USDA Natural Resources Conservation Service

Ecological site R103XY011MN
Footslope/Drainageway Prairies

Last updated: 10/04/2023
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.

MLRA notes

Major Land Resource Area (MLRA): 103X–Central Iowa and Minnesota Till Prairies

MLRA 103 is in Minnesota (56 percent) and Iowa (44 percent) and consists of approximately 18 million acres. It is in the Western Lake Section of the Central Lowland Province of the Interior Plains in an area known as the "Des Moines Lobe" of the Wisconsin-age ice sheet. The MLRA is mostly on a young, nearly level to gently rolling, glaciated till plain that has moraines and glacial lake plains in some areas. The plain is covered with glacial till, outwash, and glacial lake deposits. Recent alluvium consisting of clay, silt, sand, and gravel fill the bottoms of most of the major river valleys. Paleozoic bedrock sediments, primarily shale and limestone, underlie the glacial deposits in most of the area.

The annual precipitation increases from northwest to southeast. Most of the rainfall occurs as high-intensity, convective thunderstorms during the summer. Two-thirds or more of the precipitation falls during the freeze-free period. Snowfall is common in winter. Ground water supplies are adequate for the domestic, livestock, municipal, and industrial needs. Nearly all of this area is farmland, and about four-fifths is cropland.

Classification relationships

Major Land Resource Area (MLRA): Central Iowa and Minnesota Till Prairies (103) (USDA Handbook 296, 2006)

USFS Subregions: North Central Glaciated Plains Section (251B); Upper Minnesota River-Des Moines Lobe (251BA) and Southern Des Moines Lobe (251Be) Subsections (Cleland et al. 2007)

Relationship to Other Established Classifications:
The reference community has similarities to Minnesota Department of Natural Resources UPs23 Southern Mesic Prairie

Ecological site concept

The Footslope/Drainageway Prairies ecological site are located on mainly on footslopes, toeslopes, and upland drainageways. Soils are slope alluvial in origin. The site may incur frequent but very brief flooding, and the available water capacity is high (9-12 inches).

Associated sites

R103XY004MN	**Loamy Upland Prairies** The Loamy Upland Prairies ecological site is located on uplands extensively throughout MRLA 103. Soils are formed from fine loamy till and medium textured lacustrine materials. Soil drainage is somewhat poorly drained to well drained. This site does not flood or pond and is extensive throughout MLRA 103.

F103XY032MN	**Loamy Floodplains** The Loamy Floodplains ecological site is located on medium textured alluvium throughout MRLA 103. Soils textures include loam, silt loam, sandy loam and fine sandy loam. Some areas within this ecological site will exhibit long-term flooding (7-30 days).
R103XY002MN	**Calcareous Upland Prairies** The Calcareous Upland Prairies ecological site is located on upland calcareous soils that do not flood or pond. Soils developed under prairie vegetation, and the soil drainage class include somewhat poorly drained to well drained.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Amorpha canescens*
Herbaceous	(1) *Andropogon gerardii* (2) *Spartina pectinata*

Physiographic features

The Footslope/Drainageway Prairies ecological site is often located at the base of steep sloping areas on ground moraines, till plains, valleys, and end or lateral moraines throughout MLRA 103. Specifically, this site occurs on footslope and drainageway positions. Some areas within this ecological site may flood frequently but very briefly.

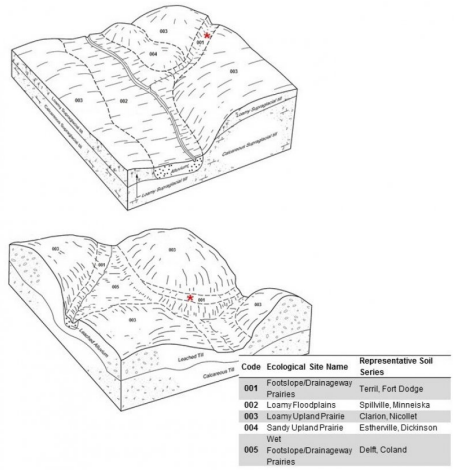


Figure 1. Block diagrams of the representative Footslope/Drainageway and associated ecological sites.

