USDA Natural Resources
Conservation Service

Ecological site R107XB027IA
Calcareous Till Upland Prairie

Last updated: 5/21/2020
Accessed: 05/12/2025

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. This prairie-oak savanna 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 (Cleland et al. 2007).

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

Biophysical Setting (LANDFIRE 2009): Central Tallgrass Prairie (4214210)

Ecological Systems (National Vegetation Classification System, Nature Serve 2015): Central Tallgrass Prairie (CES205.683)

Eilers and Roosa (1994): Loess Hills

Iowa Department of Natural Resources (INAI nd): Western Dry-Mesic Prairie

Missouri Natural Heritage Program (Nelson 2010): Mesic Loess/Glacial Till Prairie

Nebraska Game and Parks Commission (Steinauer and Rolfsmeier 2010): Upland Tall-Grass Prairie

Plant Associations (National Vegetation Classification System, Nature Serve 2015): Andropogon gerardii – Sorghastrum nutans – (Sporobolus heterolepis) – Liatris spp. – Ratibida pinnata Grassland (CEGL002203)

White (1983): Iowan Erosion Surface Upland Type

Ecological site concept

Ecological Site Concept

Calcareous Till Upland Prairies are generally located within the green areas on the map (Figure 1). They occur on uplands on summits and backslopes where the loess has eroded. Soils are Entisols, Inceptisols, and Mollisols that are well-drained and very deep, formed from glacial till with a significant component of calcium carbonates at or near the surface that result in an alkaline (increased pH) environment. Compared to the neighboring loess soils, these fine-loamy soils have a higher bulk density, slower permeability, and lower cation-exchange capacity making them somewhat less fertile.

The historic pre-European settlement vegetation on this site was dominated by a variety of tallgrass prairie species. Big bluestem (Andropogon gerardii Vitam) is the dominant monocot species, while little bluestem (Schizachyrium scoparium (Michx.) Nash) and porcupinegrass (Hesperostipa spartea (Trin.) Barkworth) are important indicators for the ecological site. Herbaceous species typical of an undisturbed plant community associated with this ecological site include white prairie clover (Dalea candida Michx. ex Willd.), purple prairie clover (Dalea purpurea Vent.), prairie dropseed (Sporobolus heterolepis (A. Gray) A. Gray), rattlesnake master (Eryngium yuccifolium Michx.), and prairie cinquefoil (Potentilla arguta Pursh) (Drobney et al. 2001). Leadplant (Amorpha canescens Pursh) and prairie rose (Rosa arkansana Porter) are common shrubs that can be found scattered throughout the prairie. Fire was the primary disturbance factor that maintained this site, while drought and large mammal grazing were secondary factors (Kennedy 1970, LANDFIRE 2009).

Relative to other prairie ecological sites in the MLRA, Calcareous Till Upland Prairies are the only ones that occur on glacial till as other sites are formed from loess. Herbaceous production is similar across sites, but species composition differentiates them as a result of varying soil moisture. Along a moisture spectrum, this ecological site is moister than the Calcareous Loess ecological sites but slightly drier than the Loess and Deep Loess Upland Prairie ecological sites.

Associated sites

R107XB007MO	**Loess Upland Prairie** Loess soils on summits overlying paleosols, including Arisburg, Arispe, Arthur, Exira, Marshall, Minden, and Polo
R107XB008MO	**Loamy Footslope Savanna** Loess soils on footslopes, including Castana, Colo, Danbury, Deloit, Ely, Judson, Napier, Nodaway, Olmitz, Udarents, and Udorthents

Similar sites

R107XB006MO	**Calcareous Loess Exposed Backslope Prairie** Calcareous Loess Exposed Backslope Prairies are similar in landscape position but only occurs on south and west aspects, is drier as evidenced by a more xeric species composition, and parent material is calcareous loess
R107XB007MO	**Loess Upland Prairie** Loess Upland Prairies are similar in general species present but soils contain no carbonates
R107XB012MO	**Calcareous Loess Upland Prairie** Calcareous Loess Upland Prairies are similar in general species present but parent material is calcareous loess
R107XB002MO	**Deep Loess Upland Prairie** Deep Loess Upland Prairies are similar in general species present but soils contains no carbonates and only occurs on summits

