

# Ecological site F107XB010MO

## Calcareous Loess Protected Backslope Forest

Last updated: 5/21/2020  
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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): 107X—Iowa and Missouri Deep Loess Hills

The Iowa and Missouri Deep Loess Hills (MLRA 107B) includes the Missouri Alluvial Plain, Loess Hills, Southern Iowa Drift Plain, and Central Dissected Till Plains landform regions (Prior 1991; Nigh and Schroeder 2002). It spans four states (Iowa, 53 percent; Missouri, 32 percent; Nebraska, 12 percent; and Kansas 3 percent), encompassing over 14,000 square miles (Figure 1). The elevation ranges from approximately 1,565 feet above sea level (ASL) on the highest ridges to about 600 feet ASL along the Missouri River near Glasgow in central Missouri. Local relief varies from 10 to 20 feet in the major river floodplains, to 50 to 100 feet in the dissected uplands, and loess bluffs of 200 to 300 feet along the Missouri River. Loess deposits cover most of the area, with deposits reaching a thickness of 65 to 200 feet in the Loess Hills and grading to about 20 feet in the eastern extent of the region. Pre-Illinoian till, deposited more than 500,000 years ago, lies beneath the loess and has experienced extensive erosion and dissection. Pennsylvanian and Cretaceous bedrock, comprised of shale, mudstones, and sandstones, lie beneath the glacial material (USDA-NRCS 2006).

The vegetation in the MLRA has undergone drastic changes over time. Spruce forests dominated the landscape 30,000 to 21,500 years ago. As the last glacial maximum peaked 21,500 to 16,000 years ago, they were replaced with open tundras and parklands. The end of the Pleistocene Epoch saw a warming climate that initially prompted the return of spruce forests, but as the warming continued, spruce trees were replaced by deciduous trees (Baker et al. 1990). Not until approximately 9,000 years ago did the vegetation transition to prairies as climatic conditions continued to warm and subsequently dry. Between 4,000 and 3,000 years ago, oak savannas began intermingling within the prairie landscape, while the more wooded and forested areas maintained a foothold in sheltered areas. This prairie-forest transition ecosystem formed the dominant landscapes until the arrival of European settlers (Baker et al. 1992).

### Classification relationships

Major Land Resource Area (MLRA): Iowa and Missouri Deep Loess Hills (107B) (USDA-NRCS 2006)

USFS Subregions: Central Dissected Till Plains Section (251C); Loess Hills (251Cb) Subsection; Nebraska Rolling Hills Section (251H), Pawnee City-Seneca Rolling Hill (251Hd) (Cleland et al. 2007)

U.S. EPA Level IV Ecoregion: Steeply Rolling Loess Prairies (47e), Rolling Loess Prairies (47f), Nebraska/Kansas Loess Hills (47h) (USEPA 2013)

Biophysical Setting (LANDFIRE 2009): North-Central Interior Dry-Mesic Oak Forest and Woodland (4313100)

Ecological Systems (National Vegetation Classification System, Nature Serve 2015): North-Central Interior Dry-Mesic Oak Forest and Woodland (CES202.046)

Eilers and Roosa (1994): Upland Woods

Iowa Department of Natural Resources (INAI nd): Western Dry Forest

Missouri Natural Heritage Program (Nelson 2010): Dry-Mesic Loess/Glacial Till Forest

Nebraska Game and Parks Commission (Steinauer and Rolfsmeier 2003): Dry-Mesic Bur Oak Forest and Woodland

Plant Associations (National Vegetation Classification System, Nature Serve 2015): *Quercus macrocarpa*/*Cornus drummondii*/*Aralia nudicaulis* Forest (CEGL002072)

Rosburg (1994): Bur Oak Woodland

### Ecological site concept

Calcareous Loess Protected Backslope Forests are mapped in complex with Calcareous Loess Exposed Backslope Woodlands and are located within the green areas on the map (Figure 1). They occur on north- and east-facing backslopes with slopes greater than fifteen percent. Soils are Inceptisols that are well-drained and very deep, formed from loess with a significant component of calcium carbonates at or near the surface, resulting in an alkaline (increased pH) environment. These fine-silty, fertile soils have high soil uniformity resulting in increased nutrient- and water-holding capacity, increased organic matter retention, and good soil aeration that allows deep penetration by plant roots, which generally results in high plant productivity (Catt 2001). These sites occur adjacent to Calcareous Loess Upland Woodland and Calcareous Loess Exposed Backslope Woodland ecological sites.

