Ecological site F108XA011IL
Loess Upland 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): 108X–Illinois and Iowa Deep Loess and Drift

The Illinois and Iowa Deep Loess and Drift, Eastern Part (MLRA 108A) encompasses the Grand Prairie physiographic division (Schewman et al. 1973). It spans two states – Illinois (97 percent) and Indiana (3 percent) – comprising about 11,145 square miles (Figure 1). The elevation ranges from 985 feet above sea level (ASL) in the northern part to 660 feet above sea level in the southern part. Local relief varies from 3 to 10 feet on most of the area which is on broad flat uplands. The maximum relief is about 160 feet along major streams. The northern part of this area is underlain by Ordovician and Silurian limestone and the southern part is underlain by Pennsylvanian shale, siltstone, and limestone. Except for some areas along streams where bedrock is exposed, glacial drift covers all the MLRA. The glacial drift consists of till and stratified outwash and is of Wisconsinan age. A moderately thin to thick layer of loess covers the entire area (USDA-NRCS 2006).

The vegetation in the MLRA 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. Moisture continued to increase in the southernmost region 5,000 years ago, resulting in an increase of forested systems (Taft et al. 2009). Fire, droughts, and grazing by native mammals helped to maintain the prairies and savannas until the arrival of European settlers, and the forests were maintained by droughts, wind, lightning, and occasional fire (Taft et al. 2009; NatureServe 2018).

Classification relationships

USFS Subregions: Central Till Plains and Grand Prairies (251D) and Central Till Plains-Beech-Maple Sections; Northern Grand Prairie (251Dc), Eastern Grand Prairie (251Dd), Southern Grand Prairie (251De), and Entrenched Valleys (222Hf) Subsections (Cleland et al. 2007)

U.S. EPA Level IV Ecoregion: Illinois/Indiana Prairies (54a) and Glaciated Wabash Lowlands (72b) (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 4213100) (LANDFIRE 2009)

Illinois Natural Areas Inventory: Dry-mesic upland forest (White and Madany 1978)

Ecological site concept

Loess Upland Forests are located within the green areas on the map (Figure 1). They occur on uplands in fire-protected landscapes. The soils are Alfisols and Inceptisols that are somewhat poorly to well-drained and deep, formed in deep loess or loess over glacial till.

The historic pre-European settlement vegetation on this ecological site was dominated by a closed canopy of oaks. White oak (Quercus alba L.) and northern red oak (Quercus rubra L.) are the dominant species in the tree canopy, but bur oak (Quercus macrocarpa Michx.), black oak (Quercus velutina Lam.), and shagbark hickory (Carya ovata (Mill.) K. Koch) can also be present (LANDFIRE 2009; NatureServe 2018). Hophornbeam (Ostrya virginiana (Mill.) K. Koch) is the dominant subcanopy species, while clustered blacksnakeroot (Sanicula odorata (Raf.) K.M. Pryer & L.R. Phillippe) and Virginia springbeauty (Claytonia virginica L.) are dominant herbaceous species of this closed canopy forest. Herbaceous species characteristic of an undisturbed plant community associated with this ecological site include bearded shorthusk (Brachyelytrum erectum (Schreb. ex Spreng.) P. Beauv.) and ramp (Allium tricoccum Aiton) (Taft et al. 1997; 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

R108XA010IL	**Loess Upland Savanna** Parent material is deep loess or loess over glacial till transitional soils including Atterberry, Sunbury, Toronto, and Wingate
F108XA019IL	**Silty Floodplain Forest** Silty alluvial soils including Aetna, Armiesburg, Armiesburg variant, Dozaville, Jules, Lawson, Radford, and Tice
F108XA020IL	**Loamy Floodplain Forest** Loamy alluvial soils including Brouillet, DuPage, Landes, Medway, Ross, Rossburg, and Shaffton

Similar sites

F108XA015IL	**Outwash Forest** Outwash Forests are in a similar landscape position, but the parent material is shallow loess over outwash

Table 1. Dominant plant species

Tree	(1) *Quercus alba* (2) *Quercus rubra*
Shrub	(1) *Ostrya virginiana*
Herbaceous	(1) *Sanicula odorata* (2) *Claytonia virginica*

Physiographic features

Loess Upland Forests occur on uplands in fire-protected landscapes (Figure 2). They are situated on elevations ranging from approximately 341 to 1299 feet ASL. The site does not experience flooding but rather generates runoff to adjacent, downslope ecological sites (Table 1).