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Amorpha canescens*
Herbaceous	(1) *Schizachyrium scoparium* (2) *Hesperostipa spartea*

Physiographic features

Calcareous Till Upland Prairies occur on upland shoulders and backslopes on any slope on dissected till plains (Figure 2). This ecological site is situated on elevations ranging from approximately 600 to 1,500 feet ASL. This site does not experience flooding but rather generates runoff to adjacent, downslope ecological sites.

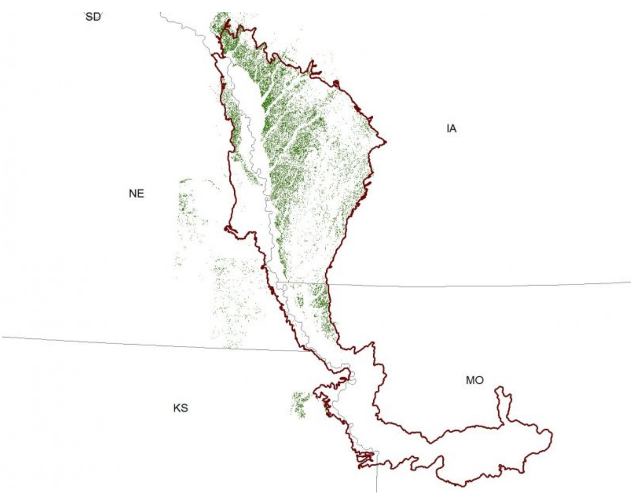


Figure 2. Figure 1. Location of Calcareous Till Upland Praifie ecological site within MLRA 107B.

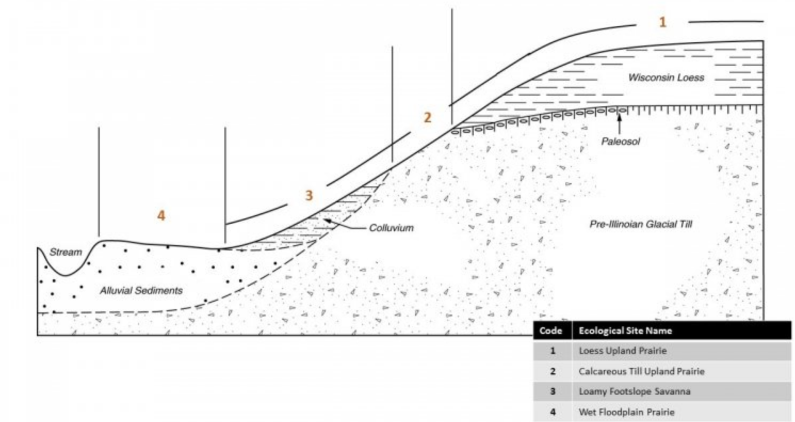


Figure 3. Figure 2. Representative block diagram of Calcareous Till Upland

Prairie and associated ecological sites.

Table 2. Representative physiographic features

Hillslope profile	(1) Shoulder (2) Backslope
Slope shape across	(1) Convex
Slope shape up-down	(1) Convex
Landforms	(1) Hillslope
Flooding frequency	None
Ponding frequency	None
Elevation	607–1,499 ft
Slope	7–13%
Water table depth	80 in
Aspect	Aspect is not a significant factor

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 you travel. The average freeze-free period of this ecological site is about 175 days, while the frost-free period is about 154 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 28 inches, which includes rainfall plus the water equivalent from snowfall (Table 3). The average annual low and high temperatures are 38 and 61°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)	133-152 days
Freeze-free period (characteristic range)	156-179 days
Precipitation total (characteristic range)	31-34 in
Frost-free period (actual range)	132-154 days
Freeze-free period (actual range)	156-184 days
Precipitation total (actual range)	28-34 in
Frost-free period (average)	140 days
Freeze-free period (average)	165 days
Precipitation total (average)	32 in

