro, Seaton, Stookey, Sylvan, Timula, and Ursa soils |
| F115XC005IL | **Loess Upland Forest**<br>Loess and loess-covered substrates on uplands including Atlas, Baylis, Bunkum, Caseyville, Creal, Derinda, Dodge, Fayette, Fishhook, Hickory, Kendall, Keomah, Keswick, Menfro, Metea, Navlys, Rozetta, Seaton, Stookey, Stronghurst, Sylvan, Thebes, Timula, Ursa, and Winfield soils |

## Similar sites

| | |
|---|---|
| F115XC008IL | **Loess Exposed Backslope Woodland**<br>Loess Exposed Backslope Woodlands occur on south and west-facing backslopes |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Quercus rubra*<br>(2) *Carya ovata* |
| Shrub | (1) *Asimina triloba* |
| Herbaceous | (1) *Laportea canadensis*<br>(2) *Hydrophyllum canadense* |

## Physiographic features

Loess Protected Backslope Forests occur on north- and east-facing backslopes. They are situated on elevations ranging from approximately 341 to 1738 feet ASL. The site does not experience flooding but rather generates runoff to adjacent, downslope ecological sites.

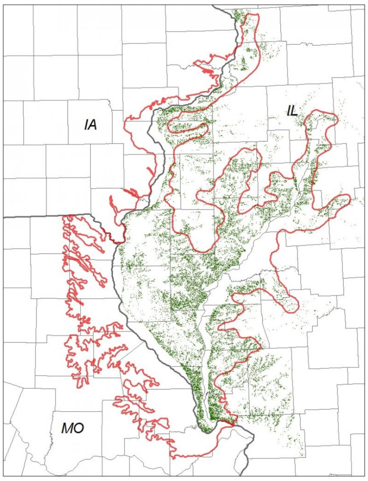



**Figure 1. Location of Loess Protected Backslope Forest ecological site within LRU 115XC.**

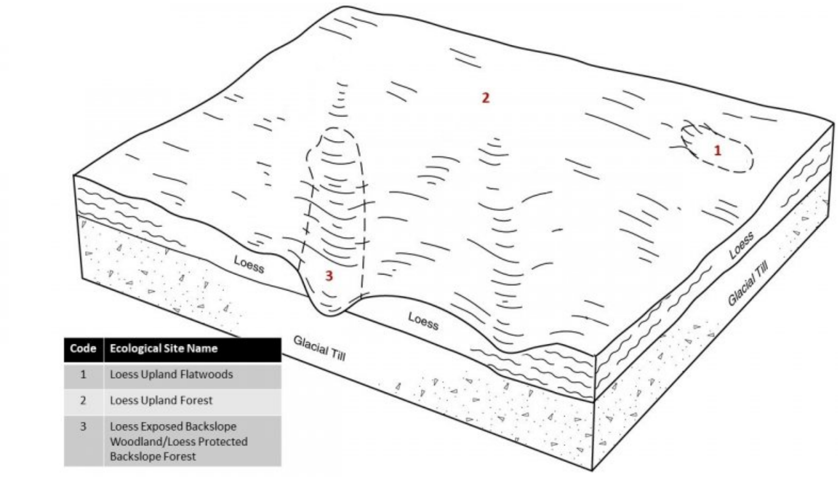



**Figure 2. Representative block diagram of Loess Protected Backslope Forest and associated ecological sites.**

**Table 2. Representative physiographic features**

| | |
|---|---|
| Hillslope profile | (1) Backslope |
| Slope shape across | (1) Convex |
| Slope shape up-down | (1) Convex |
| Landforms | (1) Upland |
| Runoff class | High to very high |
| Elevation | 341–1,738 ft |
| Slope | 15–70% |
| Water table depth | 18–80 in |
| Aspect | N, NE, E, SE |

## Climatic features

The Central Mississippi Valley Wooded Slopes, Northern Part falls into the humid subtropical (Cfa) and hot-summer humid continental climate (Dfa) Köppen-Geiger climate classifications (Peel et al. 2007). The two main factors that drive the climate of the MLRA are latitude and weather systems. Latitude, and the subsequent reflection of solar input, determines air temperatures and seasonal variations. Solar energy varies across the seasons, with summer receiving three to four times as much energy as opposed to winter. Weather systems (air masses and cyclonic storms) are responsible for daily fluctuations of weather conditions. High-pressure systems are responsible for settled weather patterns where sun and clear skies dominate. In fall, winter, and spring, the polar jet stream is responsible for the creation and movement of low-pressure systems. The clouds, winds, and precipitation associated with a low-pressure system regularly follow high-pressure systems every few days (Angel n.d.).

The soil temperature regime of LRU 115XC is classified as mesic, where the mean annual soil temperature is between 46 and 59°F (USDA-NRCS 2006). Temperature and precipitation occur along a north-south gradient, where temperature and precipitation increase the further south one travels. The average freeze-free period of this ecological site is about 182 days, while the frost-free period is about 146 days. The majority of the precipitation occurs as rainfall in the form of convective thunderstorms during the growing season. Average annual precipitation is 39 inches, which includes rainfall plus the water equivalent from snowfall. The average annual low and high temperatures are 42 and 63°F, respectively.