The historic pre-European settlement vegetation on this site was dominated by a continuous canopy of deciduous trees with a shade-tolerant understory. Bur oak (*Quercus macrocarpa* Michx.) is the dominant tree in this ecological site, while bitternut hickory (*Carya cordiformis* (Wangenh.) K. Koch) and hophornbeam (*Ostrya virginiana* (Mill.) K. Koch) are important subcanopy components. The shrub layer is typically populated with roughleaf dogwood (*Cornus drummondii* C.A. Mey.). Herbaceous species typical of an undisturbed plant community associated with this ecological site include dutchman's breeches (*Dicentra cucullaria* (L.) Bernh.), green dragon (*Arisaema dracontium* (L.) Schott), mullein foxglove (*Dasistoma macrophylla* (Nutt.) Raf.), and violet lespedeza (*Lespedeza violacea* (L.) Pers.) (Ladd and Thomas 2015; Steinauer and Rolfsmeier 2010; Nelson 2010). Historically, infrequent, low-severity surface fires and replacement fires were the primary disturbance factors that maintained the composition of this site, while extreme drought, browsing by native ungulates, ice and wind damage, and periodic pest damage can limit woody species survival and recruitment (LANDFIRE 2009; Nelson 2010).

Relative to other calcareous loess wooded ecological sites in the MLRA, the Calcareous Loess Protected Backslope Forests are moister due to their protected landscape position and reduced exposure to solar radiation, which supports a closed-canopy deciduous forest with shade-intolerant species in the understory.

### Associated sites

F107XB009MO	<b>Calcareous Loess Upland Woodland</b> Calcareous loess soils on slopes less than 15 percent including Pohocco and Timula
F107XB011MO	<b>Calcareous Loess Exposed Backslope Woodland</b> Calcareous loess soils on slopes greater than 15 percent with south and west aspects, including Pohocco and Timula
R107XB002MO	<b>Deep Loess Upland Prairie</b> Leached soils on slopes less than 15 percent including Arents, Contrary, Deroine, Higginsville, Melia, Monona, Ponca, Sibley, Sibleyville, Strahan, Udarents, Udorthents, Wakenda

### Similar sites

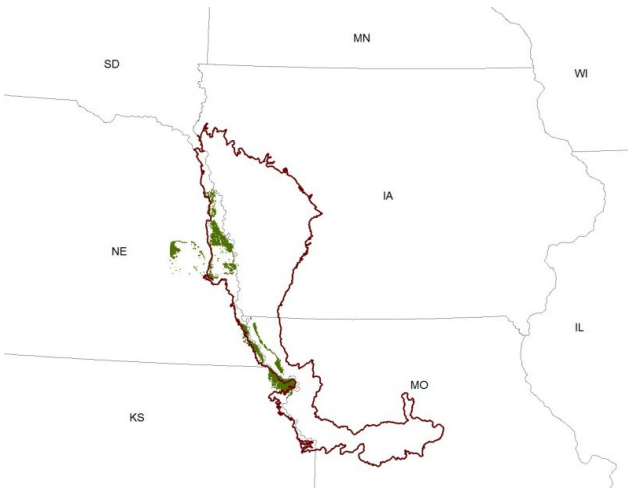
F107XB011MO	<b>Calcareous Loess Exposed Backslope Woodland</b> Calcareous Loess Exposed Backslope Woodlands only occur on south- and west aspects
F107XB004MO	<b>Deep Loess Protected Backslope Woodland</b> Deep Loess Protected Backslope Woodlands are similar in landscape position but soils lack carbonates and northern red oak is dominant
F107XB009MO	<b>Calcareous Loess Upland Woodland</b> Calcareous Loess Upland Woodlands only occur on slopes less than fifteen percent

