Ecological site R107XA207IA
Sandy Dry Prairie

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 107X–Iowa and Missouri Deep Loess Hills

The Iowa and 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 Subregion: North Central Glaciated Plains (251B) Section, Northwest Iowa Plains (251Bd) Subsection (Cleland et al. 2007)

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

National Vegetation Classification – Ecological Systems: North-Central Interior Sand and Gravel Tallgrass (CES 202.695) (NatureServe 2015)

National Vegetation Classification – Plant Associations: Schizachyrium scoparium – Hesperostipa spartea –

Bouteloua (curtipendula, gracilis) Sand Grassland (CEGL005204) (NatureServe 2015)

Biophysical Setting: North-Central Interior Sand and Gravel Tallgrass Prairie (3914120) (LANDFIRE 2009)

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

Iowa Department of Natural Resources: Sand Prairie (INAI 1984)

Minnesota Department of Natural Resources: Ups 13a Dry Barrens Prairie (Southern) (MDNR 2005)

Ecological site concept

Sandy Dry Prairies are located within the green areas on the map (Figure 1). They occur on upland flats and hillslopes and on outwash plains on stream terraces. Soils are Mollisols and Inceptisols that are moderately well to somewhat excessively-drained and deep, formed in eolian sediments. Due to the dominantly northwest winds of the MLRA and the eolian nature of the parent material, this ecological site most often occurs on the east side of major rivers. Soils are poorly developed with limited water- and nutrient-holding capabilities, resulting in a sparsely vegetated plant community.

The historic pre-European settlement vegetation on this site was dominated by herbaceous species tolerant of xeric conditions and low soil fertility. Prairie sandreed (Calamovilfa longifolia (Hook.) Scribn.) and sand dropseed (Sporobolus cryptandrus (Torr.) A. Gray) are the dominant species of Sandy Dry Prairies. Other grasses that may occur include little bluestem (Schizachyrium scoparium (Michx.) Nash), sideoats grama (Bouteloua curtipendula (Michx.) Torr.), and porcupinegrass (Hesperostipa spartea (Trin.) Barkworth) (MDNR 2005). Species typical of an undisturbed plant community associated with this ecological site include plains muhly (Muhlenbergia cuspidata (Torr. ex Hook.) Rydb.) and aromatic aster (Symphyotrichum oblongifolium (Nutt.) G.L. Nesom) (Drobney et al. 2001; MDNR 2005; NatureServe 2015). Shrub cover is sparse and, when present, typically included prairie rose (Rosa arkansana Porter). Fire and sand blowouts are the primary disturbance factors that maintain this site, while periodic drought and herbivory are secondary factors (Lesica and Cooper 1999; LANDFIRE 2009).

Associated sites

R107XA209IA	**Wet Upland Sedge Meadow** Loess or loamy sediments on uplands (slopes less than two percent) that are shallow to the water table including Gillett Grove, Letri, Marcus, Rushmore, and Spicer
R107XA206IA	**Outwash Upland Prairie** Glacial outwash on outwash plains including Allendorf, Estherville, Hawick, Kanaranzi, Kanaranzi variant, Kato, May City, Salida, and Wadena
R107XA201IA	**Loess Upland Prairie** Calcareous glacial till on uplands including Moneta and Steinauer
R107XA205IA	**Loamy Sediment Upland Prairie** Loamy sediments on uplands including Bolan, Bolan variant, Dickman, Everly, Fostoria, and Ocheyedan

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
R107XA205IA	**Loamy Sediment Upland Prairie** Loamy Sediment Upland Prairies are derived from fine-loamy sediments
R107XA206IA	**Outwash Upland Prairie** Outwash Upland Prairies are derived from glacial outwash
R107XA201IA	**Loess Upland Prairie** Loess Upland Prairies are derived from loess and have a higher soil fertility that supports greater vegetative cover, productivity and species composition

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Calamovilfa longifolia* (2) *Sporobolus cryptandrus*

Physiographic features

Sandy Dry Prairies occur on upland flats and hillslopes and on outwash plains on stream terraces (Figure 2). They are situated on elevations ranging from approximately 699 to 1706 feet ASL. The site does not experience flooding but rather generates runoff to adjacent, downslope ecological sites.