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (characteristic range) | 139-150 days |
| Freeze-free period (characteristic range) | 169-199 days |
| Precipitation total (characteristic range) | 38-41 in |
| Frost-free period (actual range) | 135-162 days |
| Freeze-free period (actual range) | 167-204 days |
| Precipitation total (actual range) | 36-41 in |
| Frost-free period (average) | 146 days |
| Freeze-free period (average) | 182 days |
| Precipitation total (average) | 39 in |

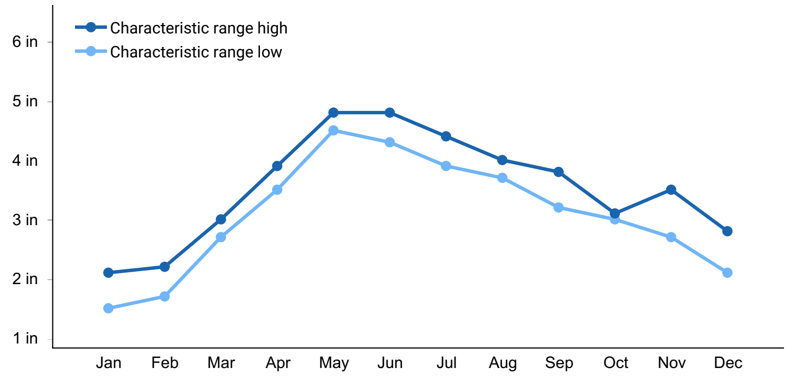



**Figure 3. Monthly precipitation range**

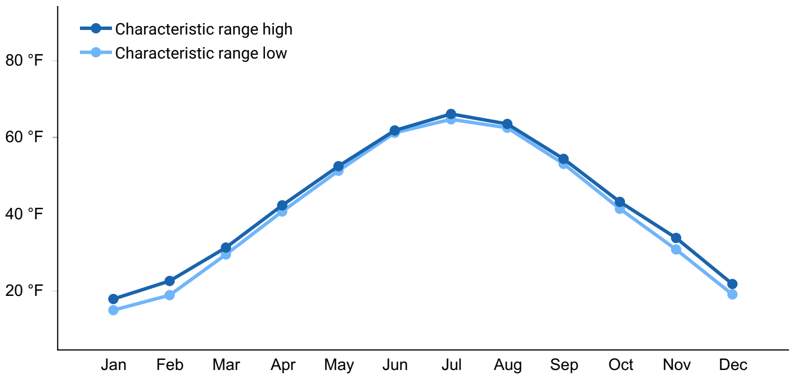



**Figure 4. Monthly minimum temperature range**

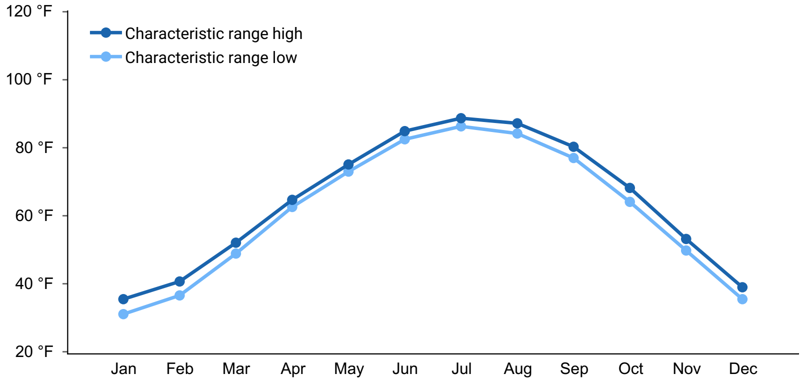



**Figure 5. Monthly maximum temperature range**

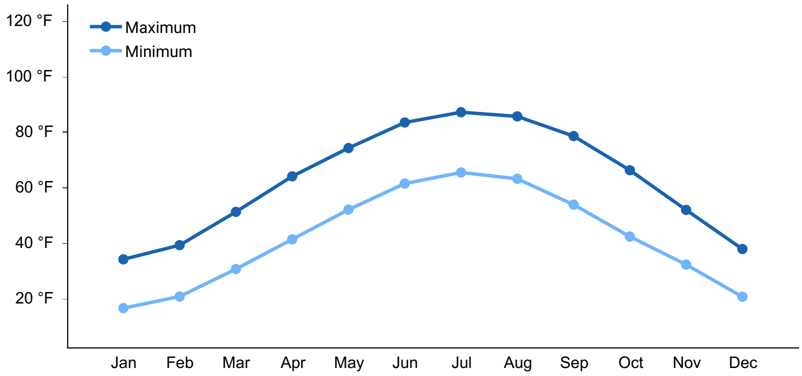



**Figure 6. Monthly average minimum and maximum temperature**

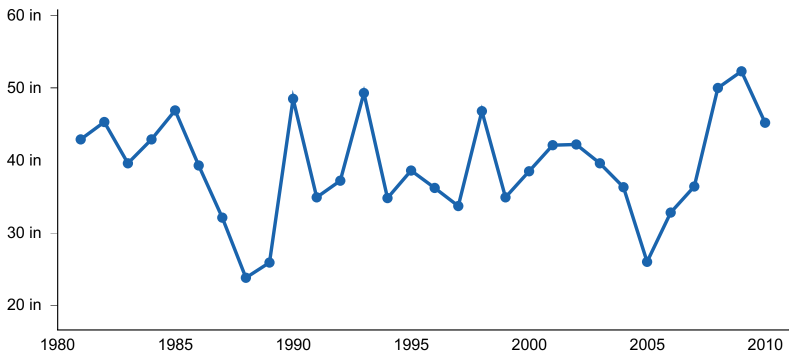



**Figure 7. Annual precipitation pattern**

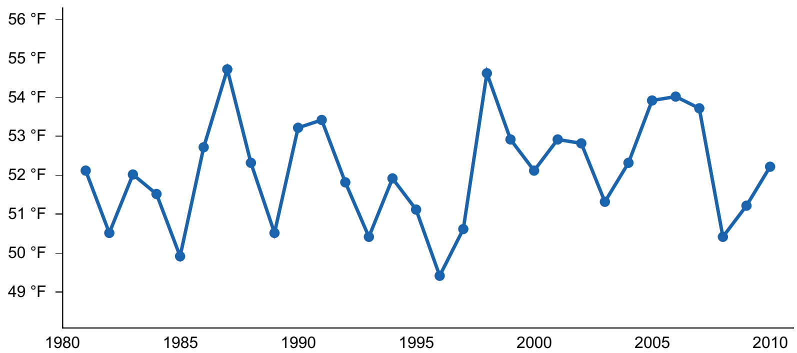



**Figure 8. Annual average temperature pattern**

## Climate stations used

- (1) MORRISON [USC00115833], Morrison, IL
- (2) NEW BOSTON DAM 17 [USC00116080], Wapello, IL
- (3) LA HARPE [USC00114823], La Harpe, IL

- (4) HAVANA [USC00113940], Lewistown, IL
- (5) PITTSFIELD #2 [USC00116837], Pittsfield, IL
- (6) ST CHARLES CO AP [USW00053904], Portage des Sioux, MO

## Influencing water features

Loess Protected Backslope Forests are not influenced by wetland or riparian water features. Precipitation is the main source of water for this ecological site. Infiltration is very slow to moderate (Hydrologic Groups B, C, and D), and surface runoff is high to very high. Surface runoff contributes some water to downslope ecological sites.

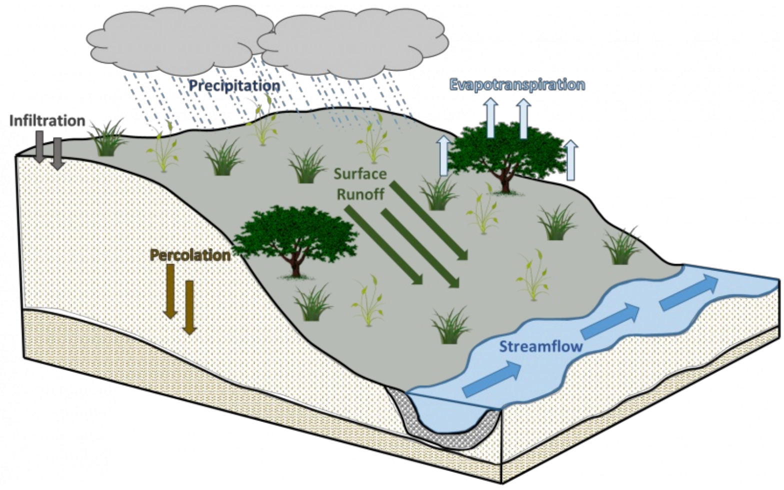



**Figure 9. Hydrologic cycling in Loess Protected Backslope Forest ecological site.