USDA Natural Resources Conservation Service

Ecological site R103XY008MN
Clayey Wet 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 state shares similarities with Minnesota Department of Natural Resources WPs54b Southern Wet Prairie

Ecological site concept

The Clayey Wet Prairie ecological site occurs predominantly on till plains and glacial lake plains, particularly in the area of Glacial Lake Minnesota physiographic area. Soils have a clayey texture and are poorly drained. These soils developed under prairie vegetation and have a dark colored surface horizons. This site has an inherent water table (i.e. endosaturated) and can have slow surface infiltration, causing seasonal perching. Plant communities are diverse and include grass, sedge, and forb dominated wet prairies and meadows. Due to the slow infiltration rate of the soil, this is is comparatively wetter than other wet prairies sites in MLRA 103. As a result, average cover of wetland plant species is higher than most wet prairies. In some cases, sedge-dominated plant communities trending toward wet meadows may occur.

Associated sites

R103XY005MN	**Clayey Upland Prairies** The Clayey Upland Prairies ecological site is located on uplands, including lakeplains, ground moraines, and till plains. Soils in this ecological site have a dark surface layer (mollic epipedon) and clayey textures. This site is not subject to flooding or ponding. Drainage class is somewhat poorly drained to well drained.
R103XY016MN	**Organic Marsh** The Organic Marsh ecological site occurs in the centers of medium to large-sized depressions and is typically surrounded by mineral soils associated with the Depressional Marsh ecological site. Soils are very poorly drained and ponded with deep water throughout the growing season in most years (i.e. semi-permanent wetlands). Soils are developed from organic parent materials.
R103XY014MN	**Recharge Depressions** The Recharge Depressions ecological site ponded in the natural state and soils are classified as very poorly drained. Soils have a relatively high organic matter content in the surface and near surface horizons. Hydrologic interactions with adjacent sloping ground classifies this site as a recharge wetland.

Similar sites

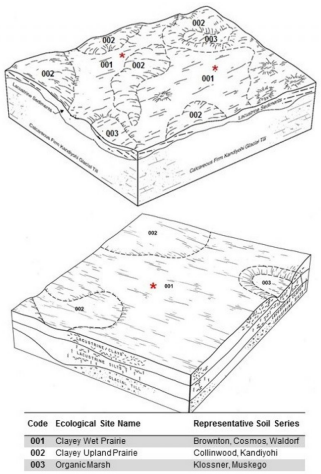
R103XY009MN	**Calcareous Rim Prairies** The Calcareous Rim Prairies ecological site is characterized by landscape position (rim), calcareous soils, low slope (0-2%), and poorly drained soils. This site is hydrologically connected to adjacent ponded depressions. This site does not pond.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Spartina pectinata* (2) *Carex pellita*

Physiographic features

The Clayey Wet Prairies ecological site is common in the Glacial Lake Minnesota physiographic area, near the central part of the MLRA 103. This site also occurs as isolated glacial lacustrine deposits within broader till plain landscapes. As a result, the fine-textured lacustrine materials are often thinner than the series control section (200cm), and landforms may appear like those derived by characteristic Des Moines Lobe glacial till. Landscapes have poorly integrated drainage networks. The site is typically are part of a broader semi-closed wetland basin and is hydrologically connected to adjacent ponded depressions. As a result, delineations of these areas often are irregularly shaped, usually surrounding multiple depressions of varying sizes. The term “low gradient linear segment” best describes the landscape position of Clayey Wet Prairies. Low relief 0 to 2 percent linear slopes with fine soil textures interact to make this ecological site wetter than the adjacent upslope areas but drier than adjacent downslope depressional areas. Subtle and uneven areas of swales or depressions may occur. The low slope gradient and linear to slightly concave slope shape are the most defining parameters. As a result, these sites do not typically pond water. However, the water table is usually at or near the soil surface during the spring months.



Code	Ecological Site Name	Representative Soil Series
001	Clayey Wet Prairie	Brownton, Cosmos, Waldorf
002	Clayey Upland Prairie	Collinwood, Kandiyohi
003	Organic Marsh	Klossner, Muskego

Figure 1. Representative block diagram of Clayey Wet Prairies and associated Provisional Ecological Sites.