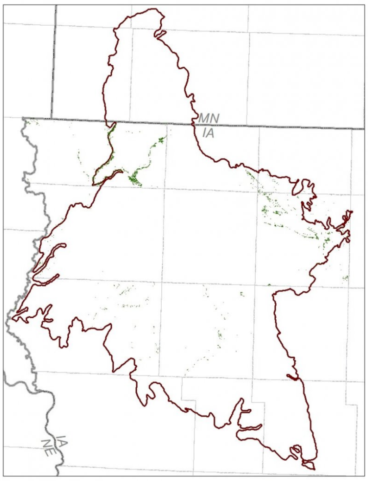


Figure 2. Figure 1. Location of Sandy Dry Prairie ecological site within MLRA 107A.

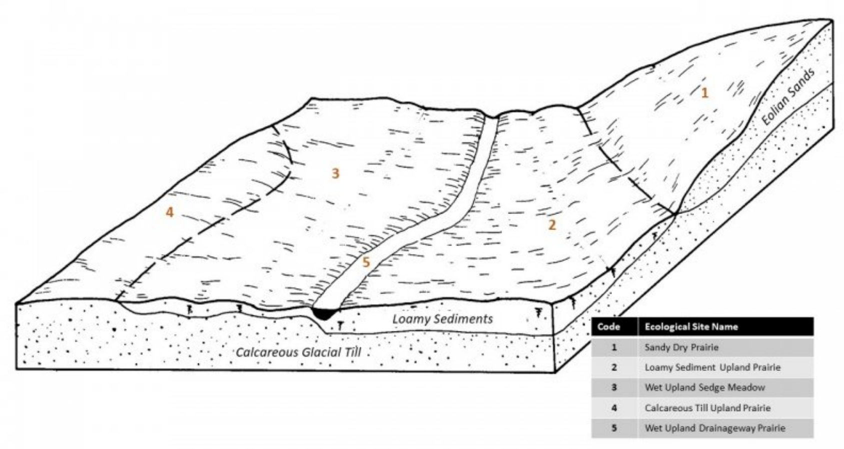


Figure 3. Figure 2. Representative block diagram of Sandy Dry Prairie and associated ecological sites.

Table 2. Representative physiographic features

Slope shape across	(1) Linear (2) Convex
Slope shape up-down	(1) Linear (2) Convex
Landforms	(1) Upland > Flat (2) Outwash plain
Runoff class	Very low to low
Elevation	699–1,706 ft

Slope	2–14%
Water table depth	80 in
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 160 days, while the frost-free period is about 140 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 31 inches, which includes rainfall plus the water equivalent from snowfall (Table 3). The average annual low and high temperatures are 35 and 57°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)	125-133 days
Freeze-free period (characteristic range)	147-149 days
Precipitation total (characteristic range)	29-30 in
Frost-free period (actual range)	121-137 days
Freeze-free period (actual range)	140-149 days
Precipitation total (actual range)	28-31 in
Frost-free period (average)	128 days
Freeze-free period (average)	146 days
Precipitation total (average)	30 in

Climate stations used

- (1) PRIMGHAR [USC00136800], Primghar, IA
- (2) ROCK RAPIDS [USC00137147], Rock Rapids, IA
- (3) CHEROKEE [USC00131442], Cherokee, IA
- (4) LE MARS [USC00134735], Le Mars, IA
- (5) SHELDON [USC00137594], Sheldon, IA
- (6) SPENCER 1 N [USC00137844], Spencer, IA

Influencing water features

Sandy Dry Prairies are not influenced by wetland or riparian water features. Precipitation is the main source of water for this ecological site. Infiltration is high (Hydrologic Group A), and surface runoff is very low to low. 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 (Prior et al. 2003). Surface runoff contributes some water to downslope ecological sites (Figure 5).