Climate stations used

- (1) SIDNEY [USC00137669], Sidney, IA
- (2) SIOUX CITY GATEWAY AP [USW00014943], Sioux City, IA
- (3) GLENWOOD 3SW [USC00133290], Glenwood, IA
- (4) LOGAN [USC00134894], Logan, IA
- (5) ONAWA 3NW [USC00136243], Onawa, IA
- (6) TARKIO [USW00014945], Tarkio, MO

Influencing water features

Calcareous Till Upland Prairies are not influenced by wetland or riparian water features. Precipitation is the main source of water for this ecological site. Infiltration is low to very low (Hydrologic Group C and D), and surface runoff is medium to very 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 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).

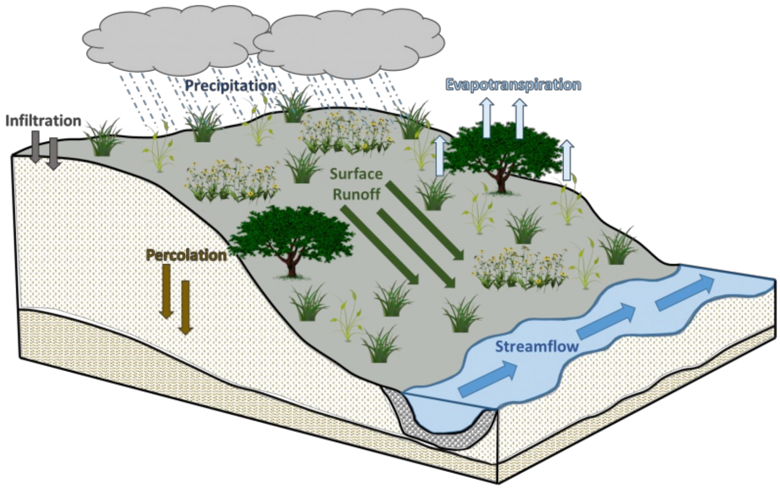


Figure 10. Figure 5. Hydrologic cycling in Calcareous Till Upland Prairie ecological site.

Soil features

Soils of Calcareous Till Upland Prairies are in the Entisol, Inceptisol, and Mollisol orders, further classified as Typic Udorthents, Typic Eutrudepts, or Typic Argiudolls. They were formed under prairie vegetation. The soil series associated with this site includes Burchard, Liston, and Steinauer. The parent material is calcareous till, and the soils are well-drained and very deep with coarse fragments. Soil pH classes are moderately acid to moderately alkaline. No rooting restrictions are noted for the soils of this ecological site. Average clay content is between 27 to 35 percent limiting extreme compaction, but erosion from water can be high.

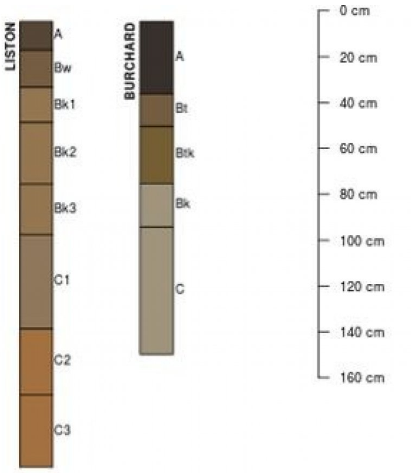


Figure 11. Figure 6. Profile sketches of soil series associated with Calcareous Till Upland Prairie.

Table 4. Representative soil features

Parent material	(1) Till
Family particle size	(1) Fine-loamy
Drainage class	Well drained
Permeability class	Very slow to moderately slow
Soil depth	80 in
Available water capacity (0-40in)	5–7 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	5.6–8.4

Ecological dynamics

Prairie ecosystems are regarded as the most endangered ecosystem in North America where an estimated four percent of the tallgrass prairie habitat remains (Steinauer and Collins 1996). The Loess Hills region of MLRA 107B were once dominated by tall- and midgrass prairies, extending across more than 90 percent of the area (Rosburg 1994; Farnsworth 2009). However, by the early twenty-first century much of the land had been converted to agriculture, leaving an estimated 20 percent of the region to be classified as “grassland” and another three percent classified as “remnant prairie” (Farnsworth 2009).