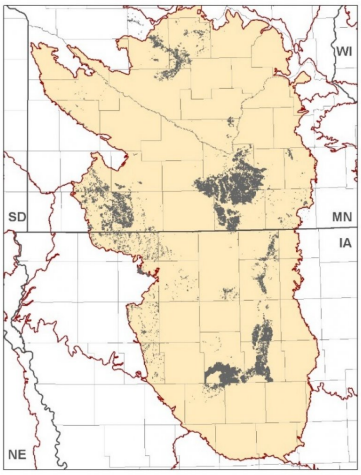


Figure 2. Distribution of Clayey Wet Prairies within MLRA 103. In many cases, data is not spatially consistent across political boundaries due to the method with which soils were mapped; e. g. county subsets.

Table 2. Representative physiographic features

Landforms	(1) Glacial lake (2) Till plain
Runoff class	Negligible to low
Elevation	210–560 m
Slope	0–2%
Ponding depth	0 cm
Water table depth	0–122 cm
Aspect	Aspect is not a significant factor

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 ecological site is 151 days, while the frost-free period is 128 days. Average mean annual precipitation is 30 inches, which includes rainfall plus the water equivalent from snowfall. Cold air drainage from above and the fact that wet soils are generally colder than dry soils make this site colder than adjacent, upslope sites. 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)	127-128 days
Freeze-free period (characteristic range)	149-152 days
Precipitation total (characteristic range)	762-787 mm
Frost-free period (actual range)	127-128 days
Freeze-free period (actual range)	148-153 days
Precipitation total (actual range)	762-787 mm
Frost-free period (average)	128 days
Freeze-free period (average)	151 days
Precipitation total (average)	762 mm