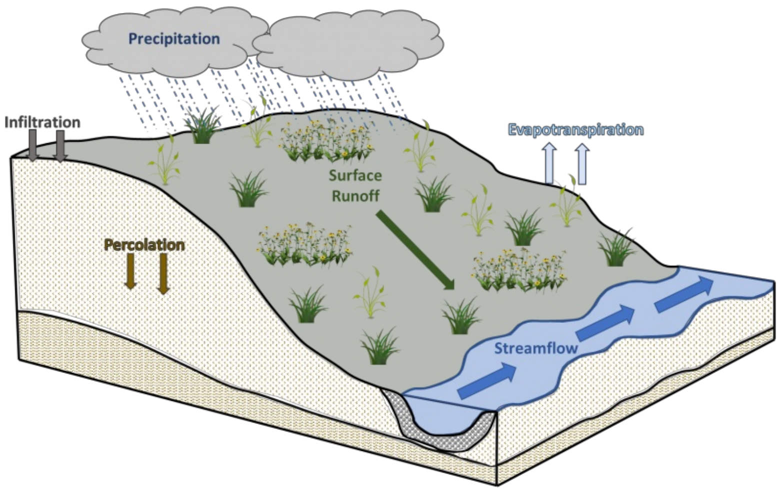


Figure 8. Figure 5. Hydrologic cycling in Sandy Dry Prairie ecological site.

Soil features

Soils of Sandy Dry Prairies are in the Mollisols and Inceptisols orders, further classified as Entic Hapludolls, Typic Hapludolls, Typic Dystrudepts, and Typic Eutrudepts with high infiltration and very low to low runoff potential. The soil series associated with this site includes Dickman, Hoopeston variant, Roine, and Sparta (Figure 6). The parent material is eolian sediments, and the soils are moderately well to somewhat excessively-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).

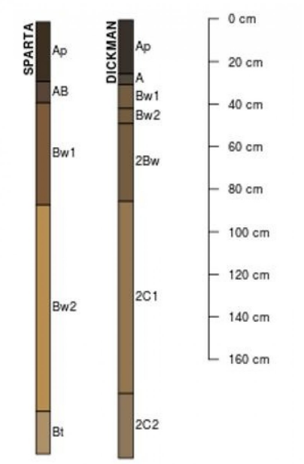


Figure 9. Figure 6. Profile sketches of soil series associated with Sandy Dry Prairie.

Table 4. Representative soil features

Parent material	(1) Eolian deposits
Family particle size	(1) Sandy (2) Coarse-loamy
Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Slow to moderate
Soil depth	80 in

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). Sandy Dry Prairies form an aspect of this vegetative continuum. This ecological site occurs on upland flats and hillslopes and on outwash plains on stream terraces on well to somewhat excessively drained soils. Due to the dominantly northwest winds of the MLRA and the eolian nature of the parent material, this ecological site most often occurs on the east side of major rivers. Species characteristic of this ecological site consist of herbaceous vegetation adapted to xeric conditions and low soil fertility.

The vegetation of Sandy Dry Prairies can be sparse and patchy making fire a limited, but important, ecosystem driver for maintaining this ecological site. Fire intensity typically consisted of periodic, low-intensity surface fires occurring every 1 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). This continuous disturbance provided critical conditions for perpetuating the native sand prairie ecosystem (MDNR 2005).