**

## Soil features

Soils of Loess Protected Backslope Forests are in the Alfisols and Entisols orders, further classified as Aeric Chromic Vertic Epiaqualfs, Aquertic Chromic Hapludalfs, Chromic Vertic Hapludalfs, Typic Hapludalfs, Typic Paleudalfs, Typic Eutrudepts with very slow to moderate infiltration and high to very high runoff potential. The soil series associated with this site includes Atlas, Baylis, Fayette, Hennepin, Hickory, Keswick, Menfro, Seaton, Stookey, Sylvan, Timula, and Ursa. The parent material is loess and loess-covered substrates, and the soils are somewhat poorly to well-drained and very deep. Soil pH classes are very strongly acid to moderately alkaline. A shallow, densic material may be noted as a rooting restriction are for some soils of this ecological site.

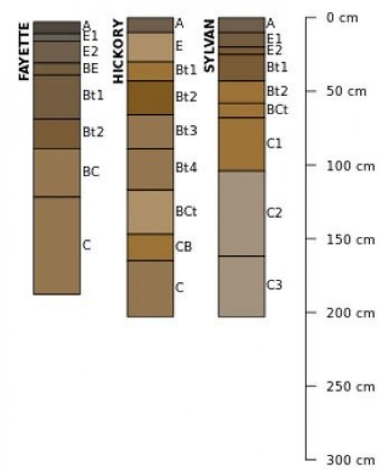



**Figure 10. Profile sketches of soil series associated with Loess Protected Backslope Forest.**

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Loess |
| Surface texture | (1) Silt loam |

| | |
|---|---|
| Family particle size | (1) Fine-silty |
| Drainage class | Somewhat poorly drained to well drained |
| Permeability class | Very slow to moderately slow |
| Depth to restrictive layer | 80 in |
| Soil depth | 80 in |
| Surface fragment cover <=3" | 0–2% |
| Surface fragment cover >3" | 0–5% |
| Available water capacity (Depth not specified) | 3–8 in |
| Calcium carbonate equivalent (Depth not specified) | 0–40% |
| Electrical conductivity (Depth not specified) | 0–2 mmhos/cm |
| Soil reaction (1:1 water) (Depth not specified) | 4.5–7.3 |
| Subsurface fragment volume <=3" (Depth not specified) | 3–18% |
| Subsurface fragment volume >3" (Depth not specified) | 0–16% |

## Ecological dynamics

The information in this Ecological Site Description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The MLRA lies within the tallgrass prairie ecosystem of the Midwest, but a variety of environmental and edaphic factors resulted in a landscape that historically supported upland hardwood forests, lowland mixed forests, and scattered grass and sedge meadows. Loess Protected Backslope Forests form an aspect of this vegetative continuum. This ecological site occurs on north and east-facing backslopes on somewhat poorly to well-drained soils. Species characteristic of this ecological site include a closed canopy of oak and hickory with shade-tolerant herbaceous vegetation.