Calcareous Till Upland Prairies form a vegetative continuum throughout the Loess Hills, where soil moisture serves as the primary influence on community composition (White 1983; White and Glenn-Lewin 1984). This ecological site can occur on nearly any aspect. Species characteristic of this ecological site are sun-loving, fire- and drought-adapted plants.

Fire is the most important ecosystem driver for maintaining this ecological site (Vogl 1974; Anderson 1990; Eilers and Roosa 1994). Fire intensity typically consisted of periodic, low-intensity surface fires (Stambaugh et al. 2006; 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, driving large game, improving grazing and browsing habitat, agricultural and village clearing, and enhancing vital ethnobotanical plants (Day 1953; Barrett 1980; White 1994). Fire frequency has been estimated to occur on average every 6.6 years in the Loess Hills region (Stambaugh et al. 2006). This continuous disturbance provided critical conditions for perpetuating the native prairie ecosystem.

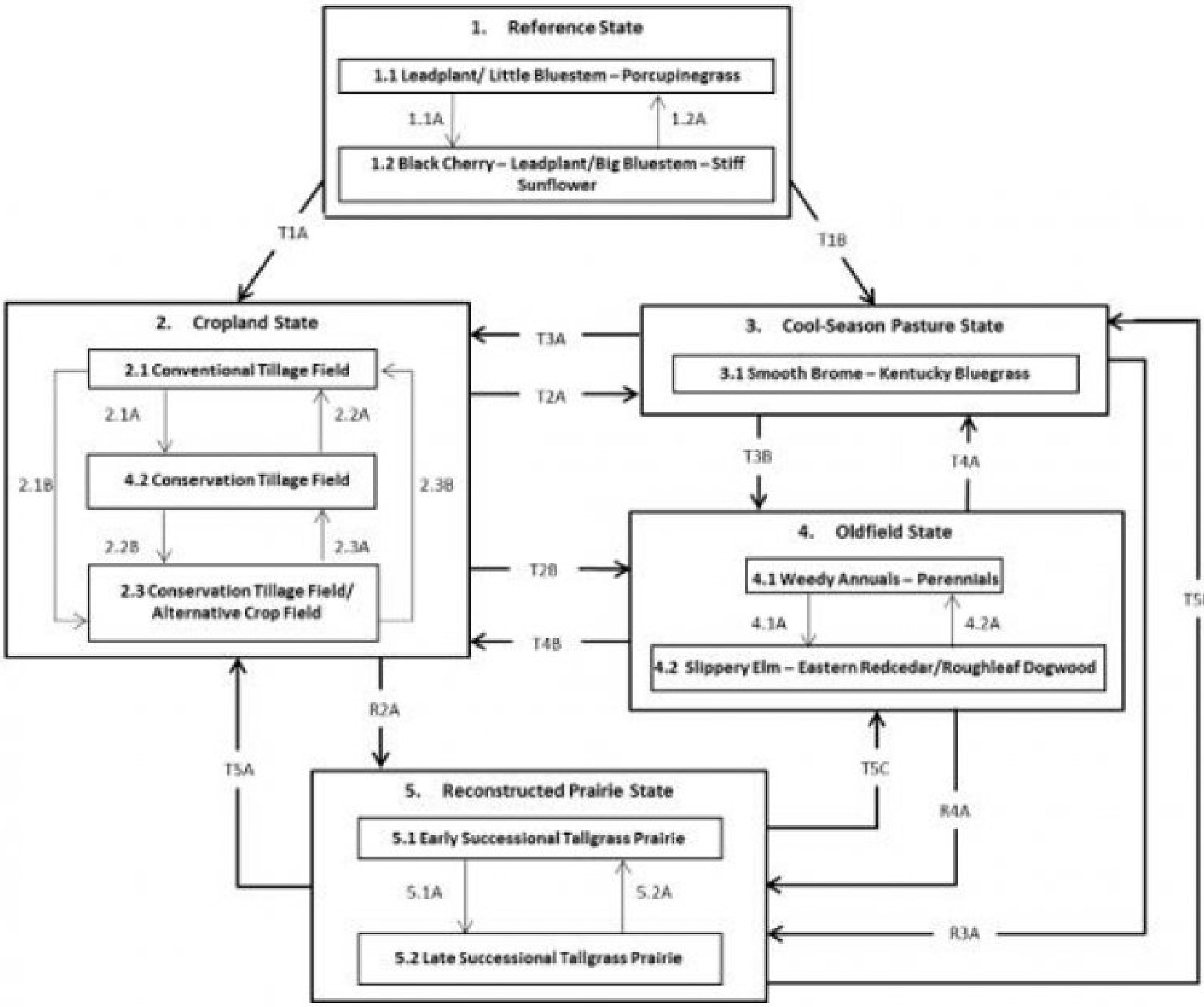
Grazing by native ungulates is often cited as an important disturbance regime of North American grasslands, with bison (Bison bison), prairie elk (Cervus elaphus), and white-tailed deer (Odocoileus virginianus) serving as the dominant herbivores of the area. However, plant community succession in the Loess Hills region does not necessarily follow this hypothesis. The steep and rugged topography of the Loess Hills has been considered an impediment to grazing by large ungulates such as bison. Any role bison played in the area was most likely relegated to the northwestern extent where the terrain is milder (Dinsmore 1994). Elk and deer are believed to have played a relatively significant role in keeping woody vegetation at bay in the prairies of the Loess Hills (Farnsworth 2009; LANDFIRE 2009).