**Table 1. Dominant plant species**

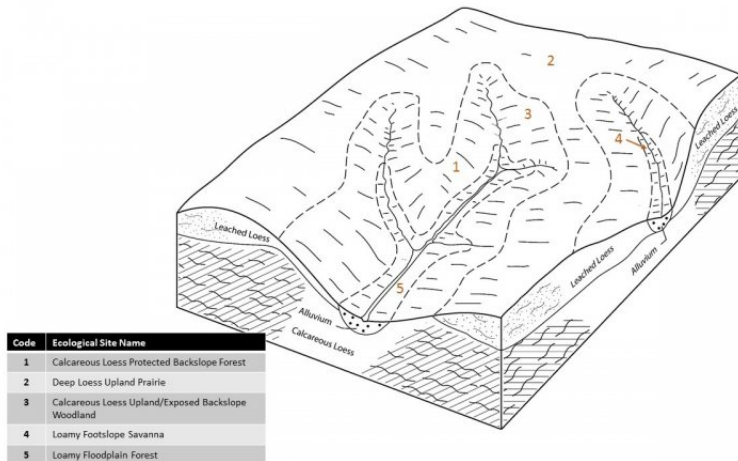
Tree	(1) <i>Quercus macrocarpa</i> (2) <i>Quercus alba</i>
Shrub	(1) <i>Cornus drummondii</i>
Herbaceous	(1) <i>Elymus villosus</i> (2) <i>Dicentra cucullaria</i>

### Physiographic features

Calcareous Loess Protected Backslope Forests occur on uplands on backslopes with slopes greater than fifteen percent on north- and east-facing aspects on dissected till plains (Figure 2). This ecological site is unique to the Loess Hills landform situated on elevations ranging from approximately 500 to 1,600 feet ASL. This site does not experience flooding but rather generates runoff to adjacent, downslope ecological sites.



**Figure 2. Figure 1. Location of Calcareous Loess Protected Backslope Forest ecological site within MLRA 107B.**



**Figure 3. Figure 2. Representative block diagram of Calcareous Loess Protected Backslope Forest and associated ecological sites.**

**Table 2. Representative physiographic features**

Hillslope profile	(1) Backslope
Slope shape across	(1) Linear (2) Convex
Slope shape up-down	(1) Concave (2) Convex
Landforms	(1) Loess hill
Flooding frequency	None
Ponding frequency	None
Elevation	152–488 m
Slope	16–45%
Water table depth	203 cm
Aspect	N, NE, E

### Climatic features

The Iowa and Missouri Deep Loess Hills falls into two Köppen-Geiger climate classifications (Peel et al. 2007): hot humid continental climate (Dfa) dominates the majority of the MLRA with small portions in the south falling into the humid subtropical climate (Cfa). In winter, dry, cold air masses periodically shift south from Canada. As these air masses collide with humid air, snowfall and rainfall result. In summer, moist, warm air masses from the Gulf of Mexico migrate north, producing significant frontal or convective rains (Decker 2017). Occasionally, high pressure will stagnate over the region, creating extended droughty periods. These periods of drought have historically occurred on 22-year cycles (Stockton and Meko 1983).

The soil temperature regime of MLRA 107B 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 186 days, while the frost-free period is about 160 days (Table 2). The majority of the precipitation occurs as rainfall in the form of convective thunderstorms during the growing season. Average annual precipitation is 33 inches, which includes rainfall plus the water equivalent from snowfall (Table 3). The average annual low and high temperatures are 41 and 62°F, respectively.

Climate data and analyses are derived from 30-year average gathered from six National Oceanic and Atmospheric Administration (NOAA) weather stations contained within the range of this ecological site (Table 4).

**Table 3. Representative climatic features**

Frost-free period (characteristic range)	134-150 days
Freeze-free period (characteristic range)	165-183 days
Precipitation total (characteristic range)	813-864 mm
Frost-free period (actual range)	131-154 days
Freeze-free period (actual range)	163-191 days
Precipitation total (actual range)	787-940 mm
Frost-free period (average)	143 days
Freeze-free period (average)	175 days
Precipitation total (average)	838 mm

### Climate stations used

- (1) TROY 3N [USC00148250], Troy, KS
- (2) BLAIR [USC00250930], Blair, NE

- (3) RULO 2W [USC00257401], Falls City, NE
- (4) OREGON [USC00236357], Oregon, MO
- (5) TEKAMAH [USC00258480], Tekamah, NE
- (6) AUBURN 5 ESE [USC00250435], Auburn, NE

## Influencing water features

Calcareous 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 moderate (Hydrologic Group B), and surface runoff is medium to high. Precipitation infiltrates the soil surface and percolates downward through the horizons unimpeded by any restrictive layer. The Dakota bedrock aquifer in the northern region of this ecological site is typically deep and confined, leaving it generally unaffected by recharge. However, there are surficial aquifers in the Pennsylvanian strata in the southern extent of the ecological site that are shallow and allow some recharge (Prior et al. 2003). Surface runoff contributes some water to downslope ecological sites. Evapotranspiration rates occur on a latitudinal gradient, with the northern end of the ecological site receiving a greater number of days with sun and high winds resulting in a higher average evapotranspiration rate compared to the southern end (Visher 1954).