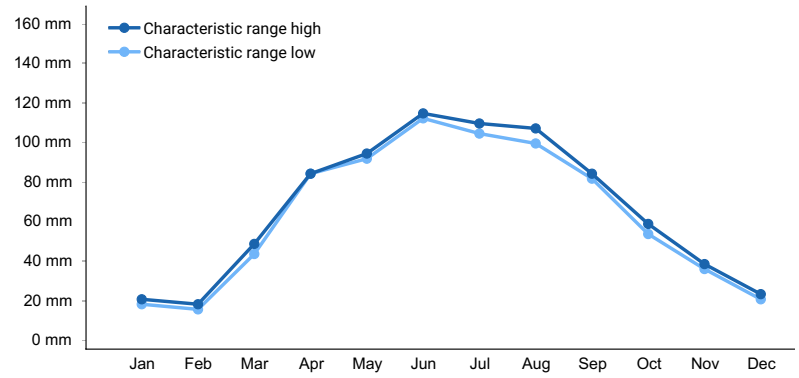


Figure 3. Monthly precipitation range

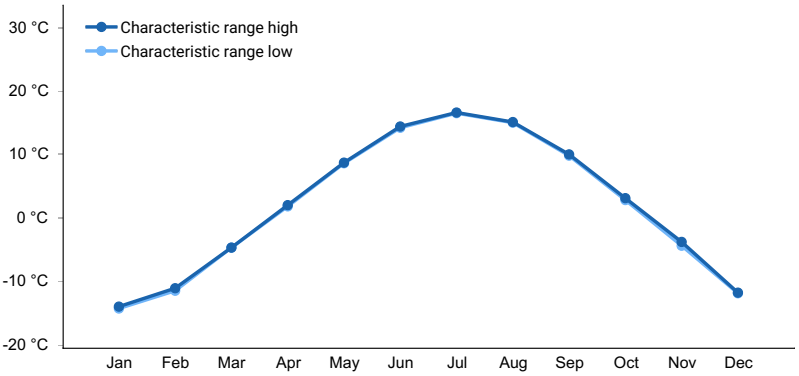


Figure 4. Monthly minimum temperature range

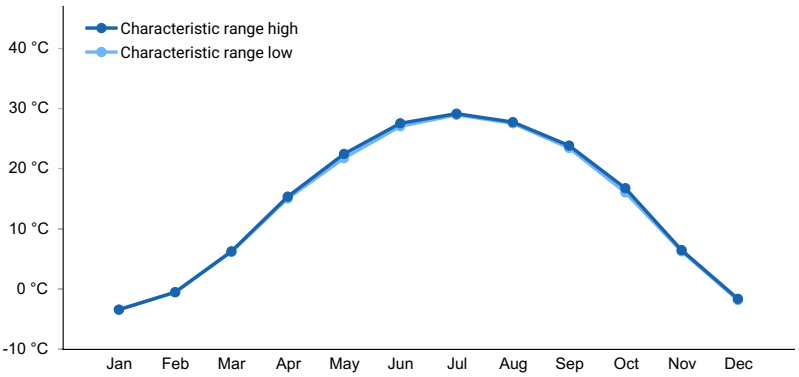


Figure 5. Monthly maximum temperature range

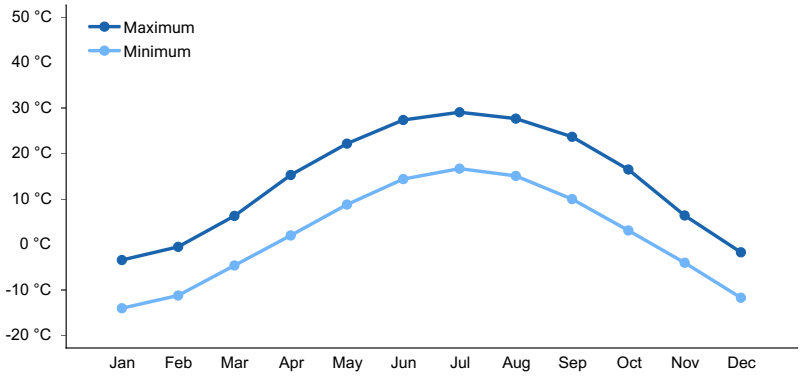


Figure 6. Monthly average minimum and maximum temperature

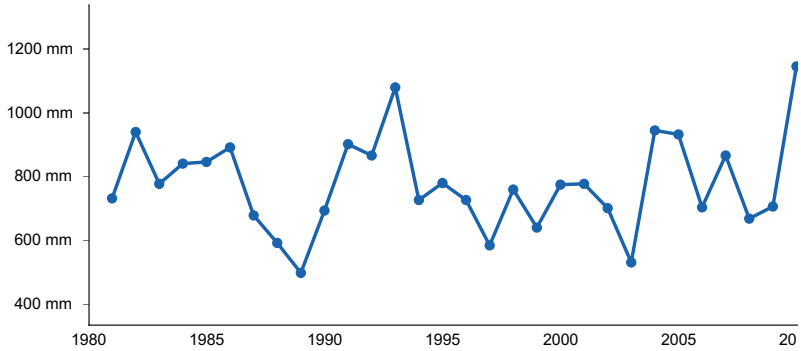


Figure 7. Annual precipitation pattern

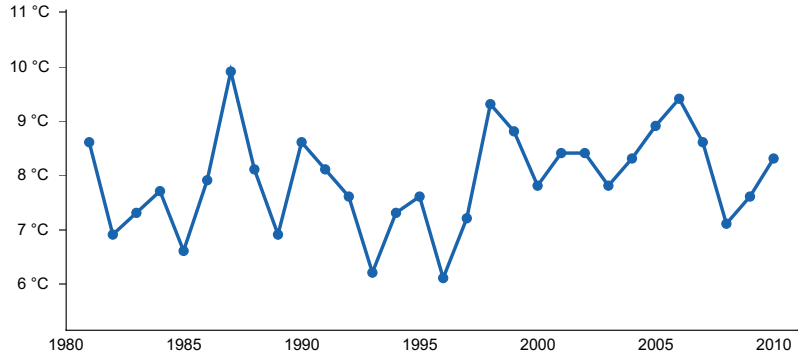


Figure 8. Annual average temperature pattern

Climate stations used

- (1) SPENCER 1 N [USC00137844], Spencer, IA
- (2) AMBOY [USC00210157], Amboy, MN

Influencing water features

With natural hydrology intact, the Clayey Wet Prairies ecological site receives water from three sources: direct precipitation, runoff, and recharge through base flow from adjacent uplands. In the spring months, this site can produce surface runoff. Soils are classified as endosaturated. Two soil series (Cosmos, Beauford) are associated with this site and are classified as episaturated.