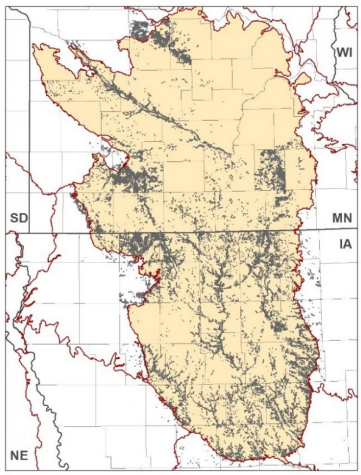


Figure 2. Distribution of the Footslope / Drainageway ecological site within MLRA 103. In many cases, the data set is not spatially consistent across political boundaries due to the method by which soils were mapped; e.g. due to county subsets.

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope
Landforms	(1) Ground moraine (2) End moraine (3) Lateral moraine (4) Till plain (5) Valley
Runoff class	Low to very high
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	Frequent
Elevation	210–560 m
Slope	0–60%
Water table depth	30–203 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The soil temperature regime of MLRA 103 is classified as “mesic” (i.e., mean annual soil temperature between 46 and 59°F). The average freeze-free period of this site is 156 days, while the frost-free period is 132 days. The average mean annual precipitation is 32 inches, which includes rainfall plus the water equivalent from snowfall. Cold air drainage from above and the fact that footslope soils are generally colder than higher soils make this ecological site colder than adjacent, upslope areas. As a result, snow and frost remain longer in the spring, thus resulting in shorter growing seasons than the adjacent uplands.

Table 3. Representative climatic features

Frost-free period (characteristic range)	128-136 days
Freeze-free period (characteristic range)	150-162 days
Precipitation total (characteristic range)	762-889 mm
Frost-free period (actual range)	127-139 days
Freeze-free period (actual range)	144-168 days
Precipitation total (actual range)	737-940 mm
Frost-free period (average)	132 days
Freeze-free period (average)	156 days
Precipitation total (average)	813 mm