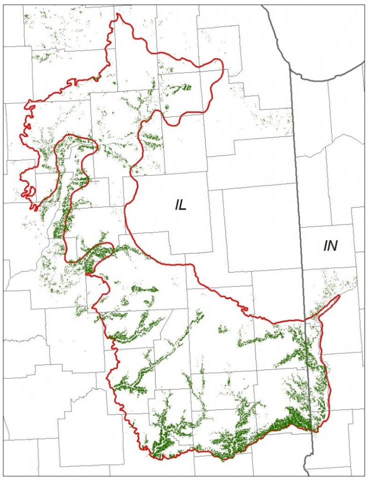


Figure 1. Figure 1. Location of Loess Upland Forest ecological site within MLRA 108A.

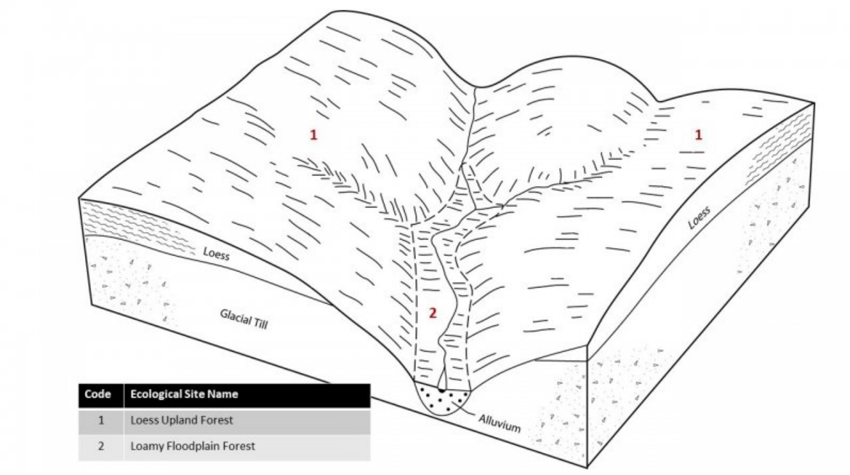


Figure 2. Figure 2. Representative block diagram of Loess Upland Forest and associated ecological sites.

Table 2. Representative physiographic features

Slope shape across	(1) Convex
Slope shape up-down	(1) Convex
Landforms	(1) Upland
Runoff class	Low to very high
Elevation	104–396 m
Slope	2–70%
Water table depth	38–203 cm
Aspect	Aspect is not a significant factor

Climatic features

The Illinois and Iowa Deep Loess and Drift, Eastern Part falls into the hot-summer humid continental climate (Dfa) and the humid subtropical continental climate (Cfa) 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 MLRA 108A 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 169 days, while the frost-free period is about 141 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 approximately 39 inches, which includes rainfall plus the water equivalent from snowfall (Table 3). The average annual low and high temperatures are 41 and 61°F, respectively.

Climate data and analyses are derived from 30-year averages gathered from four 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)	135-149 days
Freeze-free period (characteristic range)	154-187 days
Precipitation total (characteristic range)	914-1,041 mm
Frost-free period (actual range)	129-151 days
Freeze-free period (actual range)	139-189 days
Precipitation total (actual range)	914-1,067 mm
Frost-free period (average)	141 days
Freeze-free period (average)	169 days
Precipitation total (average)	991 mm

