USDA Natural Resources
Conservation Service

Ecological site R107XA205IA
Loamy Sediment Upland Prairie

Last updated: 5/21/2020
Accessed: 05/19/2024

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 Minnesota Loess Hills (MLRA 107A) includes the Northwest Iowa Plains, Inner Coteau, and Coteau Moraines landforms (Prior 1991; MDNR 2005). It spans two states (Iowa, 89 percent; Minnesota, 11 percent), encompassing approximately 4,470 square miles (Figure 1). The elevation ranges from approximately 1,700 feet above sea level (ASL) on the highest ridges to about 1,115 feet ASL in the lowest valleys. Local relief is mainly 10 to 100 feet. However, some valley floors can range from 80 to 200 feet, while some upland flats only range between 3 and 6 feet. The eastern half of the MLRA is underlain by Wisconsin-age till, deposited between 20,000 and 30,000 years ago and is known as the Sheldon Creek Formation. The western half is underlain by Pre-Illinoian glacial till, deposited more than 500,000 years ago and has since undergone extensive erosion and dissection. Both surfaces are covered by approximately 4 to 20 feet of loess on the hillslopes, and Holocene alluvium covers the till in the drainageways. Cretaceous bedrock, comprised of sandstone and shale, lies 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

U.S. Forest Service Ecological Subregions: North Central Glaciated Plains (251B) Section, Outer Coteau des Prairies (251Bb), Northwest Iowa Plains (251Bd) Subsections (Cleland et al. 2007)

U.S. EPA Level IV Ecoregion: Loess Prairies (47a) (USEPA 2013)

National Vegetation Classification – Ecological Systems: Northern Tallgrass Prairie (CES205.686) (NatureServe 2015)

National Vegetation Classification - Plant Associations: Andropogon gerardii – Hesperostipa spartea – Sporobolus heterolepis Grassland (CEGL002202) (NatureServe 2015)

Biophysical Settings: Northern Tallgrass Prairie (4214200) (LANDFIRE 2009)

Natural Resources Conservation Service – Iowa Plant Community Species List: Prairie, Northern Mesic Tallgrass (USDA-NRCS 2007)

Iowa Department of Natural Resources: Blacksoil Tallgrass Prairie (INAI 1984)

Minnesota Department of Natural Resources: Ups23a Mesic Prairie (Southern) (MDNR 2005)

Ecological site concept

Loamy Sediment Upland Prairies are located within the green areas on the map (Figure 1). They occur on uplands and high stream terraces not subject to flooding. Soils are Mollisols and Inceptisols that are somewhat poorly to well-drained and deep, formed in loamy glacial sediments. These fine- to coarse-loamy soils have organic-rich surfaces with high base saturation and will intermittently dry out for periods during the summer season (MDNR 2005; NatureServe 2015).

The historic pre-European settlement vegetation on this site was dominated by herbaceous tallgrass species. Porcupinegrass (Hesperostipa spartea (Trin.) Barkworth) and smooth blue aster (Symphyotrichum leave (L.) Á. Löve & D. Löve) are the dominant and characteristic species, respectively. Other grasses that may occur include big bluestem (Andropogon gerardii Vitman), Indiangrass (Sorghastrum nutans (L.) Nash), little bluestem (Schizachyrium scoparium (Michx.) Nash), and prairie dropseed (Sporobolus heterolepis (A. Gray) A. Gray) (MDNR 2005). Forbs typical of an undisturbed plant community associated with this ecological site include autumn onion (Allium stellatum Fraser ex Ker Gawl.), western silver aster (Symphyotrichum sericeum (Vent.) G.L. Nesom), and meadow zizia (Zizia aptera (A. Gray) Fernald) (Drobney et al. 2001; MDNR 2005). Shrub cover is sparse but, when present, leadplant (Amorpha canescens Pursh) and prairie rose (Rosa arkansana Porter) are the most commonly encountered species (MDNR 2005). Fire and herbivory are the primary disturbance factors that maintain this site, while drought is a secondary factor (MDNR 2005; LANDFIRE 2009).