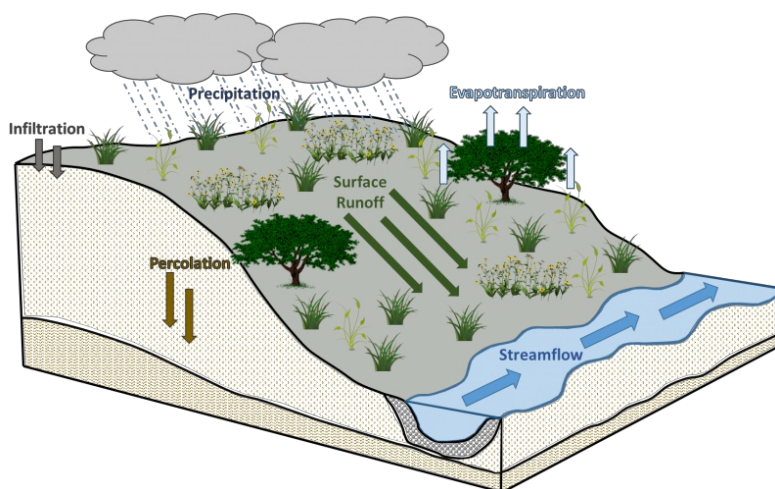
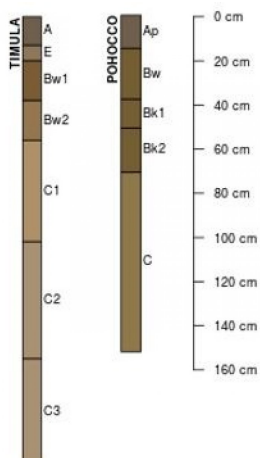


Figure 10. Figure 5. Hydrologic cycling in Calcareous Loess Protected Backslope Forest ecological site.

## Soil features

Soils of Calcareous Loess Protected Backslope Forests are in the Inceptisol order, further classified as Typic Eutrudepts, with moderate infiltration and medium to high runoff potential. The soil series associated with this site includes Pohocco and Timula. The parent material is calcareous loess, and the soils are well-drained and very deep with no coarse fragments. Soil pH classes are slightly acid to moderately alkaline. No rooting restrictions are noted for the soils of this ecological site. Average clay content is low limiting compaction susceptibility, but erosion from wind and water can be high.



**Figure 11. Figure 6. Profile sketches of soil series associated with Calcareous Loess Protected Backslope Forest.**

**Table 4. Representative soil features**

Parent material	(1) Calcareous loess
Surface texture	(1) Silt loam
Family particle size	(1) Coarse-silty
Drainage class	Well drained
Permeability class	Moderately slow
Soil depth	203 cm
Available water capacity (0-101.6cm)	20.32 cm
Calcium carbonate equivalent (0-101.6cm)	5–35%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.1–8.4

## Ecological dynamics

The Loess Hills region lies within the transition zone between the eastern deciduous forests and the Great Plains. The heterogeneous topography of the area results in variable microclimates and fuel matrices that in turn are able to support prairies, savannas, woodlands, and forests (Novacek et al. 1985; Nelson 2010). Calcareous Loess Protected Backslope Forests form an aspect of this vegetative continuum. This ecological site occurs on north- and east-facing aspects of upland backslopes on calcareous soils. Species characteristic of this ecological site consist of deciduous trees forming a closed canopy with a well-developed, shade-tolerant understory.

Infrequent fires are the major disturbance factor in Calcareous Loess Protected Backslope Forests. As this ecological site occurred on north- and east-facing fire shadows, fires were limited to mostly low-severity, surface fires. Low frequency replacement fires transition the reference community from a mid-developed closed canopy to a mid-developed open canopy. These events typically occurred every twenty to forty years (LANDFIRE 2009).