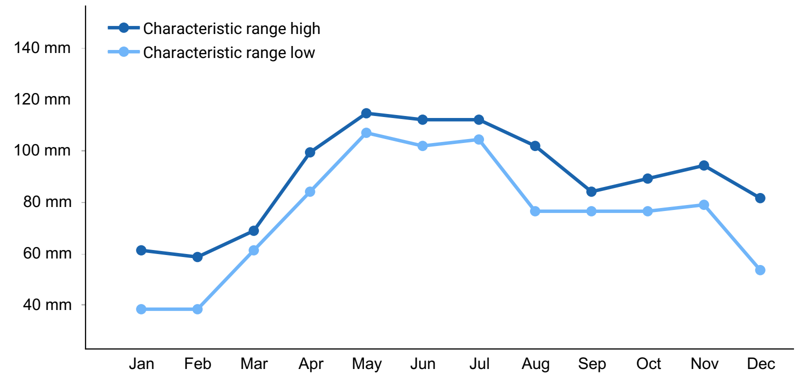


Figure 3. Monthly precipitation range

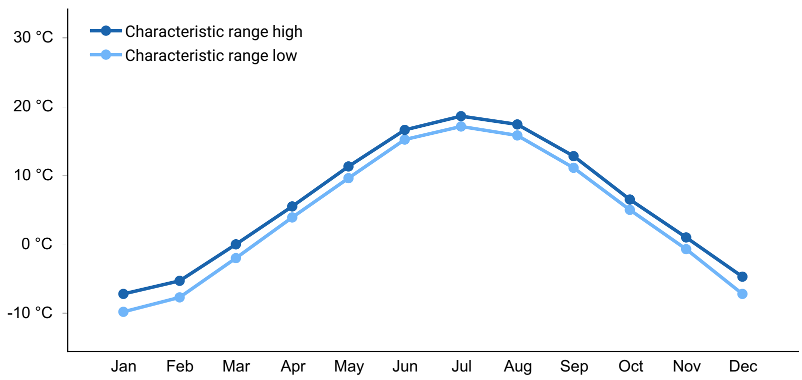


Figure 4. Monthly minimum temperature range

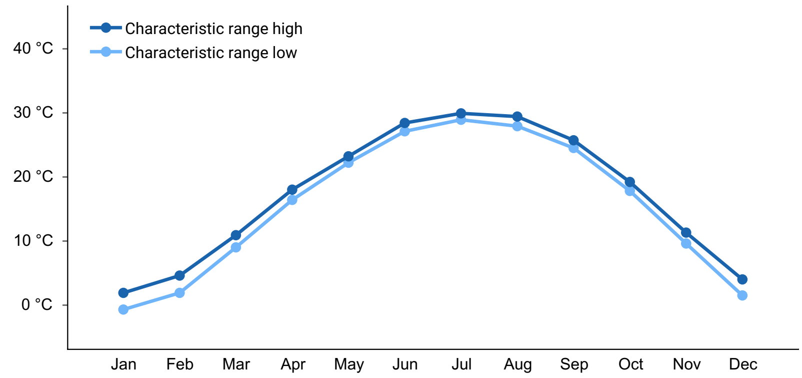


Figure 5. Monthly maximum temperature range

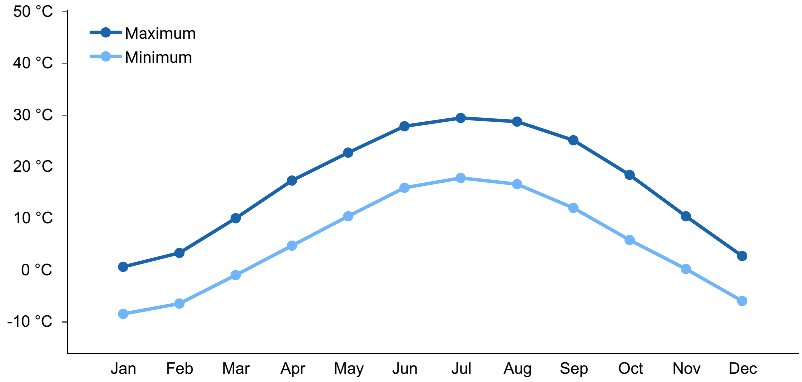


Figure 6. Monthly average minimum and maximum temperature

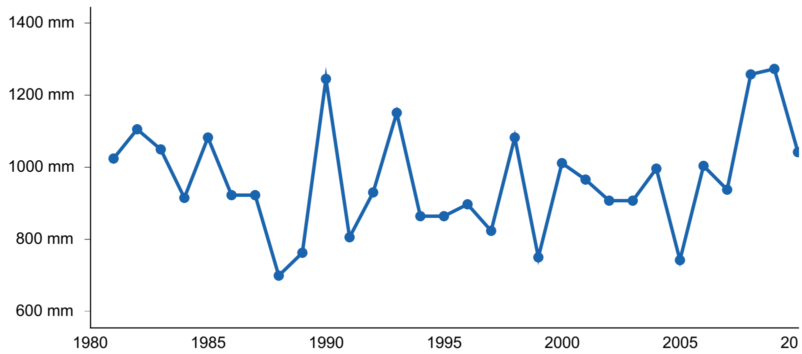


Figure 7. Annual precipitation pattern

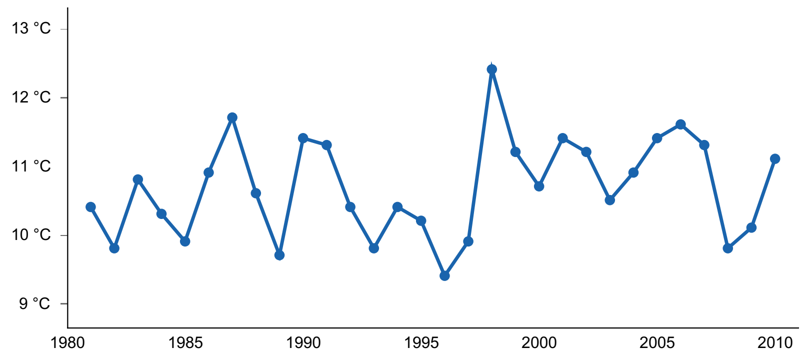


Figure 8. Annual average temperature pattern

Climate stations used

- (1) CHICAGO AURORA MUNI AP [USW00004808], Sugar Grove, IL