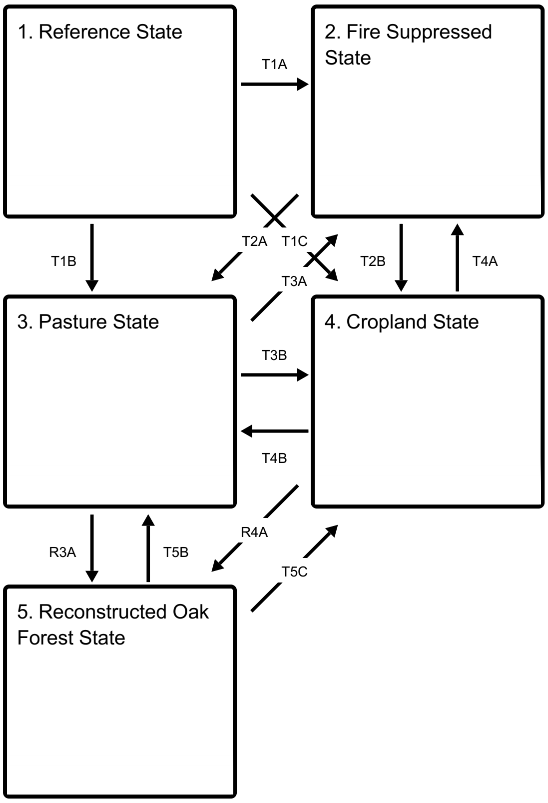
Fire is a critical factor that maintains Loess Protected Backslope Forests. Fire typically consisted of low-severity surface fires every 25 to 50 years (LANDFIRE 2009). Ignition sources included summertime lightning strikes from convective storms and bimodal, human ignitions during the spring and fall seasons. Native Americans regularly set fires to improve sight lines for hunting, drive large game, improve grazing and browsing habitat, agricultural clearing, and enhance vital ethnobotanical plants (Barrett 1980; LANDFIRE 2009).

Drought and storm damage have also played a role in shaping this ecological site. The periodic episodes of reduced soil moisture in conjunction with the somewhat poorly to well-drained soils have favored the proliferation of plant species tolerant of such conditions. Drought can also slow the growth of plants and result in dieback of certain species. Damage to trees from wind and ice storms can vary from minor, patchy effects of individual trees to stand effects that temporarily affect community structure and species richness and diversity (Irland 2000; Peterson 2000). When coupled with fire, periods of drought and catastrophic storm damage can greatly delay the establishment and maturation of woody vegetation (Pyne et al. 1996).

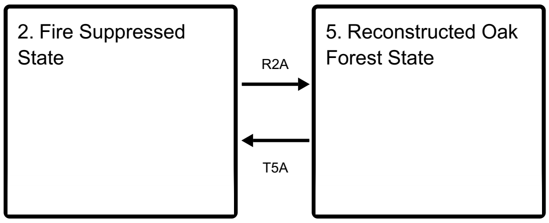
Today, Loess Protected Backslope Forests have been reduced from their pre-settlement extent. Moderate slopes have been converted to cropland, while steeper slopes have been converted to forage land. Remnants that do exist have experienced long-term fire suppression and overbrowsing resulting in significant changes to the forest structure. A return to the historic plant community may not be possible following extensive land modification, but long-term conservation agriculture or forest reconstruction efforts can help to restore some biotic diversity and ecological function. The state-and-transition model that follows provides a detailed description of each state, community phase, pathway, and transition. This model is based on available experimental research, field observations, literature reviews, professional consensus, and interpretations.

## State and transition model

**Ecosystem states**




**States 2 and 5 (additional transitions)**




**T1A** - Fire suppression 50 yrs +

**T1B** - Cultural treatments are implemented to increase forage quality and yield

**T1C** - Agricultural conversion via tillage, seeding, and non-selective herbicide

**T2A** - Cultural treatments are implemented to increase forage quality and yield

**T2B** - Agricultural conversion via tillage, seeding, and non-selective herbicide

**R2A** - Site preparation, tree planting, non-native species control, and native seeding

**T3A** - Long-term fire suppression and/or land abandonment

**T3B** - Agricultural conversion via tillage, seeding, and non-selective herbicide

**R3A** - Site preparation, tree planting, non-native species control, and native seeding

**T4A** - Long-term fire suppression and/or land abandonment

**T4B** - Cultural treatments are implemented to increase forage quality and yield

**R4A** - Site preparation, tree planting, non-native species control, and native seeding

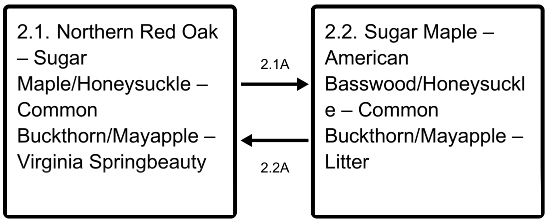
**T5A** - Long-term fire suppression and/or land abandonment