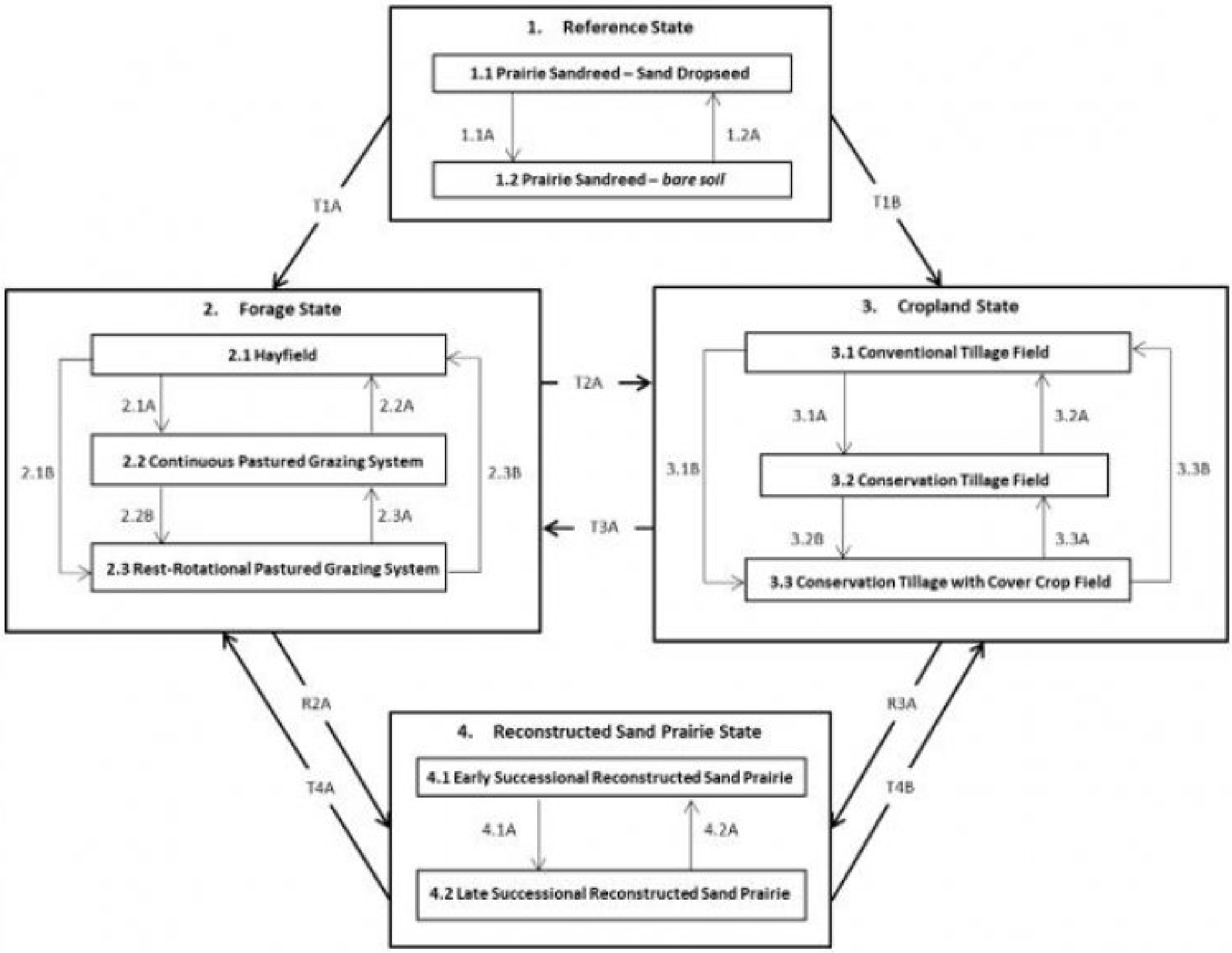
Sand blowouts are another disturbance factor that shape this ecological site. The high sand content coupled with increasing slopes allows for much erosion or shifting, creating numerous bare soil pockets across the site. These conditions result in an early-successional phase as evidenced by a reduced vegetative cover and low plant diversity (MDNR 2005).