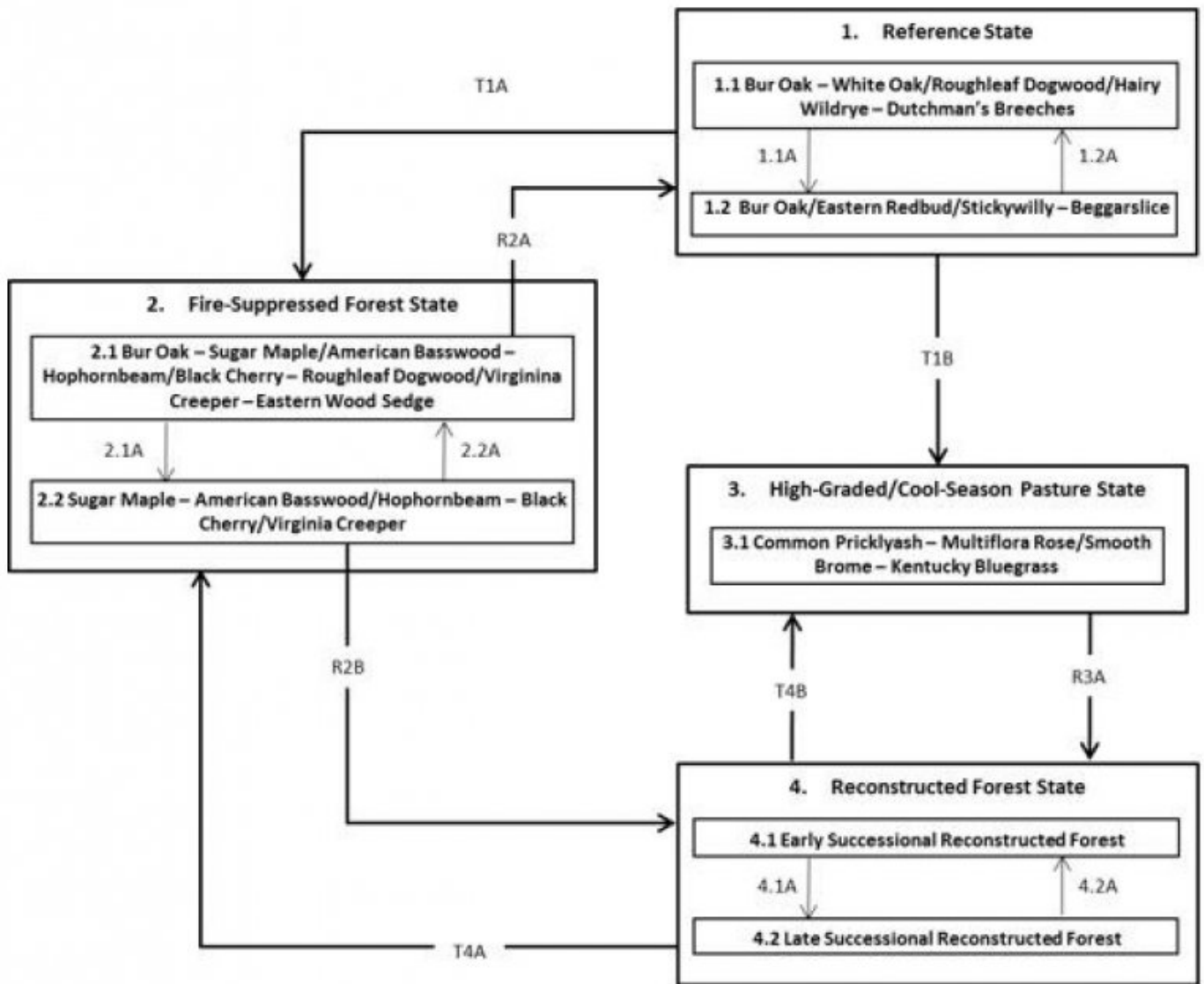
Drought also played a role in shaping the forest ecosystems in the Loess Hills. The periodic episodes of reduced soil moisture in conjunction with the well-drained soils have favored the proliferation of plant species tolerant of such conditions (Stambaugh et al. 2006). In addition, drought can also slow the growth of plants and result in dieback of certain species. When coupled with fire, periods of drought can also greatly delay the recovery of woody vegetation, substantially altering the extent of shrubs and trees (Pyne et al. 1996).