**T5B** - Cultural treatments are implemented to increase forage quality and yield

**T5C** - Agricultural conversion via tillage, seeding, and non-selective herbicide

**State 1 submodel, plant communities**

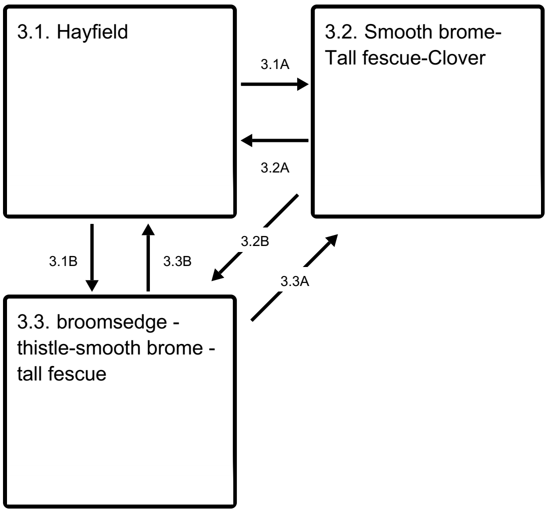
**State 2 submodel, plant communities**




**2.1A** - Fire suppression; increase in deer population

**2.2A** - Increase in fire frequency

**State 3 submodel, plant communities**




**3.1A** - Grazing; forage to animal balance

**3.1B** - Grazing; forage plants overutilized

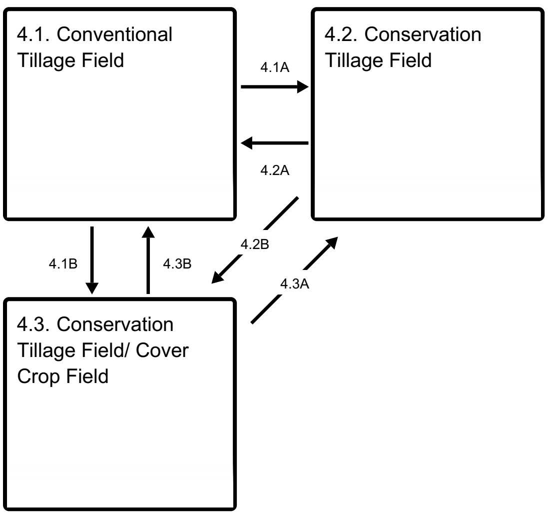
**3.2A** - Mechanical harvest

**3.2B** - Grazing; forage plants overutilized

**3.3B** - Mechanical harvest

**3.3A** - Grazing; correct animal to forage balance

**State 4 submodel, plant communities**




**4.1A** - Reduced tillage

**4.1B** - Reduced tillage; cover crops

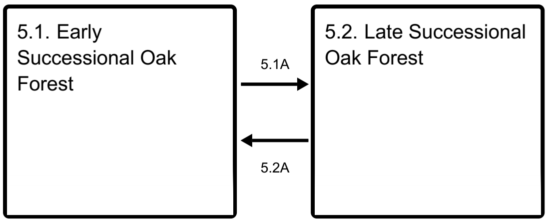
**4.2A** - Intensive tillage

**4.2B** - Cover crops

**4.3B** - Intensive tillage; no cover crops

**4.3A** - Stop cover crop practices

**State 5 submodel, plant communities**




**5.1A** - Community succession as outlined in management plan

**5.2A** - Setback to community development

## State 1
## Reference State

The reference plant community is categorized as an oak-hickory forest, dominated by deciduous trees and shade-tolerant herbaceous vegetation. The one community phase within the reference state is dependent on recurring fire intervals. The severity and intensity of fire alters species composition, cover, and extent, while regular fire intervals keep the canopy from succeeding to mesophytic, fire-intolerant species. Drought and catastrophic storm damage have more localized impacts in the reference phases, but do contribute to overall species composition, diversity, cover, and productivity

### Dominant plant species

- northern red oak (*Quercus rubra*), tree
- shagbark hickory (*Carya ovata*), tree
- pawpaw (*Asimina triloba*), shrub
- Canadian woodnettle (*Laportea canadensis*), other herbaceous
- bluntleaf waterleaf (*Hydrophyllum canadense*), other herbaceous

## Community 1.1
## Northern Red Oak - Shagbark Hickory / Pawpaw / Canadian Woodnettle - Bluntleaf Waterleaf

Sites in this reference community phase are a closed canopy forest. Northern red oak and shagbark hickory are the dominant species, but white oak, sugar maple, and American basswood are common canopy associates. Trees are large (21 to 33-inch DBH), and cover is approximately 80 percent (LANDFIRE 2009). Tall shrubs – e.g., pawpaw and blackhaw (*Viburnum prunifolium* (L.)) – can be present. The herbaceous layer is nearly continuous with shade-tolerant species such as Canadian woodnettle and bluntleaf waterleaf (Nelson 2015). Spring ephemerals, such as mayapple (*Podophyllum peltatum* L.), dutchamn’s breeches (*Dicentra cucullaria* (L.) Bernh.), bloodroot (*Sanguinaria canadensis* L.), and Virginia springbeauty (*Claytonia virginica* L.) can be very abundant in the early spring before the trees have leafed out. Low-severity surface fires every 25 to 50 years will maintain this community phase (LANDFIRE 2009).