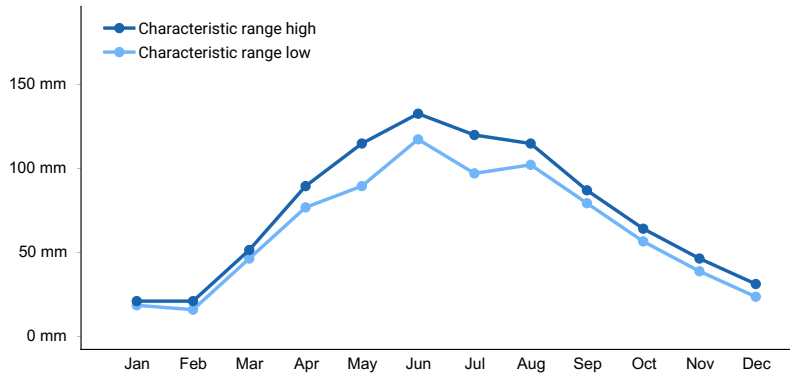


Figure 3. Monthly precipitation range

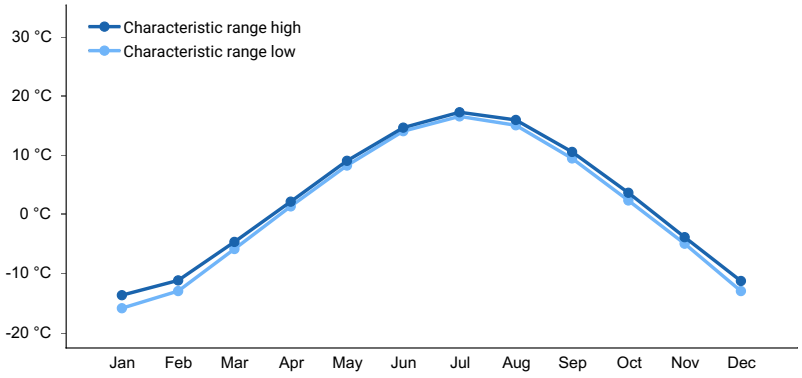


Figure 4. Monthly minimum temperature range

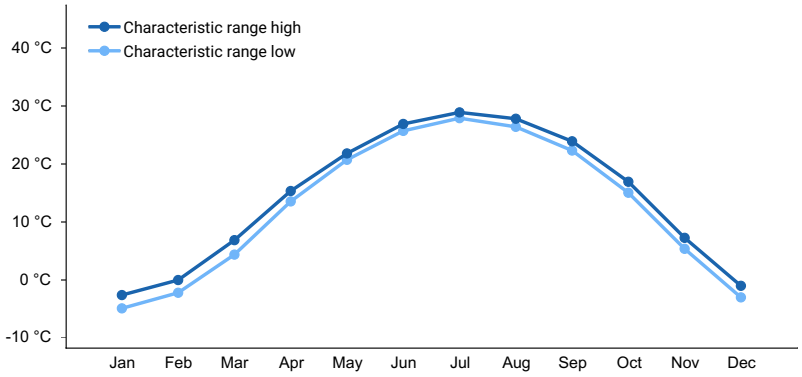


Figure 5. Monthly maximum temperature range

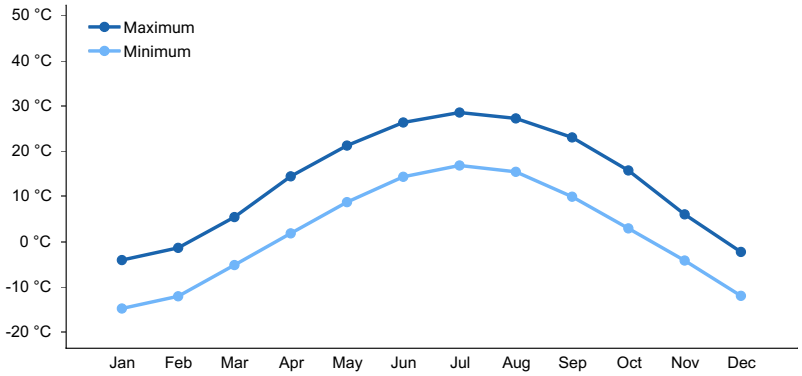


Figure 6. Monthly average minimum and maximum temperature

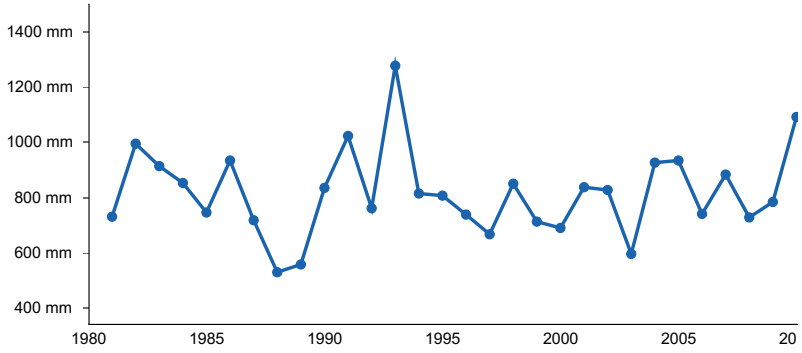


Figure 7. Annual precipitation pattern

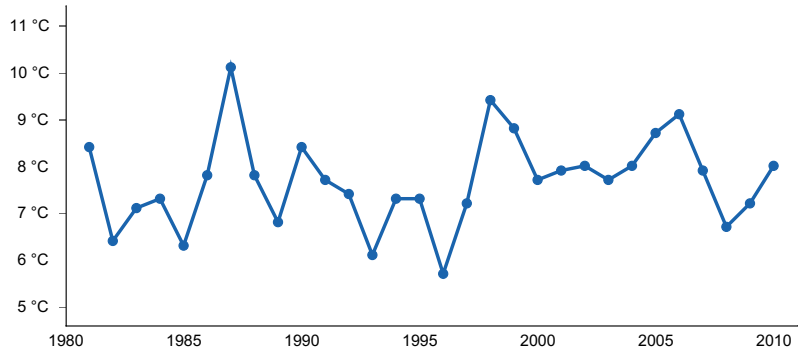


Figure 8. Annual average temperature pattern

Climate stations used

- (1) STEWART [USC00218025], Brownton, MN
- (2) WINNEBAGO [USC00219046], Winnebago, MN
- (3) FAIRMONT [USC00212698], Fairmont, MN
- (4) LAKEFIELD 2NE [USC00214453], Lakefield, MN
- (5) WEBSTER CITY [USC00138806], Webster City, IA
- (6) LITCHFIELD [USC00214778], Litchfield, MN
- (7) BOONE [USC00130807], Boone, IA
- (8) LAKE PARK [USC00134561], Lake Park, IA
- (9) ALBERT LEA 3 SE [USC00210075], Albert Lea, MN

Influencing water features

The Footslope/Drainageway Prairies ecological site primarily receives water through lateral subsurface flow from the higher adjacent ground. During most months, especially the warmer ones, this site also receives runoff and precipitation; however, these are minor water sources compared to the subsurface groundwater table. During the spring months some of the included soils can be flooded for very brief duration. Soils are classified as endosaturated, which means that soil saturation comes from below. The water table is typically between 12 and 25 inches from the surface during the spring and may drop to as low as 6 or more feet later in the growing season during dry periods.