Associated sites

R107XA202IA	**Calcareous Till Upland Prairie** Glacial till on uplands that are shallow to calcium carbonates including Moneta and Steinauer
R107XA209IA	**Wet Upland Sedge Meadow** Loess or loamy sediments on upland flats (slopes <2%) and shallow to water table including Gillet Grove, Letri, Marcus, Rushmore, and Spicer
R107XA210IA	**Wet Upland Drainageway Prairie** Colluvium and alluvium in upland drainageways including Ackmore, Afton, Colo, Ely, Judson, Radford, and Terril

Similar sites

R107XA202IA	**Calcareous Till Upland Prairie** Calcareous Till Upland Prairies are derived from glacial till that is shallow to calcium carbonates and have a higher pH
R107XA206IA	**Outwash Upland Prairie** Outwash Upland Prairies are derived from glacial outwash
R107XA207IA	**Sandy Dry Prairie** Sandy Dry Prairies are derived from coarse-loamy and sandy materials
R107XA201IA	**Loess Upland Prairie** Loess Upland Prairies are derived from loess

Table 1. Dominant plant species

Tree	Not specified

Shrub	(1) *Amorpha canescens* (2) *Rosa arkansana*
Herbaceous	(1) *Hesperostipa spartea* (2) *Symphyotrichum laeve*

Physiographic features

Loamy Sediment Upland Prairies occur on uplands and high stream terraces (Figure 2). They are situated on elevations ranging from approximately 984 to 1801 feet ASL. The site does not experience flooding but rather generates runoff to adjacent, downslope ecological sites.

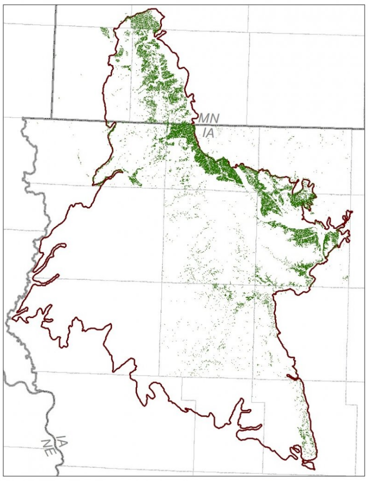


Figure 2. Figure 1. Location of Loamy Sediment Upland Prairie ecological site within MLRA 107A.

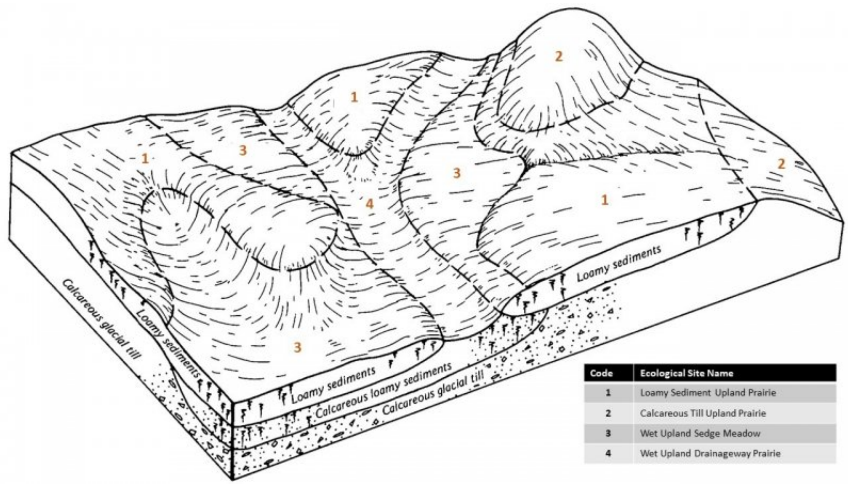


Figure 3. Figure 2. Representative block diagram of Loamy Sediment Upland Prairie and associated ecological sites.

Table 2. Representative physiographic features

Slope shape across	(1) Convex
Slope shape up-down	(1) Convex (2) Linear
Landforms	(1) Upland (2) River valley > Terrace
Runoff class	Low to medium
Elevation	300–549 m
Slope	2–14%

Water table depth	30–203 cm
Aspect	Aspect is not a significant factor

Climatic features

The Iowa and Minnesota Loess Hills falls into the hot humid continental climate (Dfa) Köppen-Geiger climate classification (Peel et al. 2007). 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. Occasionally, hot, dry winds originating from the Desert Southwest will stagnate over the region, creating extended droughty periods in the summer from unusually high temperatures. Air masses from the Pacific Ocean can also spread into the region and dominate producing mild, dry weather in the autumn known as Indian Summers (NCDC 2006).

The soil temperature regime of MLRA 107A 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 154 days, while the frost-free period is about 129 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 30 inches, which includes rainfall plus the water equivalent from snowfall. The average annual low and high temperatures are 34 and 56°F, respectively (Table 3).