### Dominant plant species

- northern red oak (*Quercus rubra*), tree
- shagbark hickory (*Carya ovata*), tree
- pawpaw (*Asimina triloba*), shrub
- blackhaw (*Viburnum prunifolium*), shrub
- bluntleaf waterleaf (*Hydrophyllum canadense*), other herbaceous
- Canadian woodnettle (*Laportea canadensis*), other herbaceous

## State 2
## Fire Suppressed State

Fire suppression can transition the reference plant community from an oak forest to an oak-maple mesophytic forest. As the natural fire regime is removed from the landscape, encroachment and dominance by shade-tolerant, fire-intolerant species ensues. This results in a positive feedback loop of mesophication whereby plant community succession continuously creates cool, damp shaded conditions that perpetuate a closed canopy ecosystem (Nowacki and Abrams 2008). Succession to this forested state can occur in as little as 50 years from the last fire (LANDFIRE 2009). Overbrowsing by an unnaturally abundant deer population can also lead to changes in the composition, diversity, and production of the forest. Continuous browsing has been reported to prevent the regeneration of the historic canopy, which is replaced by mid-level and invasive species (Gubanyi et al. 2008; VerCauteren and Hygnstrom 2011). Similarly, herbaceous diversity and composition is also affected by selective browsing pressure (Gubanyi et al. 2008).

**Dominant plant species**

- northern red oak (*Quercus rubra*), tree
- sugar maple (*Acer saccharum*), tree
- blackhaw (*Viburnum prunifolium*), shrub

### Community 2.1
### Northern Red Oak – Sugar Maple/Honeysuckle – Common Buckthorn/Mayapple – Virginia Springbeauty

This community phase represents the early stages of long-term fire suppression and overbrowsing. Mature oaks and hickories are still present, but the more shade tolerant sugar maple (*Acer saccharum* Marshall) and American basswood begin to co-dominate. The tree canopy closes to 100 percent cover and basal area increases (LANDFIRE 2009). Non-native shrubs, such as honeysuckle (Lonicera L.) and common buckthorn (*Rhamnus cathartica* L.), can rapidly colonize. The herbaceous layer continues to support shade-tolerant species, but diversity is reduced as the fully closed canopy results in favorable conditions mostly by spring ephemerals. Grazing pressure alters species composition, allowing plants such as mayapple to increase as it is commonly avoided by deer (Gubanyi et al. 2008; Rawbinski 2008).

**Dominant plant species**

- northern red oak (*Quercus rubra*), tree
- sugar maple (*Acer saccharum*), tree
- honeysuckle (*Lonicera*), shrub
- common buckthorn (*Rhamnus cathartica*), shrub
- mayapple (*Podophyllum peltatum*), other herbaceous
- Virginia springbeauty (*Claytonia virginica*), other herbaceous

### Community 2.2
### Sugar Maple – American Basswood/Honeysuckle – Common Buckthorn/Mayapple – Litter

Sites falling into this community phase have a well-established, fire-intolerant canopy dominated by sugar maple and American basswood. Oak seedlings are virtually absent from the understory due to the lack of available light. Without recurring fire, downed woody debris and leaf litter are frequently encountered on the forest floor.

**Dominant plant species**

- sugar maple (*Acer saccharum*), tree
- honeysuckle (*Lonicera*), shrub
- common buckthorn (*Rhamnus cathartica*), shrub
- mayapple (*Podophyllum peltatum*), other herbaceous
- Litter, herbaceous (*Litter, herbaceous*), other herbaceous

### Pathway 2.1A
### Community 2.1 to 2.2

Continued fire suppression and increasing deer populations.

## Pathway 2.2A
## Community 2.2 to 2.1

Fire on the landscape

## State 3
## Pasture State

The pasture state occurs when the reference state is converted to a farming system that emphasizes domestic livestock production known as grassland agriculture. Fire suppression, periodic cultural treatments (e.g., clipping, drainage, soil amendment applications, planting new species and/or cultivars, mechanical harvesting) and grazing by domesticated livestock transition and maintain this state (USDA-NRCS 2003). Early settlers seeded non-native species, such as smooth brome (*Bromus inermis* Leyss.) and Kentucky bluegrass (*Poa pratensis* L.), to help extend the grazing season. Over time, as lands were continuously harvested or grazed by herds of cattle, the non-native species were able to spread and expand across the landscape, reducing the native species diversity and ecological function.

#### Dominant plant species

- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

## Community 3.1
## Hayfield

Sites in this community phase consist of forage plants that are planted and mechanically harvested. Mechanical harvesting removes much of the aboveground biomass and nutrients that feed the soil microorganisms (Franzluebbers et al. 2000; USDA-NRCS 2003). As a result, soil biology is reduced leading to decreases in nutrient uptake by plants, soil organic matter, and soil aggregation. Frequent biomass removal can also reduce the site’s carbon sequestration capacity (Skinner 2008).

#### Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- timothy (*Phleum pratense*), grass
- orchardgrass (*Dactylis glomerata*), grass
- alfalfa (*Medicago*), other herbaceous
- clover (*Trifolium*), other herbaceous

## Community 3.2
## Smooth brome-Tall fescue-Clover

This community is characterized by seeded cool-season grass and forbs. Species will depend upon landowner goals and objectives and may include many different grasses and forbs. Common species include smooth brome (*Bromus inermis*), tall fescue (Festuca arundinacea), Kentucky bluegrass (*Poa pratensis*), timothy (*Phleum pratense*), red clover ( *Trifolium pratense*) and white clover (*Trifolium repens* L.). Management inputs include control of weeds and brush. These sites are managed to ensure a proper forage/animal balance. Plants are not over utilized and have adequate rest and recovery.

#### Dominant plant species

- smooth brome (*Bromus inermis*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- timothy (*Phleum pratense*), grass
- white clover (*Trifolium repens*), other herbaceous
- red clover (*Trifolium pratense*), other herbaceous

### Community 3.3
### broomsedge -thistle-smooth brome -tall fescue

Overutilization of the pasture will result in a shift to include more undesirable species such as thistle (Cirsium spp.), broomsedge (*Andropogon virginicus* L.), ironweed (*Vernonia gigantea*), buttercup (Ranunculus spp.), ragweed (Ambrosia spp.) and berries (Rubus spp.). Many woody and weed species may be present depending on seed sources and level of soil disturbance. This community reflects an improper forage-to-animal balance which will negatively impact forage productivity and reproduction, soil health, and water quality. Ecological resiliency is compromised under these conditions.