- (2) OTTAWA 5SW [USC00116526], Ottawa, IL
- (3) SULLIVAN 3S [USC00118389], Sullivan, IL

- (4) CHARLESTON [USC00111436], Charleston, IL

Influencing water features

Loess Upland Forests are not influenced by wetland or riparian water features. Precipitation is the main source of water for this ecological site. Infiltration is moderate to slow (Hydrologic Groups B and C), and surface runoff is low to very high. Surface runoff contributes some water to downslope ecological sites (Figure 5).

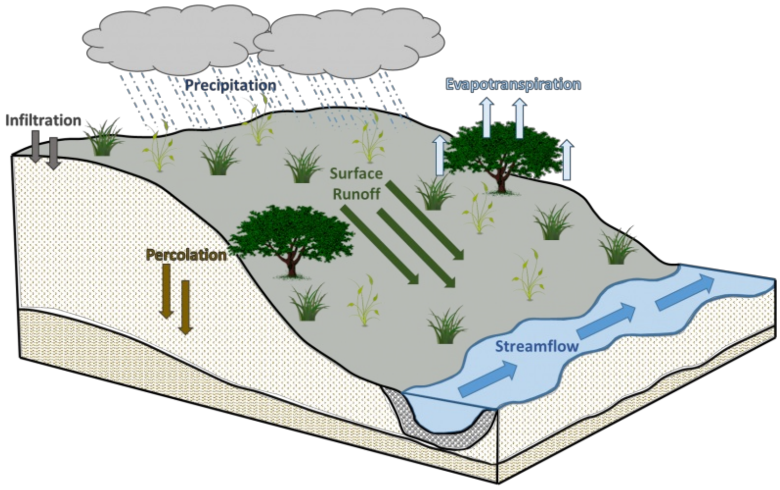


Figure 9. Figure 5. Hydrologic cycling in Loess Upland Forest ecological site.