Drought has also played a role in shaping the prairie 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).

Today, Calcareous Till Upland Prairies are limited in their extent, having been converted to pasture or agricultural land. What remnants do exist show evidence of indirect anthropogenic influence as some non-native species (e.g., Kentucky bluegrass (*Poa pratensis* L.), quackgrass (*Elymus repens* (L.) Gould), sweetclover (*Melilotus officinalis* (L.) Lam.)) are present in the understory. A return to the historic plant community is likely not possible, but long-term restoration efforts can help to restore some natural diversity and ecological functioning.

State and transition model

R107BY027IA Calcareous Till Upland Prairie



Code	Process
T1A, T3A, T4B, T5A	Agricultural conversion via tillage, seeding, and non-selective herbicide
T1B, T2A, T4A, T5B	Brush control, interseeding of non-native cool-season grasses
1.1A	Fire-free period, 4-6 years
1.2A	Fire-free period, 1-4 years
2.1A	Less tillage, residue management
2.1B	Less tillage, residue management, and implementation of cover cropping
2.2B	Implementation of cover cropping
2.2A, 2.3B	Intensive tillage, remove residue, and reinitiate monoculture row-cropping
2.3A	Remove cover cropping
T2B, T3B	Agricultural practices abandoned; opportunistic succession ensues
4.1A	More than 2 years of no soil-disturbing activities
4.2A	Fire or other disturbance reduces woody plant cover
R2A, R3A, R4A	Site preparation, non-native species control, and seeding native species
5.1A	Invasive species control, native seeding, and implementation of natural disturbance regime
5.2A	Drought or improper timing/use of management actions
T5C	Active management is removed

State 1
Reference State

The reference plant community is categorized as a mesic tallgrass prairie and includes grasses, forbs, and varying components of shrubs. The reference community phase is dependent on a fire frequency of every one to six years. Shorter fire intervals maintain dominance by grasses, while less frequent intervals allow woody vegetation to increase their importance in the plant canopy. Grazing and drought disturbances have less impact in the reference phases, but do contribute to overall species composition, diversity, cover, and productivity.