The water table is at or near the soil surface during the spring months and may drop to as low as four feet later in the growing season during dry periods. In the hydrogeomorphic (HGM) classification system, the Clayey Wet Prairies ecological site is considered a Recharge Mineral Soil Flat, producing recharge to groundwater and adjacent depressional wetlands (USDA-NRCS, 2008; Gilbert et al., 2006). This site has a Saturated Cowardin Hydrologic Regime of Palustrine; Persistent Emergent Wetlands. It also has a United States Army Corps of Engineers Wetland Plant Community of D; Fresh (wet) Meadows, Sedge Meadows and Wet Prairies (Mineral Soils).

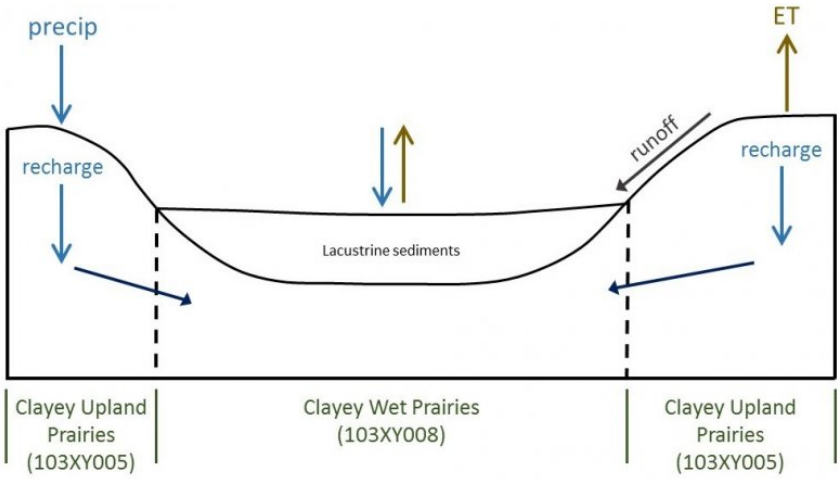


Figure 9. Hydrologic representation of a typical Des Moines Lobe (MLRA 103) Clayey Wet Prairies and associated Provisional Ecological Sites.

Soil features

Soil series include Beauford, Belmann, Brownton, Cosmos, Marna, and Waldorf. These mineral soils are rich in organic matter and developed under prairie vegetation. Prairie soils tend to have thick, nearly black, organic rich mollic epipedons. The central parent material for these soils includes clayey glacial lacustrine deposits, often in close association with typical glacial till below. Soils associated with the latter have lacustrine mantles ranging from 20 to 60 inches. Some soils may have a mantle of 20 to 40 inches of loamy drift over lacustrine materials (the Belmann series). Soil drainage class is poorly drained. The most common surface textures are clay, silty clay, silty clay loam, and clay loam. The subsurface textural group is classified as fine (35 to 60 percent clay) and very fine (greater than 60 percent clay).

Most of the soils are classified Mollisols with one Vertisol (Beauford) included. The most common taxonomic subgroup is Vertic Endoaquolls, indicating an endosaturated soil rich in high shrink-swell clays. Two series (Brownton, Belmann),are classified as having a calcareous reaction class.

These soils were formed under saturated conditions that produced anaerobic conditions during at least part of the year. Organic matter tends to mask the typical redoximorphic features used to determine seasonal high water table depths. Beneath the mollic epipedon, these soils have a depleted matrix with low chroma (2 or less) and high value (4 or more). The primary hydric soil indicators include: Depleted Below Dark Surface (A11), Thick Dark Surface (A12), and Redox Dark Surface (F6, option a; USDA-NRCS, 2010).