In addition to fire and drought, other natural disturbances (native mammal herbivory, catastrophic windthrow and ice/snow storms, and period pest outbreaks) contribute to the development and perpetuation of Calcareous Loess Protected Backslope Forests on a more localized scale.

Today, many original Calcareous Loess Protected Backslope Forests have been converted to cool-season pasture and will likely remain as such for the foreseeable future. This ecological site has also decreased as fire suppression has resulted in the type conversion of many stands to a more mesophytic maple-basswood dominated habitat (LANDFIRE 2009). In addition, invasion by non-native species (e.g., Kentucky bluegrass (*Poa pratensis* L.), smooth brome (*Bromus inermis* L.), common buckthorn (*Rhamnus cathartica* L.), and multiflora rose (*Rosa multiflora* Thunb.)) is rapidly threatening the remaining native community (Steinauer and Rolfsmeier 2010).

## State and transition model

# F107BY010MO CALCAREOUS LOESS PROTECTED BACKSLOPE FOREST



Code	Process
T1A, T4A	Fire suppression in excess of 50 years
T1B, T4b	Woody removal, <del>interseeding</del> cool-season grasses, and continuous grazing
1.1A	20-year mean fire return interval
1.2A	10-year absence of fire or other natural disturbance
R2A	Selective tree thinning and prescribed fire
2.1A	Continued fire suppression
2.2A	Single fire event
R2B, R3A	Tree planting, native seeding, invasive species control
5.1A	Application of stand improvement practices in line with a developed management plan
5.2A	Reconstruction experiences a setback from extreme weather event or improper timing of management actions

Figure 12. STM

## State 1 Reference State

The reference plant community is categorized as a dry-mesic, closed canopy oak-hickory forest. The two community phases within the reference state are dependent on low-intensity surface fires and occasional replacement fires. A longer mean fire return interval results in a mature overstory canopy, while recent wind events can reset the community to an earlier-successional status. Drought, grazing, wind and ice storms, and periodic pest outbreaks have less impact in the reference phases, but do contribute to overall species composition, diversity,

cover, and productivity.

### **Dominant plant species**

- bur oak (*Quercus macrocarpa*), tree
- white oak (*Quercus alba*), tree
- eastern redbud (*Cercis canadensis*), shrub
- roughleaf dogwood (*Cornus drummondii*), shrub
- hairy wildrye (*Elymus villosus*), grass
- dutchman's breeches (*Dicentra cucullaria*), other herbaceous
- stickywilly (*Galium aparine*), other herbaceous
- beggarslice (*Hackelia virginiana*), other herbaceous

## **Community 1.1**

### **Bur Oak – White Oak/Roughleaf Dogwood/Hairy Wildrye – Dutchman's Breeches**

Bur oak and white oak are the dominant and diagnostic tree species for this reference community phase, while northern red oak (*Quercus rubra* L.), black oak (*Quercus velutina* Lam.), shagbark hickory (*Carya ovata* (Mill.) K. Koch), and sugar maple (*Acer saccharum* Marshall) may occur in varying abundances as well (Nelson 2010; Steinauer and Rolfsmeier 2010). Tree heights range between 33 and 164 feet tall, tree size class is large (21 to 33-inches DBH), the canopy coverage can be 61 to 80 percent (LANDFIRE 2009). The subcanopy is dominated by bitternut hickory and hophornbeam, and the shrub layer is most commonly populated by roughleaf dogwood. Numerous shade-tolerant grasses and forbs form a moderate herbaceous layer and include hairy wildrye, dutchman's breeches, pale Indian plantain (*Arnoglossum atriplicifolium* (L.) H. Rob.), and Jack in the pulpit (*Arisaema triphyllum* (L.) Schott) (Steinauer and Rolfsmeier 2010).