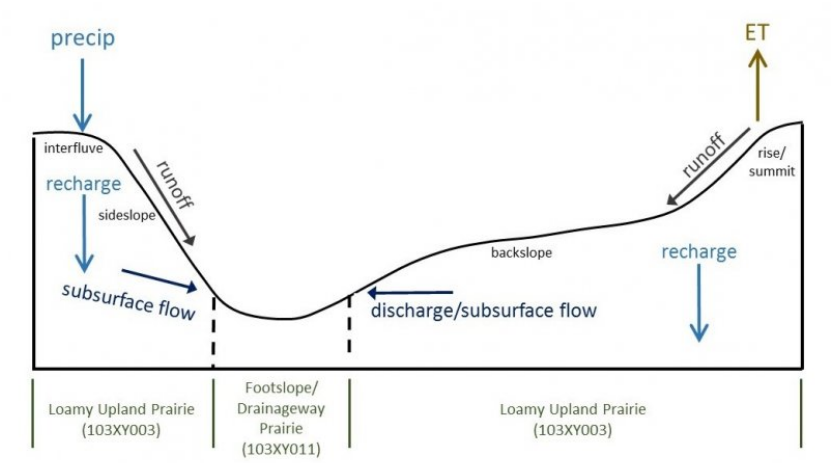


Figure 9. Hydrologic representation of a typical Des Moines Lobe (MLRA 103) Footslope-Drainageway Prairie and associated Provisional Ecological Sites.

Soil features

Soil series include Ankeny, Arctander, Danielson, Delft, Derrynane, Fort Dodge, Ridgeton, Spillville, and Terril. These soils are slope alluvial in origin and have a drainage class and moisture status that makes them drier than hydric. They are composed of mineral soil material and often have irregular decreases in carbon from the surface.

Taxonomic subdivisions are Cumulic Hapludolls (Terril, Spillville, Ankenny, Arctander, Delft), Cumulic Vertic Hapludolls (Danielson and Derrynane), and Pachic Hapludolls (Ridgeton). Pachic Hapludolls, like Ridgeton, also have thick Mollic epipedons but have an irregular decrease in carbon. Most of the soils in this group are Cumulic Hapludolls. The surface texture is variable within the fine, fine-loamy, or coarse-loamy family. The subsurface, below the mollic epipedon, can be stratified, sometimes strongly stratified. The subsurface textural group, like the surface horizon is also fine, fine-loamy, or coarse loamy, and in some cases, there is a sandy second parent material. These soils are slope alluvial materials derived mostly from original Des Moines lobe materials, except in some cases where a second parent material exists in the series control that is more reflective of loamy or sandy Des Moines lobe materials.

Table 4. Representative soil features

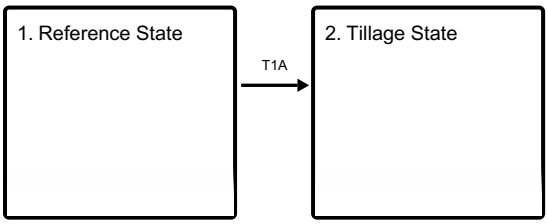
Parent material	(1) Slope alluvium
Surface texture	(1) Loam (2) Sandy loam (3) Clay loam (4) Sandy clay loam (5) Silt loam (6) Fine sandy loam
Drainage class	Somewhat poorly drained to well drained
Permeability class	Slow to very rapid
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-152.4cm)	22.86–30.48 cm
Calcium carbonate equivalent (0-101.6cm)	0–30%
Soil reaction (1:1 water) (0-101.6cm)	5.6–8.4
Subsurface fragment volume <=3" (0-101.6cm)	0–15%
Subsurface fragment volume >3" (0-101.6cm)	0–5%

Ecological dynamics

The Footslope/Drainageway Prairies ecological site is characterized by two states: the Reference State (native prairie) and the Tillage State. In this model, two plant communities exist in the Reference State and are characterized by different fire return intervals. The mechanism of change between communities is fire frequency and the resulting effects fire has on the plant community. Grazing and drought can also be a triggers for change on this ecological site. The Tillage State describes areas that have been tilled and may have modified hydrology (ditching, tiling). Two communities make up the Tillage State: the Row Crop Community and the Seeded Grassland Community. Some areas of this ecological site are wooded; however, the percentage of acreage in MLRA 103 is small, so this community is not described within the current state and transition model.