Soil features

Soils of Loess Upland Forests are in the Alfisols and Inceptisols orders, further classified as Aeric Epiaqualfs, Aquic Hapludalfs, Oxyaquic Eutrudepts, Oxyaquic Hapludalfs, Typic Eutrudepts, and Typic Hapludalfs with slow to moderate infiltration and low to very high runoff potential. The soil series associated with this site includes Appleriver, Birkbeck, Chatsworth, Hennepin, Kernan, Mayville, Russell, Sabina, Senachwine, Strawn, and Xenia (Figure 6). The parent material is deep loess or loess over glacial till and the soils are somewhat poorly to well-drained and deep. Soil pH classes are very strongly acid to moderately alkaline. A densic material within 20-50 inches of the soil surface may be present in some soils of this ecological site (Table 5).

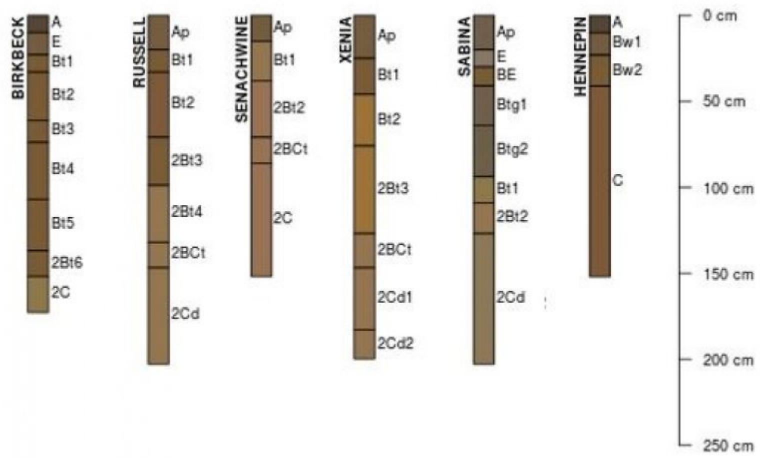


Figure 10. Figure 6. Profile sketches of soil series associated with Loess Upland Forest.

Table 4. Representative soil features

Parent material	(1) Loess
Family particle size	(1) Fine (2) Fine-silty (3) Fine-loamy

Drainage class	Somewhat poorly drained to moderately well drained
Permeability class	Very slow to moderately slow
Soil depth	203 cm

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.