Climate data and analyses are derived from 30-year averages gathered from three 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)	124-127 days
Freeze-free period (characteristic range)	144-150 days
Precipitation total (characteristic range)	737 mm
Frost-free period (actual range)	123-127 days
Freeze-free period (actual range)	143-151 days
Precipitation total (actual range)	737 mm
Frost-free period (average)	125 days
Freeze-free period (average)	147 days
Precipitation total (average)	737 mm

Climate stations used

- (1) SIBLEY 3 NE [USC00137664], Sibley, IA
- (2) SPENCER 1 N [USC00137844], Spencer, IA
- (3) LAKE WILSON [USC00214534], Lake Wilson, MN

Influencing water features

Loamy Sediment Upland Prairies are not influenced by wetland or riparian water features. Precipitation is the main source of water for this ecological site. Infiltration is slow to high (Hydrologic Groups A, B, C) for undrained soils, and surface runoff is very low to medium. Precipitation infiltrates the soil surface and percolates downward through the horizons unimpeded by any restrictive layer. The Dakota bedrock aquifer underlying this ecological site is typically deep and confined, leaving it generally unaffected by recharge (Prior et al. 2003). Surface runoff contributes some water to downslope ecological sites (Figure 5).

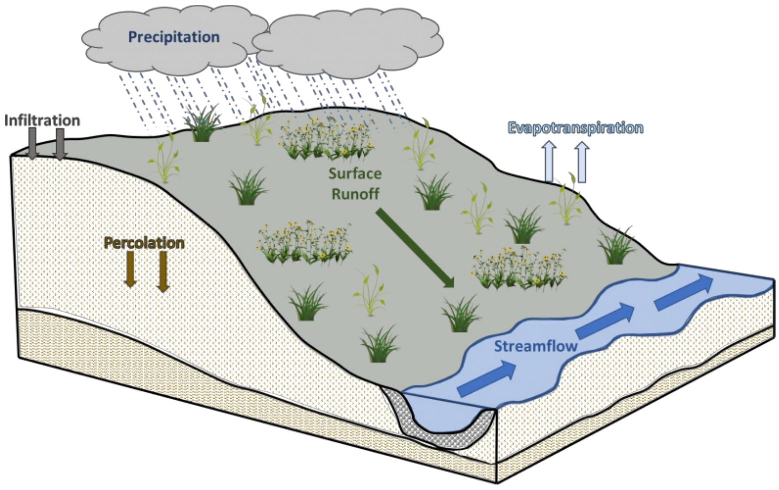


Figure 10. Figure 5. Hydrologic cycling in Loamy Sediment Upland Prairie ecological site.

Soil features

Soils of Loamy Sediment Upland Prairies are in the Mollisols and Inceptisols orders, further classified as Aquic Hapludolls, Typic Hapludolls, and Typic Eutrudepts with slow to high infiltration and low to medium runoff potential. The soil series associated with this site includes Bolan, Bolan variant, Dickinson, Everly, Fostoria, and Ocheyedan (figure 6). The parent material is glacial loamy sediments, and the soils are somewhat poorly to well-drained and deep. Soil pH classes are strongly acid to moderately alkaline. No rooting restrictions are noted for the soils of this ecological site (Table 5).

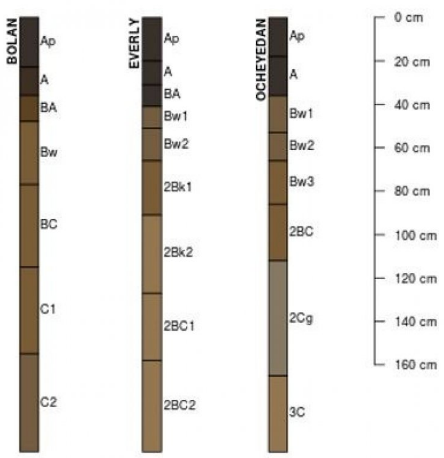


Figure 11. Figure 6. Profile sketches of soil series associated with Loamy Sediment Upland Prairie.

Table 4. Representative soil features

Family particle size	(1) Fine-loamy (2) Coarse-loamy
Drainage class	Somewhat poorly drained to well drained
Permeability class	Slow to moderate
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.

MLRA 107A is defined by a relatively low relief landscape that experiences lower rainfall amounts and available moisture compared to other MLRAs occurring to the south and east. As a result, prairie vegetation communities dominate the uplands, while forested communities are restricted to medium and large streams (Prior 1991; Eilers and Roosa 1994; MDNR 2017a, b). Loamy Sediment Upland Prairies form an aspect of this vegetative continuum. This ecological site occurs on upland summits, shoulders, and backslopes and on high stream terraces on somewhat poorly to well-drained soils. Plants characteristic of this ecological site consist of sun-loving, fire-adapted herbaceous vegetation.