Community 1.1
Leadplant/ Little Bluestem - Procupinegrass

Many grass species are present on the site, but little bluestem and porcupinegrass are the diagnostic species. Characteristic forbs include wholeleaf rosinweed (*Silphium integrifolium* Michx.), roundhead lespedeza (*Lespedeza capitata* Michx.), prairie blazing star (*Liatris pycnostachya* Michx.), and downy phlox (*Phlox pilosa* L.). Shrubs – such as leadplant– are scattered throughout the community.

Dominant plant species

- leadplant (*Amorpha canescens*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- porcupinegrass (*Hesperostipa spartea*), grass

Community 1.2
Black Cherry – Leadplant/Big Bluestem – Stiff Sunflower

This reference community phase can occur when fire frequency is reduced to every four to six years (Stambaugh et al. 2006). The native prairie grasses continue to form the dominant herbaceous canopy, but increasing litter from may shade out shorter-statured grasses and forbs. Tall species such as big bluestem and stiff sunflower (*Helianthus pauciflorus* Nutt.) can be expected to remain. The reduced fire interval allows woody species to increase shrub cover across the prairie, with canopy coverage ranging from ten to 30 percent (LANDFIRE 2009). Important shrub species in this phase include leadplant, black cherry (*Prunus serotina* Ehrh.), and prairie rose.

Dominant plant species

- black cherry (*Prunus serotina*), tree
- leadplant (*Amorpha canescens*), shrub
- big bluestem (*Andropogon gerardii*), grass
- stiff sunflower (*Helianthus pauciflorus*), other herbaceous

Pathway P1.1A
Community 1.1 to 1.2

Natural succession as a result of an average fire return interval of four to six years.

Pathway P1.2A
Community 1.2 to 1.1

Natural succession as a result of an average fire return interval of four years or less.

State 2
Cropland State

The Midwest is well-known for its highly-productive agricultural soils, and as a result, much of the MLRA has been converted to cropland, including significant portions of this ecological site. The continuous use of tillage, row-crop planting, and chemicals (i.e., herbicides, fertilizers, etc.) have effectively eliminated the reference community and many of its natural ecological functions in favor of crop production. Corn (*Zea mays* L.) and soybeans (*Glycine max* (L.) Merr.) are the dominant crops for the site. These areas are likely to remain in crop production for the foreseeable future.

Community 2.1
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 impact 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 2.2
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 system, conservation tillage methods can reduce soil erosion, increase organic matter and water availability, improve water quality, and reduce soil compaction.

Community 2.3
Conservation Tillage Field/Alternative Crop Field

This condition 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. 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 P2.1A
Community 2.1 to 2.2

Tillage operations are greatly reduced, crop rotation occurs on a regular schedule, and crop residue is allowed to remain on the soil surface.

Pathway P2.1B
Community 2.1 to 2.3

Cover crops are implemented to prevent soil erosion

Pathway P2.2A
Community 2.2 to 2.1

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

Pathway P2.2B
Community 2.2 to 2.3

Cover crops are implemented to prevent soil erosion.

Pathway P2.3B
Community 2.3 to 2.1

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

Pathway P2.3A
Community 2.3 to 2.2

Cover crop practices are abandoned.

State 3
Cool Season Grasses

The cool-season pasture state occurs when the reference state has been anthropogenically-altered for livestock production. Fire suppression, seeding of non-native cool-season grasses, removal of woody vegetation, periodic cultural treatments, and grazing by domesticated livestock transition and maintain this simplified grassland state (Rosburg 1994; USDA-NRCS 2003). Early settlers seeded such non-native cool-season species as smooth brome (*Bromus inermis* Leyss.) and Kentucky bluegrass in order to help extend the grazing season (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 prairie habitat, reducing the native species diversity.

Community 3.1
Smooth Brome – Kentucky Bluegrass

Species characteristic of this community phase include big bluestem, smooth brome, and Kentucky bluegrass. While the native big bluestem forms the dominant component of the canopy, smooth brome and Kentucky bluegrass occur in higher frequencies across the site. Annuals and biennials are important components of this community phase and are indicative of the disturbed nature of the site (Rosburg 1994).