### **Dominant plant species**

- bur oak (*Quercus macrocarpa*), tree
- white oak (*Quercus alba*), tree
- roughleaf dogwood (*Cornus drummondii*), shrub
- hairy wildrye (*Elymus villosus*), grass
- dutchman's breeches (*Dicentra cucullaria*), other herbaceous

## **Community 1.2**

### **Bur Oak/Eastern Redbud/Stickywilly - Beggarslice**

This reference community phase can occur following replacement fires occurring approximately every twenty years. Forest structure shifts to a more open canopy (21 to 60 percent cover), tree height is reduced (16 to 82 feet tall), but size class remains the same. Dominant overstory canopy species remain relatively similar following disturbance, but the subcanopy changes. Eastern redbud (*Cercis canadensis* L.), a disturbance-dependent species closely associated with deep calcareous soils, rapidly increases and dominates the subcanopy (Sullivan 1994). Similarly, the understory is populated by early-successional, disturbance-tolerant species such as stickywilly (*Galium aparine* L.) and beggarslice (*Hackelia virginiana* (L.) I.M. Johnst.) (Steinauer and Rolfsmeier 2010).

### **Dominant plant species**

- bur oak (*Quercus macrocarpa*), tree
- eastern redbud (*Cercis canadensis*), shrub
- stickywilly (*Galium aparine*), other herbaceous
- beggarslice (*Hackelia virginiana*), other herbaceous

## **Pathway P1.1A**

### **Community 1.1 to 1.2**

Natural succession as a result of a mean fire interval of twenty years.

## **Pathway P1.2A**



## Community 1.2 to 1.1

Natural succession as a result of lack of natural disturbances for more than 10 years.

### State 2

#### Fire Suppressed Forest State

Fire suppression can transition the reference oak-hickory community into a sugar maple-basswood dominated forest state. This forest plant community historically only occurred on landscape positions that provided natural fire breaks. Over the past 150 years, however, fire suppression policies have allowed the oak-hickory forest to succeed into forest dominated by fire-sensitive trees (LANDFIRE 2009).

#### Dominant plant species

- sugar maple (*Acer saccharum*), tree
- American basswood (*Tilia americana*), tree
- hophornbeam (*Ostrya virginiana*), shrub
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

## Community 2.1

#### Bur Oak – Sugar maple/American Basswood – Hophornbeam/Black Cherry – Roughleaf Dogwood/Virginia Creeper – Eastern Wood Sedge

This community phase represents the community composition when fire has been suppressed from the landscape for at least 50 years. Mature bur and white oaks may persist during this phase, but the fire-intolerant sugar maple has rapidly increased (LANDFIRE 2009). American basswood (*Tilia americana* L.), generally found lower on the slopes, begins to co-dominate with hophornbeam in the subcanopy, while the shade-tolerant black cherry (*Prunus serotina* Ehrh.) increases in the shrub component. The understory also shift to more shade tolerant species such as Virginia creeper (*Parthenocissus quinquefolia* (L.) Planch.) and eastern wood sedge (*Carex blanda* Dewey) (Steinauer and Rolfsmeier 2010).

#### Dominant plant species

- bur oak (*Quercus macrocarpa*), tree
- sugar maple (*Acer saccharum*), tree
- hophornbeam (*Ostrya virginiana*), shrub
- black cherry (*Prunus serotina*), shrub
- eastern woodland sedge (*Carex blanda*), grass
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

## Community 2.2

#### Sugar Maple – Basswood/Hophornbeam – Black Cherry/Virginia Creeper

As fire suppression efforts continue the overstory canopy eventually shifts to sugar maple and basswood (Flickinger 2010), except in Nebraska where northern red oak (*Quercus rubra* L.) and bitternut hickory take the place of the sugar maple (Steinauer and Rolfsmeier 2010). Hophornbeam and black cherry for the subcanopy, but non-native species such as common buckthorn and multiflora rose can also occur (Steinauer and Rolfsmeier 2010). The understory becomes sparser and dominated only by shade tolerant species like Virginia creeper.

#### Dominant plant species

- sugar maple (*Acer saccharum*), tree
- American basswood (*Tilia americana*), tree
- hophornbeam (*Ostrya virginiana*), shrub
- black cherry (*Prunus serotina*), shrub
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

## Pathway P2.1A

### Community 2.1 to 2.2

– Fire suppression continues.

## **Pathway P2.2A**

### **Community 2.2 to 2.1**

Single fire event.