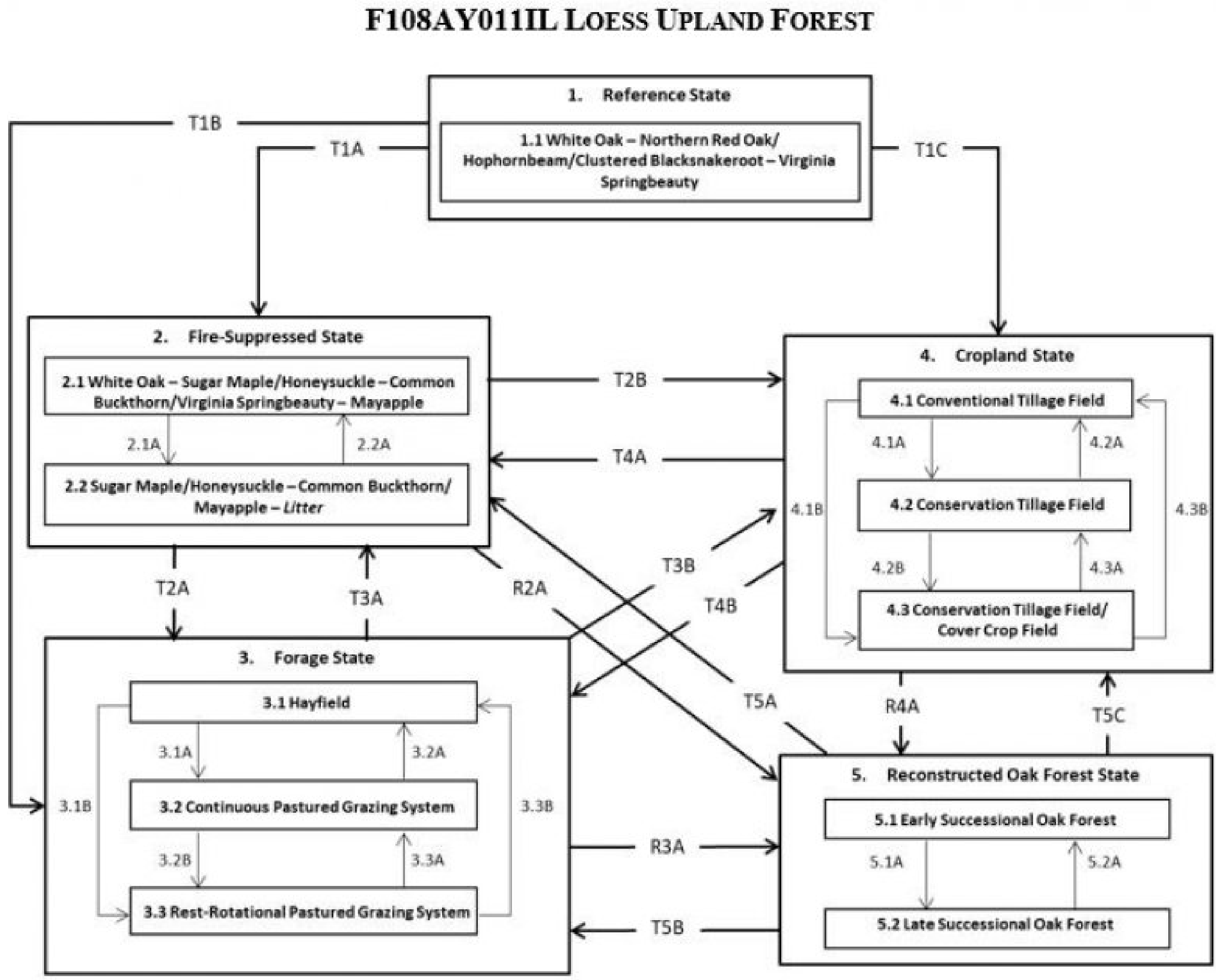
The MLRA lies within the tallgrass prairie ecosystem of the Midwest. The heterogeneous topography of the area results in variable microclimates and fuel matrices that in turn support prairies, savannas, and forests. Loess Upland Forests form an aspect of this vegetative continuum. This ecological site occurs on fire-protected uplands on somewhat poorly to well-drained soils. Species characteristic of this ecological site consist of a closed canopy of oaks with shade-tolerant herbaceous vegetation.

Fire is a critical factor that maintains Loess Upland 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 moderately well 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 Upland Forests have been reduced from their pre-settlement extent. Low to 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



State 1
Reference State

The reference plant community is categorized as an oak 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.

Community 1.1
White Oak - Northern Red Oak/Hophornbeam/Clustered Blacksnakeroot - Virginia Springbeauty

Sites in this reference community phase are a closed canopy forest. White oak and northern oak are the dominant species, but bur oak, black oak, and shagbark hickory are common canopy associates. Trees are large (21 to 33-inch DBH), and cover is approximately 80 percent (LANDFIRE 2009). Hophornbeam is regularly found in the subcanopy, and tall shrubs – e.g., American hazelnut (*Corylus americana* Walter) – can be present. The herbaceous layer is nearly continuous with shade-tolerant species such as clustered blacksnakeroot, pointedleaf ticktrefoil (*Desmodium glutinosum*(Muhl. ex Willd.) Alph. Wood), and spotted geranium (*Geranium maculatum* L.) (NatureServe 2018). Spring ephemerals, such as Virginia springbeauty, mayapple (*Podophyllum peltatum* L.), and bloodroot (*Sanguinaria canadensis* 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.

Dominant plant species

- white oak (*Quercus alba*), tree
- northern red oak (*Quercus rubra*), tree
- hophornbeam (*Ostrya virginiana*), shrub
- clustered blacksnakeroot (*Sanicula odorata*), other herbaceous
- Virginia springbeauty (*Claytonia virginica*), 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).