Dominant plant species

- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- big bluestem (*Andropogon gerardii*), grass

State 4
Oldfield State

Agricultural lands that have been abandoned and left fallow undergo ecological succession to the oldfield state. Two community phases define this state and are determined by time and human activities. Initially, the site is inhabited by ruderal, herbaceous annuals and perennials. As the land remains untouched from natural or anthropogenic disturbances, woody species begin to dominate eventually forming a near continuous canopy. Community Phase 4.1 Weedy Annuals - Perennials – This community phase represents the early stages of land abandonment characterized by bare soil and lack of human land modification. During these first few years, the phase is dominated by herbaceous annual (e.g. lambsquarters (*Chenopodium album* L.)) and perennial (e.g., red clover (*Trifolium pratense* L.), goldenrods (Solidago L.)) species. Annuals are the dominant life form comprising nearly 85 percent of the species richness but within a few years perennial species increase their importance on the site. Non-natives and natives are relatively equally dominant throughout this phase, with natives contributing around 40 percent of the species richness initially and increasing to 60 percent (Brown et al. 1987).

Community 4.1
Weedy Herbaceous Annuals - Perennials

This community phase represents the early stages of land abandonment characterized by bare soil and lack of human land modification. During these first few years, the phase is dominated by herbaceous annual (e.g. lambsquarters (*Chenopodium album* L.)) and perennial (e.g., red clover (*Trifolium pratense* L.) and goldenrod (Solidago L.)) species. Annuals are the dominant life form comprising nearly 85 percent of the species richness but within a few years perennial species increase their importance on the site. Non-natives and natives are relatively equally dominant throughout this phase, with natives contributing around 40 percent of the species richness initially and increasing to 60 percent (Brown et al. 1987).

Dominant plant species

- red clover (*Trifolium pratense*), other herbaceous
- lambsquarters (*Chenopodium album*), other herbaceous
- goldenrod (*Solidago*), other herbaceous

Community 4.2
Slippery Elm-Eastern Redcedar/Roughleaf Dogwood

Sites falling into this community phase are strongly dominated by a limited number of early-successional woody species. Plant community composition is largely shaped by abiotic effects of patch size, dispersal dynamics, and distance effects. Generally, roughleaf dogwood (*Cornus drummondii* C.A. Mey.) forms the most frequent or abundant woody species across the site due to its clonal stem production and high seed yield. Slippery elm (*Ulmus rubra* Muhl.) is a frequent invader of abandoned agricultural or pasture lands with a roughly linear colonization rate over the years. Eastern redcedar (*Juniperus virginiana* L.) is a pioneer species and can be a co-dominant component of the tree canopy, with densities typically higher in smaller fields (Yao et al. 1999). Herbaceous species that can be found in the understory include common blue violet (*Viola sororia* Willd.), white snakeroot (*Ageratina altissima* (L.) R.M. King & H. Rob. Var. altissima), and creeper (Parthenocissus Planch.) (Rosburg 1994).

Dominant plant species

- roughleaf dogwood (*Cornus drummondii*), shrub
- slippery elm (*Ulmus rubra*), shrub
- eastern redcedar (*Juniperus virginiana*), shrub

Pathway P4.1A
Community 4.1 to 4.2

Soil is left undisturbed for more than six years.

Pathway P4.2A
Community 4.2 to 4.1

Fire or other disturbance factor is used to control and eliminate the woody plant cover.