## **State 3**

### **High-graded / Cool Season Pasture State**

The high-graded/cool-season pasture state occurs when the reference state has been anthropogenically altered for livestock production. Early settlers harvested the trees for timber and fuel and seeded such non-native cool-season species as smooth brome (*Bromus inermis* Leys.) and Kentucky bluegrass (*Poa pratensis* L.), converting the woodland to pasture (Smith 1998). Over time, as lands were continually grazed by large herds of cattle, the non-native species were able to spread and expand across the site, reducing the native species diversity.

#### **Dominant plant species**

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

## **Community 3.1**

### **Common Pricklyash – Multiflora Rosa/Smooth Brome – Kentucky Bluegrass**

Sites in this community phase arise from selective tree removal and seeding of non-native cool-season grasses (Steinauer and Rolfsmeier 2010). Oak, hickory, and basswood provided a valuable source of fuel and timber for early settlers, and many were harvested as a result. Tree regeneration may occur for some time, but livestock can trample and eat tree seedlings thereby reducing the overstory. Unpalatable woody species, such as common pricklyash (*Zanthoxylum americanum* Mill.) and multiflora rose (*Rosa multiflora* Thunb.), can invade under excessive grazing (Randall and Herring 2012). Smooth brome and Kentucky bluegrass were common species used for pasture planting.

#### **Dominant plant species**

- common pricklyash (*Zanthoxylum americanum*), shrub
- multiflora rose (*Rosa multiflora*), shrub
- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

## **State 4**

### **Reconstructed Forest State**

The combination of natural and anthropogenic disturbances occurring today has resulted in a number of forest health issues, and restoration back to the historic reference condition is likely not possible. Woodlands and forests are being stressed by non-native diseases and pests, habitat fragmentation, permanent changes in soil hydrology, past uncontrolled livestock grazing, and overabundant deer populations on top of naturally-occurring disturbances (severe weather and native pests) (Flickinger 2010). However, these habitats provide multiple ecosystem services including carbon sequestration; clean air and water; soil conservation; wildlife habitat; biodiversity support; timber, fiber, and fuel products; as well as a variety of cultural activities (e.g., hiking, camping, hunting) (Millennium Ecosystem Assessment 2005; Flickinger 2010). 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 of Calcareous 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 forest state is the result of a long-term commitment involving a multi-step, adaptive management process.

## **Community 4.1**

### **Early Successional Reconstructed Forest**

This community phase represents the early community assembly from forest reconstruction. It is highly dependent on the current condition of the forest 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 stewardship management plans.

## **Community 4.2**

### **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 understory.

### **Pathway P4.1A**

#### **Community 4.1 to 4.2**

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

### **Pathway P4.2A**

#### **Community 4.2 to 4.1**

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

### **Transition T1A**

#### **State 1 to 2**

Fire suppression in excess of 50 years.

### **Transition T1B**

#### **State 1 to 3**

Woody species reduction, interseeding of non-native, cool-season grasses, and continuous grazing transition this site to the high-graded/cool-season pasture state (3).

### **Restoration pathway R2A**

#### **State 2 to 1**

Selective thinning and prescribed fire.

### **Restoration pathway R2B**

#### **State 2 to 4**

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

### **Transition R3A**

#### **State 3 to 4**

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

### **Transition T4A**

## **State 4 to 2**

Fire suppression in excess of 50 years.

## **Transition T4B**

### **State 4 to 3**

Woody removal, interseeding cool season grasses and continuous grazing.

## **Additional community tables**

### **Animal community**

#### Wildlife

This forest type contains high structural and compositional diversity important for a number of songbirds and amphibians.

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

Management: Site index values range from 60 to 80 for oak. Timber management opportunities are excellent. These groups respond well to even-aged management. 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. Uneven-aged management will slowly cause an increase in more shade tolerant species such as sugar maple. 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. Where possible, favor white oak, black walnut, black cherry, and northern red oak.

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**

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 ecological site description.

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## Approval

Chris Tecklenburg, 5/21/2020

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## Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Lisa Kluesner
Contact for lead author	
Date	05/03/2024
Approved by	Chris Tecklenburg
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

1. **Number and extent of rills:**

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2. **Presence of water flow patterns:**

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3. **Number and height of erosional pedestals or terracettes:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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5. **Number of gullies and erosion associated with gullies:**

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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:**
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17. **Perennial plant reproductive capability:**

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