**Dominant plant species**

- blackberry (*Rubus*), shrub
- broomsedge bluestem (*Andropogon virginicus*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- smooth brome (*Bromus inermis*), grass
- crabgrass (*Digitaria*), grass
- ironweed (*Vernonia*), other herbaceous
- thistle (*Cirsium*), other herbaceous
- buttercup (*Ranunculus*), other herbaceous
- ragweed (*Ambrosia*), other herbaceous

### Pathway 3.1A
### Community 3.1 to 3.2

Mechanical harvesting is replaced with domestic livestock grazing.

### Pathway 3.1B
### Community 3.1 to 3.3

Mechanical harvesting is replaced with domestic livestock grazing.

### Pathway 3.2A
### Community 3.2 to 3.1

Domestic livestock are removed, and mechanical harvesting is implemented.

### Pathway 3.2B
### Community 3.2 to 3.3

Grazing of livestock with overutilization of the forage plants.

### Pathway 3.3B
### Community 3.3 to 3.1

Domestic livestock are removed, and mechanical harvesting is implemented.

### Pathway 3.3A
### Community 3.3 to 3.2

Forage plants are not overutilized and the site has a proper forage-to-animal balance.

### State 4
### Cropland State

The continuous use of tillage, row-crop planting, and chemicals (i.e., herbicides, fertilizers, etc.) has effectively eliminated the reference community and many of its natural ecological functions in favor of crop production. Corn and soybeans are the dominant crops for the site, and oats (Avena L.) and alfalfa (*Medicago sativa* L.) may be rotated periodically. These areas are likely to remain in crop production for the foreseeable future.

**Dominant plant species**

- corn (*Zea mays*), other herbaceous
- soybean (*Glycine max*), other herbaceous

## Community 4.1
## Conventional Tillage Field

Sites in this community phase typically consist of monoculture row-cropping maintained by conventional tillage practices. They are cropped in either continuous corn or corn-soybean rotations. The frequent use of deep tillage, low crop diversity, and bare soil conditions during the non-growing season negatively impacts soil health. Under these practices, soil aggregation is reduced or destroyed, soil organic matter is reduced, erosion and runoff are increased, and infiltration is decreased, which can ultimately lead to undesirable changes in the hydrology of the watershed (Tomer et al. 2005).

**Dominant plant species**

- corn (*Zea mays*), other herbaceous
- soybean (*Glycine max*), other herbaceous

## Community 4.2
## Conservation Tillage Field

Community Phase 4.2 Conservation Tillage Field – This community phase is characterized by rotational crop production that utilizes various conservation tillage methods to promote soil health and reduce erosion. Conservation tillage methods include strip-till, ridge-till, vertical-till, or no-till planting systems. Strip-till keeps seedbed preparation to narrow bands less than one-third the width of the row where crop residue and soil consolidation are left undisturbed in-between seedbed areas. Strip-till planting may be completed in the fall and nutrient application either occurs simultaneously or at the time of planting. Ridge-till uses specialized equipment to create ridges in the seedbed and vegetative residue is left on the surface in between the ridges. Weeds are controlled with herbicides and/or cultivation, seedbed ridges are rebuilt during cultivation, and soils are left undisturbed from harvest to planting. Vertical-till systems employ machinery that lightly tills the soil and cuts up crop residue, mixing some of the residue into the top few inches of the soil while leaving a large portion on the surface. No-till management is the most conservative, disturbing soils only at the time of planting and fertilizer application. Compared to conventional tillage systems, conservation tillage methods can improve soil ecosystem function by reducing soil erosion, increasing organic matter and water availability, improving water quality, and reducing soil compaction.

**Dominant plant species**

- corn (*Zea mays*), other herbaceous
- soybean (*Glycine max*), other herbaceous

## Community 4.3
## Conservation Tillage Field/ Cover Crop Field

Community Phase 4.3 Conservation Tillage Field/Alternative Crop Field – This community phase applies conservation tillage methods as described above as well as adds cover crop practices. Cover crops typically include nitrogen-fixing species (e.g., legumes), small grains (e.g., rye, wheat, oats), or forage covers (e.g., turnips, radishes, rapeseed). The addition of cover crops not only adds plant diversity but also promotes soil health by reducing soil erosion, limiting nitrogen leaching, suppressing weeds, increasing soil organic matter, and improving the overall soil ecosystem. In the case of small grain cover crops, surface cover and water infiltration are increased, while forage covers can be used to graze livestock or support local wildlife. Of the three community phases for this state, this phase promotes the greatest soil sustainability and improves ecological functioning within a cropland system.

**Dominant plant species**

- rye (*Secale*), grass
- wheat (*Triticum*), grass
- oat (*Avena*), grass
- corn (*Zea mays*), other herbaceous
- soybean (*Glycine max*), other herbaceous
- radish (*Raphanus*), other herbaceous

### Pathway 4.1A
### Community 4.1 to 4.2

Tillage operations are greatly reduced, crop rotation occurs on a regular interval, and crop residue remains on the soil surface.

### Pathway 4.1B
### Community 4.1 to 4.3

Tillage operations are greatly reduced or eliminated, crop rotation occurs on a regular interval, crop residue remains on the soil surface, and cover crops are planted following crop harvest.