State 5
Reconstructed Prairie State

Prairie reconstruction has become an important tool for repairing natural ecological functioning and providing habitat protection for numerous grassland-dependent species. The historic plant community of the tallgrass prairie was extremely diverse and complex, and prairie replication is not considered to be possible once the native vegetation has been altered by post-European settlement land uses. 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 natural ranges of stress and disturbance, and create and maintain positive biotic and abiotic interactions (SER 2002). The reconstructed prairie state is the result of a long-term commitment involving a multi-step, adaptive management process. Diverse, species-rich seed mixes are important to utilize as they allow the site to undergo successional stages that exhibit changing composition and dominance over time (Smith et al. 2010). On-going management via prescribed fire and/or light grazing will help the site progress from an early successional community dominated by annuals and some weeds to a later seral stage composed of native perennial grasses, forbs, and shrubs. Establishing a prescribed fire regimen that mimics natural disturbance patterns can increase native species cover and diversity while reducing cover of non-native forbs and grasses. Light grazing alone can help promote species richness, while grazing accompanied with fire can control the encroachment of woody vegetation (Brudvig et al. 2007).

Community 5.1
Early Successional Reconstructed Tallgrass Prairie

This community phase represents the early community assembly from prairie reconstruction and is highly dependent on the seed mix utilized and the timing and priority of planting operations. The seed mix should look to include a diverse mix of native cool-season and warm-season annual and perennial grasses and forbs typical of the reference state. Cool-season annuals can help to provide litter that promotes cool, moist soil conditions to the benefit of the other species in the seed mix. The first season following site preparation and seeding will typically result in annuals and other volunteer species forming the vegetative cover. Control of non-native species, particularly perennial species, is crucial at this point in order to ensure they do not establish before the native vegetation (Martin and Wilsey 2012). After the first season, native C4 grasses should begin to become more prominent on the landscape and over time close the canopy.

Community 5.2
Late Successional Reconstructed Tallgrass Prairie

Appropriately timed disturbance regimes (e.g., prescribed fire) applied to the early successional community phase can help increase the beta diversity, pushing the site into a late successional community phase over time. While prairie communities are dominated by grasses, these species can suppress forb establishment and reduce overall diversity and ecological functioning (Martin and Wilsey 2006; Williams et al. 2007). Reducing accumulated plant litter from perennial bunchgrasses allows more light and nutrients to become available for forb recruitment, allowing for greater ecosystem complexity (Wilsey 2008).

Pathway P5.1A
Community 5.1 to 5.2

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

Pathway P5.2A
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

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

Transition T1B
State 1 to 3

Interseeding non-native cool-season grasses and brush control transition this site to the cool-season pasture state (3).

Transition T2A
State 2 to 3

Non-selective herbicide and seeding of non-native cool-season grasses transitions the site to the cool-season pasture state (3).

Transition T2B
State 2 to 4

Land is abandoned and left fellow; natural succession by opportunistic species transitions this site to the oldfield state (4).

Transition R2A
State 2 to 5

Site preparation, invasive species control (native and non-native), and seeding native species transition this site to the reconstructed prairie state (5).

Transition T3A
State 3 to 2

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

Transition T3B
State 3 to 4

Land is abandoned and left fellow; natural succession by opportunistic species transitions this site to the oldfield state (4).

Restoration pathway R3A
State 3 to 5

Site preparation, invasive species control (native and non-native), and seeding native species transition this site to the reconstructed prairie state (5).

Transition T4B
State 4 to 2

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

Transition T4A
State 4 to 3

Brush control and interseeding of non-native, cool-season grasses transition this site to the cool-season pasture state (3).

Restoration pathway R4A
State 4 to 5

Site preparation, invasive species control (native and non-native), and seeding native species transition this site to the reconstructed prairie state (5).

Transition T5A
State 5 to 2

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

Transition T5B
State 5 to 3

Land is converted to the cool-season pasture state through the use of non-selective herbicide and seeding of non-native cool-season grasses (3).

Transition T5C
State 5 to 4

Active management of the restored prairie is ceased and woody encroachment transitions this site to the oldfield state (4).

Additional community tables

Inventory data references

Tier 3 Sampling Plot(s) used to develop the reference state, community phase 1.1:

State County Ownership Legal Description Easting Northing
Iowa Guthrie Sheeder Prairie State Preserve T80N R32W S33 367849 4616537

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Approval

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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	05/12/2025
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:**

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:**