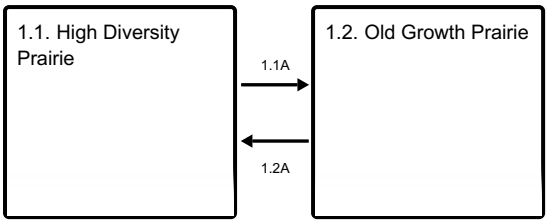
State and transition model

Ecosystem states



T1A - Transition to agriculture; tillage; seeding; continued management

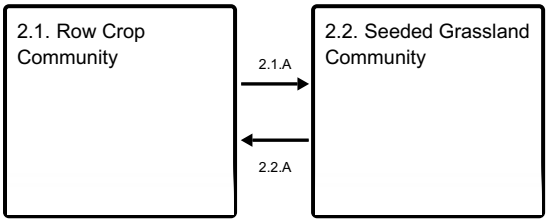
State 1 submodel, plant communities



1.1A - Fire return interval 3-5 years.

1.2A - Fire return interval less than 3 years

State 2 submodel, plant communities



2.1.A - Grass seeding; grassland management

2.2.A - Tillage; crop production

State 1
Reference State

The Footslope/Drainageway Prairies ecological site reference plant community is a diverse native tallgrass prairie. Community phases within the model Reference State are dependent upon the frequency of fire events. Fire is a trigger that promotes continued herbaceous vegetation dominance. Fire removes plant litter, helps cycle nutrients, and allows light to reach the seedbed. Frequent fire maintains the community in a grassland state, by keeping fire-sensitive woody species from proliferating and gaining dominance. A secondary trigger for this site can be grazing. Intensive grazing can reduce the extent of highly palatable species thereby allowing the growth of less desirable plants to increase. High-quality, untilled areas of this ecological site are extremely uncommon. Most remaining prairie areas that are managed for tallgrass prairie were once utilized for agricultural production. It is therefore likely that many historically present, native prairie species are extirpated even from these sites.

Resilience management. Prescribed fire and managed grazing are key resilience management practices.

Dominant plant species

- leadplant (*Amorpha canescens*), shrub
- big bluestem (*Andropogon gerardii*), grass
- prairie cordgrass (*Spartina pectinata*), grass

Community 1.1
High Diversity Prairie

This plant community is influenced primarily by fire return intervals of less than 3 years. Frequent fire will reduce the extent of woody species and will maintain the natural dominance and diversity of native grasses and forbs. The composition of forb species is diverse on high-quality sites; however, a suite of diagnostic forbs is yet to be developed.

Resilience management. Prescribed fire and managed grazing are key resilience management practices. This is a stable plant community when grazing and fire are adequately managed.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- prairie cordgrass (*Spartina pectinata*), grass

Community 1.2
Old Growth Prairie

This plant community is characterized by a fire return interval of 3 to 5 years, which is longer than that of Community 1.1. Native grasses are still dominant, but more woody species are present due to the longer fire return times. Thatch and dead plant residue are denser than in Community 1.1. Thatch increases in abundance annually and can reduce herbaceous plants through blockage and shading.

Resilience management. Prescribed fire and grazing are resilience management practices. Although this community has a longer fire return interval than Community 1.1, it also relies on fire and grazing to maintain vegetation community structure.

Dominant plant species

- leadplant (*Amorpha canescens*), shrub
- big bluestem (*Andropogon gerardii*), grass
- prairie cordgrass (*Spartina pectinata*), grass

Pathway 1.1A
Community 1.1 to 1.2

Fire is the primary trigger that affects the plant community composition. The frequency of fire is the primary factor affecting the transition from Community 1.1 and Community 1.2. Pathway 1.1. Although fire frequency is the main driver of community change in this model, other triggers include grazing and drought.

Pathway 1.2A
Community 1.2 to 1.1

This pathway consists of a fire return interval of less than 3 years. Fire intolerant woody species are set back, and the amount of dead plant material that can slow new growth is reduced.