### Pathway 4.2A
### Community 4.2 to 4.1

Intensive tillage is utilized, and monoculture row-cropping is established.

### Pathway 4.2B
### Community 4.2 to 4.3

Cover crops are implemented to minimize soil erosion.

### Pathway 4.3B
### Community 4.3 to 4.1

Intensive tillage is utilized, cover crops practices are abandoned, monoculture row-cropping is established, and crop rotation is reduced or eliminated.

### Pathway 4.3A
### Community 4.3 to 4.2

Cover crop practices are abandoned.

## State 5
## Reconstructed Oak Forest State

The combination of natural and anthropogenic disturbances occurring today has resulted in numerous forest health issues, and restoration back to the historic reference condition may not be possible. Forests are being stressed by non-native diseases and pests, habitat fragmentation, changes in soil conditions, and overabundant deer populations on top of naturally-occurring disturbances (severe weather and native pests) (IFDC 2018). However, these habitats provide multiple ecosystem services including carbon sequestration; clean air and water; soil conservation; biodiversity support; wildlife habitat; timber, fiber, and fuel products; as well as a variety of cultural activities (e.g., hiking, camping, hunting) (Millennium Ecosystem Assessment 2005; IFDC 2018). Therefore, conservation of forests and woodlands should still be pursued. Forest reconstructions are an important tool for repairing natural ecological functioning and providing habitat protection for numerous species associated with Loess Protected Backslope Forests. Therefore, ecological restoration should aim to aid the recovery of degraded, damaged, or destroyed ecosystems. A successful restoration will have the ability to structurally and functionally sustain itself, demonstrate resilience to the ranges of stress and disturbance, and create and maintain positive biotic and abiotic interactions (SER 2002). The reconstructed oak forest state is the result of a long-term commitment involving a multi-step, adaptive management process.

**Dominant plant species**

- oak (*Quercus*), tree

### Community 5.1
### Early Successional Oak Forest

This community phase represents the early community assembly from forest reconstruction. It is highly dependent on the current condition of the site based on past and current land management actions, invasive species, and proximity to land populated with non-native pests and diseases. Therefore, no two sites will have the same early successional composition. Technical forestry assistance should be sought to develop suitable conservation management plans.

**Dominant plant species**

- oak (*Quercus*), tree

### Community 5.2
### Late Successional Oak Forest

Community Phase 5.2 Late Successional Reconstructed Forest – Appropriately timed management practices (e.g., prescribed fire, hazardous fuels management, forest stand improvement, continuing integrated pest management) applied to the early successional community phase can help increase the stand maturity, pushing the site into a late successional community phase over time. A late successional reconstructed forest will have an uneven-aged canopy and a well-developed shrub layer and understory.

**Dominant plant species**

- oak (*Quercus*), tree

### Pathway 5.1A
### Community 5.1 to 5.2

Application of stand improvement practices in line with a developed management plan.

### Pathway 5.2A
### Community 5.2 to 5.1

Reconstruction experiences a setback from extreme weather event or improper timing of management actions.

### Transition T1A
### State 1 to 2

Long-term fire suppression in excess of 50 years transitions the site to the fire suppressed state (2).

### Transition T1B
### State 1 to 3

Cultural treatments to enhance forage quality and yield-transitions the site to the pasture state (3).

### Transition T1C
### State 1 to 4

Transition 1C – Tillage, seeding of agricultural crops, and non-selective herbicide transition this site to the cropland state (4).

**Transition T2A**
**State 2 to 3**

Transition 2A – Cultural treatments to enhance forage quality and yeild transitions the site to the pasture state (3)

**Restoration pathway T2B**
**State 2 to 4**

Transition 2B – Tillage, seeding of agricultural crops, and non-selective herbicide transition this site to the cropland state (4).

**Restoration pathway R2A**
**State 2 to 5**

Restoration 2A – Site preparation, tree planting, invasive species control, seeding native species, and deer management transition this site to the reconstructed state (5).

**Transition T3A**
**State 3 to 2**

Transition 3A – Land abandonment transitions the site to the fire-suppressed state (2).

**Restoration pathway T3B**
**State 3 to 4**

Transition 3B – Tillage, seeding of agricultural crops, and non-selective herbicide transition this site to the cropland state (4).

**Restoration pathway R3A**
**State 3 to 5**

Restoration 3A – Site preparation, tree planting, invasive species control, and seeding native species transition this site to the reconstructed oak forest state (5).

**Transition T4A**
**State 4 to 2**

Transition 4A – Land abandonment transitions the site to the fire-suppressed state (2).

**Transition T4B**
**State 4 to 3**

Transition 4B – Cultural treatments to enhance forage quality and yield transitions the site to the pasture state (3).

**Restoration pathway R4A**
**State 4 to 5**

Restoration 4A – Site preparation, tree planting, invasive species control, and seeding native species transition this site to the reconstructed oak forest state (5).

**Transition T5A**
**State 5 to 2**

Transition 5A – Fire suppression and removal of active management transitions this site to the fire-suppressed state (2).

### Transition T5B
### State 5 to 3

Cultural treatments to enhance forage quality and yield transition the site to the pasture state (3).

### Transition T5C
### State 5 to 4

Transition 5C – Tillage, seeding of agricultural crops, and non-selective herbicide transition this site to the cropland state (4).

## Additional community tables

## Inventory data references

No field plots were available for this site. A review of the scientific literature and professional experience were used to approximate the plant communities for this provisional ecological site. Information for the state-and-transition model was obtained from the same sources. All community phases are considered provisional based on these plots and the sources identified in this ecological site description.

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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.

| | |
|---|---|
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| 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:**