Drought and grazing by native ungulates have also played a role in shaping this ecological site. The periodic episodes of reduced soil moisture in conjunction with the well to somewhat excessively-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. Large mammals, specifically prairie elk (Cervus elaphus) and white-tailed deer (Odocoileus virginianus), likely occurred in low densities resulting in limited impacts to plant composition and dominance (LANDFIRE 2009). When coupled with fire, periods of drought and herbivory can greatly delay the establishment of woody vegetation (Pyne et al. 1996).

Today, Sandy Dry Prairies are likely extirpated, having been converted to agricultural 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

R107AY207IA Sandy Dry 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	Sand blowout or fire
1.2A	Natural succession in the absence of 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	Tillage, forage crop planting, and mechanical harvesting replace grazing
2.2B	Implementation of rest-rotational grazing
2.3A	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, and 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 xeric plant community, dominated by herbaceous vegetation.

The two community phases within the reference state are dependent on fire and sand blowouts. The timing, duration, and extent of these natural disturbances alters species composition, cover, and extent, and regular fire intervals keep woody species from dominating. Prolonged drought and herbivory have more localized impacts on the reference phases but do contribute to overall species composition, diversity, cover, and productivity.

Dominant plant species

- prairie sandreed (*Calamovilfa longifolia*), grass
- sand dropseed (*Sporobolus cryptandrus*), grass

Community 1.1
Prairie Sandreed - Sand Dropseed

Prairie Sandreed – Sand Dropseed – Sites in this reference community phase can be somewhat open with vegetation cover as low as 50 percent. The dominant grasses include prairie sandreed, sand dropseed, little bluestem, sideoats grama, and sun sedge (*Carex inops* L.H. Bailey ssp. heliophila (Mack.) Crins). Characteristic forbs include aromatic aster, Cuman ragweed (*Ambrosia psilostachya* DC.), large beardtongue (Penstemon grandifloras Nutt.), and prairie spiderwort (*Tradescantia occidentalis* (Britton) Smyth). Sparse shrubs can occur (typically less than five percent cover) and include prairie rose. (MDNR 2005; NatureServe 2015).

Dominant plant species

- prairie sandreed (*Calamovilfa longifolia*), other herbaceous
- sand dropseed (*Sporobolus cryptandrus*), other herbaceous

Community 1.2
Prairie Sandreed - bare soil

Prairie Sandreed – bare soil – This community phase represents a recent disturbance event such as slope failure or fire that subsequently reduces the vegetative cover and exposes bare soil. Prairie sandreed is highly effective at re-colonizing exposed sands and likely forms the dominant component of this successional phase (Hauser 2005).

Dominant plant species

- prairie sandreed (*Calamovilfa longifolia*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

Sand blowout or fire

Pathway 1.2A
Community 1.2 to 1.1

Natural succession in the absence of disturbances

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, the non-native species were able to spread and expand across the prairie ecosystem, reducing the native species diversity and ecological function.

Community 2.1
Hayfield

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 2.2
Continuous Pastured Grazing System

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 2.3
Rest-Rotation Pastured Grazing System

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 2.1A
Community 2.1 to 2.2

Mechanical harvesting is replaced with domestic livestock and continuous grazing

Pathway 2.1B
Community 2.1 to 2.3

Mechanical harvesting is replaced with domestic livestock and rest-rotational grazing

Pathway 2.2A
Community 2.2 to 2.1

Tillage, forage crop planting and mechanical harvesting replace grazing

Pathway 2.2B
Community 2.2 to 2.3

Implementation of rest-rotational grazing

Pathway 2.3B
Community 2.3 to 2.1

Tillage, forage crop planting and mechanical harvesting replace grazing

Pathway 2.3A
Community 2.3 to 2.2

Implementation of continuous grazing

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.