State 2
Tillage State

Tillage is the primary mechanism transitioning a site to this state. Tillage alters dynamic soil properties such as bulk density, structure, organic carbon content, and saturated hydraulic conductivity. Some areas in this ecological site are not appropriate for intensive crop production due to slope. Where the gradient exceeds 20 percent row crop production is not feasible due to limitations on farm machinery. Conservation practices can mitigate the impacts of traditional agricultural practices on soil health. Conservation tillage minimizes soil disturbance and can improve soil structure and overall soil health. Corn or soybean plantings and a cover crop rotation can build soil structure, improve infiltration rates, reduce runoff and erosion, and protect water quality. Most areas in this state will remain in use for crop production in the foreseeable future. Some tilled areas in MLRA 103 have been seeded back to grass. This may occur under a NRCS conservation program. Native forbs grasses are established to benefit wildlife and pollinators. Cool-season grasses are also feasible. Species selection will depend on the landowner's objectives and site specifics. Although cool-season grasslands are not biologically diverse, they still offer soil health and wildlife benefits. A tilled site may revert to a scrubby woodland without fire, grazing, or management inputs. However, this is a minor land use in MLRA 103, and not currently described within this model.

Resilience management. Disturbance management and harvest management are resilience management practices. The maintenance of this state requires that the intensity, frequency, duration, and timing of agricultural practices (disturbances) be managed to control or modify vegetation structure.

Dominant plant species

- corn (*Zea mays*), grass
- soybean (*Glycine max*), other herbaceous

Community 2.1
Row Crop Community

This plant community typically consists of intensively produced, traditional row crops. Tillage and intentional plant establishment (crop seeding) are the primary triggers for this community. The most common crops are corn and soybeans on an annual rotation. Agriculture practices will be limited by slope on some areas within this ecological site as slopes range from 0% to 60%. The Tillage State is only feasible for lower sloping areas.

Resilience management. Resilience management practices include continual agricultural practices such as seeding, fertilizing, and managing invasive plants with herbicides or field cultivation.

Dominant plant species

- corn (*Zea mays*), grass
- soybean (*Glycine max*), other herbaceous

Community 2.2
Seeded Grassland Community

This plant community grows in areas that were previously tilled but have been seeded to either warm-season or cool-season grasses. The primary trigger is the intentional establishment of a native or non-native grassland community. Native warm-season grasses are commonly planted through a NRCS conservation program. Landowners may choose to establish cool-season grasses such as Kentucky bluegrass, smooth brome, or reed canarygrass. Many of these areas are eventually transitioned to annual crop production.

Resilience management. The maintenance of the desired vegetation structure requires management of the intensity, frequency, duration, and timing of disturbances via agricultural practices. Practices include seeding, controlling weeds and brush, and applying fertilizer. Practices include seeding, controlling weeds and brush, and fertilizing. Prescribed fire is a resilience management practice on warm-season grasslands. The controlled application of fire modifies vegetation structure and influence ecological processes.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass

Pathway 2.1.A
Community 2.1 to 2.2

This pathway converts Community 2.1 (row crops) to Community 2.2 (seeded grassland). The primary mechanism of change is the seeding of desired grass species. This pathway is commonly triggered in conjunction with a conservation program such as the NRCS Conservation Reserve Program (CRP). The site is taken out of crop production and seeded with warm-season grasses to benefit wildlife, soil health, and water quality.

Conservation practices

Forage and Biomass Planting

Pathway 2.2.A
Community 2.2 to 2.1

This pathway converts seeded grassland to cropland. This is a common pathway throughout MLRA 103 as areas are placed in crop production.

Transition T1A

State 1 to 2

Transition T1A is the conversion of the reference state to agriculture. The triggers are tillage and intentional plant establishment (crop seeding). Hydrological modifications, such as ditching and tiling, may also be installed.

Constraints to recovery. Tillage and long-term intensive agricultural production generally preclude a return to State 1. Areas in row crop production may be placed in conservation programs and seeded with warm-season grasses, but will not exhibit the natural species diversity or ecological resiliency of State 1.

Additional community tables

Inventory data references

No field plots were available for this site. A review of the scientific literature and professional experience were used to approximate the plant communities for this provisional ecological site. Information for the state-and-transition model was obtained from the same sources. All community phases are considered provisional based on these plots and the sources identified in ecological site description.

Other references

Cleland, D.T., J.A. Freeouf, J.E. Keys, G.J. Nowacki, C. Carpenter, and W.H. McNab. 2007. Ecological Subregions: Sections and Subsections of the Conterminous United States. USDA Forest Service, General Technical Report WO-76. Washington, DC.

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Approval

Suzanne Mayne-Kinney, 10/04/2023

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	Suzanne Mayne-Kinney
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:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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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:**