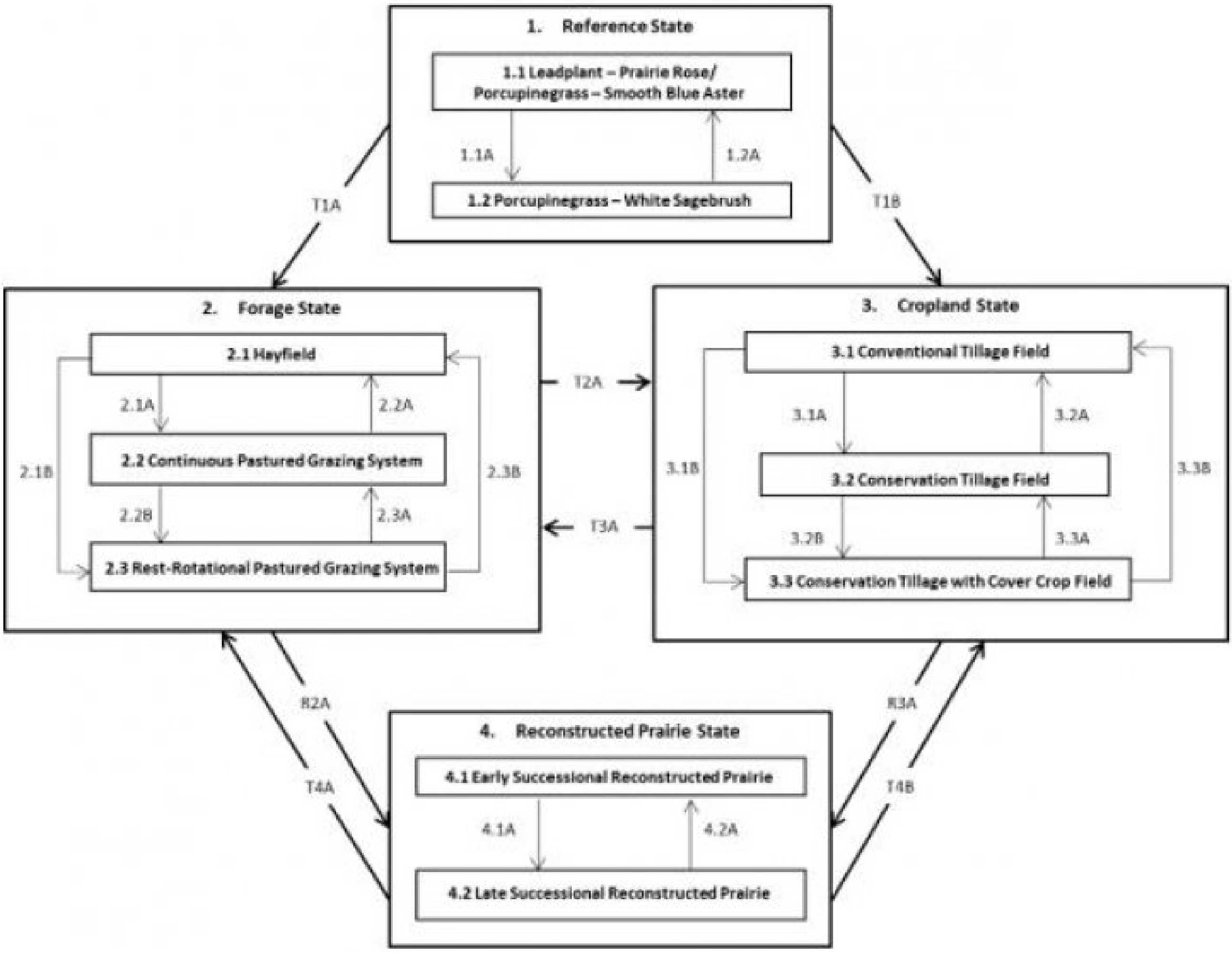
Fire and grazing are the dominant ecosystem drivers for maintaining the vegetation of Loamy Sediment Upland Prairies. Fire intensity typically consisted of periodic, high severity surface fires occurring every1 to 5 years (LANDFIRE 2009). Ignition sources included summertime lightning strikes from convective storms and bimodal, human ignitions during the spring and fall seasons. Native Americans regularly set fires to improve sight lines for hunting, driving large game, improving grazing and browsing habitat, agricultural clearing, and enhancing vital ethnobotanical plants (Barrett 1980). Bison (Bos bison) and possibly prairie elk (Cervus elaphus) were the main herbivores in northern tallgrass prairies. Herbivory occurred via mob grazing with large herds of animals rapidly moving across the prairie as they grazed (LANDFIRE 2009). These continuous disturbances provided critical conditions for perpetuating the native prairie ecosystem (MDNR 2005).