Community 3.1
Conventional Tillage Field

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 3.2
Conservation Tillage Field

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 3.3
Conservation Tillage with Cover Crop Field

Conservation Tillage with Cover 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 3.1A
Community 3.1 to 3.2

Less tillage, residue management

Pathway 3.1B
Community 3.1 to 3.3

Less tillage, residue management and implementation of cover cropping

Pathway 3.2A
Community 3.2 to 3.1

Intensive tillage, remove residue and reinitialize monoculture row cropping

Pathway 3.2B
Community 3.2 to 3.3

Implementation of cover cropping

Pathway 3.3B
Community 3.3 to 3.1

Intensive tillage, remove residue and reinitialize monoculture row cropping

Pathway 3.3A
Community 3.3 to 3.2

Remove cover cropping

State 4
Reconstructed Sandy 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).

Community 4.1
Early Successional Reconstructed Sand Prairie

Early Successional Reconstructed Sand 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 cool-season and warm-season annual and perennial grasses and forbs typical of the reference state (e.g., prairie sandreed, sand dropseed, sideoats grama, large beardtongue). Cool-season annuals can help 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 a majority of the vegetative cover. Control of non-native species, particularly perennial species, is crucial at this point to ensure they do not establish before the native vegetation (Martin and Wilsey 2012). After the first season, native warm-season grasses should begin to become more prominent on the landscape.

Community 4.2
Late Successional Reconstructed Sand Prairie

Late Successional Reconstructed Sand 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 function (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 greater ecosystem complexity (Wilsey 2008).

Pathway 4.1A
Community 4.1 to 4.2

Invasive species control and implementation of disturbance regimes

Pathway 4.2A
Community 4.2 to 4.1

Drought or improper timing/use of management actions

Transition T1A
State 1 to 2

Cultural treatments are implemented to increase forage quality and yield

Transition T1B
State 1 to 3

Agricultural conversion via tillage, seeding and non-selective herbicide

Transition T2A
State 2 to 3

Agricultural conversion via tillage, seeding and non-selective herbicide

Transition R2A
State 2 to 4

Site preparation, non-native species control and native seeding

Restoration pathway T3A
State 3 to 2

Cultural treatments are implemented to increase forage quality and yield

Transition R3A
State 3 to 4

Site preparation, non-native species control and native seeding

Restoration pathway T4A
State 4 to 2

Cultural treatments are implemented to increase forage quality and yield

Restoration pathway T4B
State 4 to 3

Agricultural conversion via tillage, seeding and non-selective herbicide

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 the sources identified in ecological site description.

Other references

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Contributors

Lisa Kluesner
Dan Pulido

Approval

Chris Tecklenburg, 5/21/2020

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editing, and conducting quality control and quality assurance reviews.

Table 6. List of primary contributors and reviewers.

Organization Name Title Location

Drake University:
Dr. Tom Rosburg, Professor of Ecology and Botany, Des Moines, IA

Iowa Department of Natural Resources:
John Pearson, Ecologist, Des Moines, IA

LANDFIRE (The Nature Conservancy):
Randy Swaty, Ecologist, Evanston, IL

Natural Resources Conservation Service:
Rick Bednarek, Iowa State Soil Scientist, Des Moines, IA
Patrick Chase, Area Resource Soil Scientist, Fort Dodge, IA
Stacey Clark, Regional Ecological Site Specialist, St. Paul, MN
James Cronin, State Biologist, Des Moines, IA
Tonie Endres, Senior Regional Soil Scientist, Indianapolis, IN
John Hammerly, Soil Data Quality Specialist, Indianapolis, IN
Lisa Kluesner, Ecological Site Specialist, Waverly, IA
Sean Kluesner, Earth Team Volunteer, Waverly, IA
Jeff Matthias, State Grassland Specialist, Des Moines, IA
Louis Moran, PhD, Area Resource Soil Scientist, Sioux City, IA
Kevin Norwood, Soil Survey Regional Director, Indianapolis, IN
Doug Oelmann, Soil Scientist, Des Moines, IA
James Phillips, GIS Specialist, Des Moines, IA
Dan Pulido, Soil Survey Leader, Atlantic, IA
Jason Steele, Area Resource Soil Scientist, Fairfield, IA
Doug Wallace, Ecological Site Specialist, Columbia, MO

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	05/11/2025
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:**