Community 2.1
White Oak - Sugar Maple/Honeysuckle - Common Buckthorn/Virginia Springbeauty - Mayapple

This community phase represents the early stages of long-term fire suppression and overbrowsing. Mature oaks are still present, but the more shade tolerant sugar maple (*Acer saccharum* Marshall) begins to co-dominate. The tree canopy closes to 100 percent cover and basal area increases (LANDFIRE 2009). Non-native shrubs, such as honeysuckle (LoniceraL.) 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

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

Community 2.2
Sugar Maple/Honeysuckle - Common Buckthorn/Mayapple - Litter

Sites falling into this community phase have a well-established, fire-intolerant canopy dominated by sugar maple. 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

Pathway 2.1A

Community 2.1 to 2.2

Continued fire suppression and increasing deer populations.

State 3
Forage State

The forage 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 (Smith 1998). 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.

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).

Community 3.2
Continuous Pastured Grazing System

This community phase is characterized by continuous grazing where domestic livestock graze a pasture for the entire season. Depending on stocking density, this can result in lower forage quality and productivity, weed invasions, and uneven pasture use. Continuous grazing can also increase the amount of bare ground and erosion and reduce soil organic matter, cation exchange capacity, water-holding capacity, and nutrient availability and retention (Bharati et al. 2002; Leake et al. 2004; Teague et al. 2011). Smooth brome, Kentucky bluegrass, and white clover (*Trifolium repens* L.) are common pasture species used in this phase. Their tolerance to continuous grazing has allowed these species to dominate, sometimes completely excluding the native vegetation.

Community 3.3
Rest-Rotation Pastured Grazing System

This community phase is characterized by rotational grazing where the pasture has been subdivided into several smaller paddocks. Through the development of a grazing plan, livestock utilize one or a few paddocks, while the remaining area is rested allowing plants to restore vigor and energy reserves, deepen root systems, develop seeds, as well as allow seedling establishment (Undersander et al. 2002; USDA-NRCS 2003). Rest-rotation pastured grazing systems include deferred rotation, rest rotation, high intensity – low frequency, and short duration methods. Vegetation is generally more diverse and can include orchardgrass (*Dactylis glomerata* L.), timothy (Phleum pretense L.), red clover (*Trifolium pratense* L.), and alfalfa (*Medicago sativa* L.). The addition of native prairie species can further bolster plant diversity and, in turn, soil function. This community phase promotes numerous ecosystem benefits including increasing biodiversity, preventing soil erosion, maintaining and enhancing soil quality, sequestering atmospheric carbon, and improving water yield and quality (USDA-NRCS 2003).

Pathway 3.1A
Community 3.1 to 3.2

Mechanical harvesting is replaced with domestic livestock utilizing continuous grazing.

Pathway 3.1B
Community 3.1 to 3.3

Mechanical harvesting is replaced with domestic livestock utilizing rotational 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

Rotational grazing replaces continuous grazing.

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

Continuous grazing replaces rotational grazing.

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 common wheat (*Triticum aestivum*L.) and alfalfa (*Medicago sativa*L.) may be rotated periodically. These areas are likely to remain in crop production for the foreseeable future.

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).

Community 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.

Community 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.

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 crop 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

Upland 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.

Community 5.1
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 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.

Community 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.

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 forage state (3).

Transition T1C
State 1 to 4

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

Transition T2A
State 2 to 3

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

Transition T2B
State 2 to 4

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

Restoration pathway R2A
State 2 to 5

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

Transition T3A
State 3 to 2

Land abandonment transitions the site to the fire-suppressed state (2).

Transition T3B
State 3 to 4

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

Restoration pathway R3A
State 3 to 5

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

Land abandonment transitions the site to the fire-suppressed state (2).

Transition T4B
State 4 to 3

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

Restoration pathway R4A
State 4 to 5

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

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 forage state (3).

Transition T5C
State 5 to 4

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.

Author(s)/participant(s)	
Contact for lead author	
Date	05/02/2024
Approved by	Chris Tecklenburg
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:**