Drought has also played a role in shaping this ecological site. The periodic episodes of reduced soil moisture in conjunction with the somewhat poorly to well-drained soils have favored the proliferation of plant species tolerant of such conditions. Drought can also slow the growth of plants and result in dieback of certain species. When coupled with fire and herbivory, periods of drought can greatly delay the establishment of woody vegetation (Pyne et al. 1996).

Today, Loamy Sediment Upland Prairies are limited in their extent, having been converted to agricultural production land. Corn (*Zea mays* L.) and soybeans (*Glycine max* (L.) Merr.) are the dominant crops grown on this ecological site, but small patches of forage land are present. A return to the historic plant community may not be possible following extensive land modification, but long-term conservation agriculture or prairie 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

R107AY205IA Loamy Sediment Upland Prairie



Code	Process
T1A, T3A, T4A	Cultural treatments are implemented to increase forage quality and yield
T1B, T2A, T4B	Agricultural conversion via tillage, seeding, and non-selective herbicide
1.1A	Recent fire or mob grazing event
1.2A	Natural succession following one year or more of no disturbances
2.1A	Mechanical harvesting is replaced with domestic livestock and continuous grazing
2.1B	Mechanical harvesting is replaced with domestic livestock and rest-rotational grazing
2.2A, 2.3B	Domestic livestock grazing is replaced with mechanical harvesting
2.2B	Implementation of rest-rotational grazing
2.3B	Implementation of continuous grazing
3.1A	Less tillage, residue management
3.1B	Less tillage, residue management, and implementation of cover cropping
3.2B	Implementation of cover cropping
3.2A, 3.3B	Intensive tillage, remove residue, reinitiate monoculture row cropping
3.3A	Remove cover cropping
R2A, R3A	Site preparation, non-native species control, and native seeding
4.1A	Invasive species control and implementation of disturbance regimes
4.2A	Drought or improper timing/use of management actions

State 1
Reference State

The reference plant community is categorized as a mesic tallgrass prairie, dominated by herbaceous vegetation. The two community phases within the reference state are dependent on periodic fire and grazing. Episodic grazing alters species composition, cover, and extent, while regular fire intervals recycle nutrients, encourage flowering and seed production, and keep woody species from dominating (MDNR 2005). Drought has a more localized impact on the reference phases, but does contribute to overall species composition, diversity, cover, and productivity.

Dominant plant species

- leadplant (*Amorpha canescens*), shrub
- prairie rose (*Rosa arkansana*), shrub
- porcupinegrass (*Hesperostipa spartea*), other herbaceous
- white sagebrush (*Artemisia ludoviciana*), other herbaceous
- smooth blue aster (*Symphyotrichum laeve*), other herbaceous

State 2
Forage State

The forage state occurs when the site 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, these species were able to spread and expand across the prairie ecosystem, reducing the native species diversity and ecological function.

State 3
Cropland State

The low topographic relief across the MLRA has resulted in nearly the entire area being converted to agriculture (Eilers and Roosa 1994). The continuous use of tillage, row-crop planting, and chemicals (i.e., herbicides, fertilizers, etc.) has effectively eliminated the reference community and many of its natural ecological functions in favor of crop production. Corn and soybeans are the dominant crops for the site, and oats (Avena L.) and alfalfa (*Medicago sativa* L.) may be rotated periodically. These areas are likely to remain in crop production for the foreseeable future.

State 4
Reconstructed Tallgrass Prairie State

Prairie reconstructions have become an important tool for repairing natural ecological functions and providing habitat protection for numerous grassland dependent species. Because the historic plant and soil biota communities of the tallgrass prairie were highly diverse with complex interrelationships, historic prairie replication cannot be guaranteed on landscapes that have been so extensively manipulated for extended timeframes (Kardol and Wardle 2010; Fierer et al. 2013). 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 can 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 a few 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).

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

Acknowledgments

This project could not have been completed without the dedication and commitment from a variety of partners and staff (Table 6). Team members supported the project by serving on the technical team, assisting with the development of state and community phases of the state-and-transition model, providing peer review and technical editing, and conducting quality control and quality assurance reviews.

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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	05/19/2024
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:**