Table 4. Representative soil features

Parent material	(1) Lacustrine deposits–shale (2) Till–limestone (3) Slope alluvium (4) Glaciofluvial deposits
Surface texture	(1) Clay (2) Silty clay (3) Clay loam (4) Silty clay loam (5) Silt loam (6) Loam
Drainage class	Poorly drained
Permeability class	Slow to moderate
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–1%

Available water capacity (0-101.6cm)	17.78–30.48 cm
Calcium carbonate equivalent (0-101.6cm)	0–30%
Soil reaction (1:1 water) (0-101.6cm)	5.6–8.1
Subsurface fragment volume <=3" (0-101.6cm)	0–10%
Subsurface fragment volume >3" (0-101.6cm)	0–1%

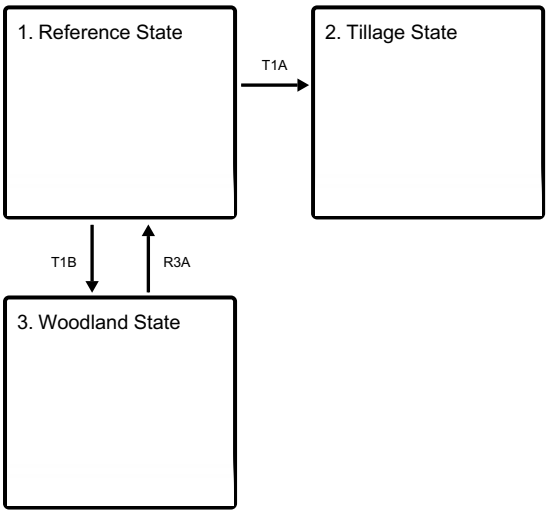
Ecological dynamics

The Clayey Wet Prairies ecological site is characterized by three states: the Reference State, the Tillage State, and the Woodland State. The Reference State is a wet prairie with a diversity of native grasses, sedges, and forbs tolerant of poorly drained soils. The state has two plant communities that are characterized by different fire return intervals. The Tillage State describes sites that have been tilled and generally have modified hydrology (ditching, tiling). The Woodland State describes a disturbed community dominated by trees. Species on these sites will vary depending on the hydrology, disturbances, and seed sources.

Reference plant communities are characterized as wet prairie, which include a diversity of grasses, sedges, and forbs characteristic of poorly drained conditions. Prairie cordgrass (*Spartina pectinata* Bosc ex Link) is indicative of wetland conditions. Other grasses include big bluestem (*Andropogon gerardii* Vitman) and Indiangrass (*Sorghastrum nutans* (L.) Nash). Sedges are an important component, and several dozen species are possible. The most noteworthy species are Bicknell's sedge (*Carex bicknellii* Britton), woolly sedge (*Carex pellita* Muhl ex. Willd.), and Buxbaum's sedge (*Carex buxbaumii* Wahlenb.). Tussock-forming species like Hayden's sedge (*Carex haydenii* Dewey) and upright sedge (*Carex stricta* Lam.) are also important. Common forbs include those typical of wetland conditions such as fourflower yellow loosestrife (*Lysimachia quadriflora* Sims) and swamp milkweed (*Asclepias incarnata* L.). Shrub cover is variable in density and includes willows (Salix L.) and dogwoods(Cornus L.), which quickly spread in the absence of frequent fire.

State and transition model

Ecosystem states

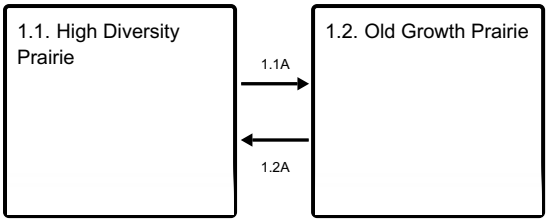


T1A - Transition to agriculture; tillage; seeding; continued management

T1B - Plant succession absent of fire, grazing, or management.

R3A - Restoration of site

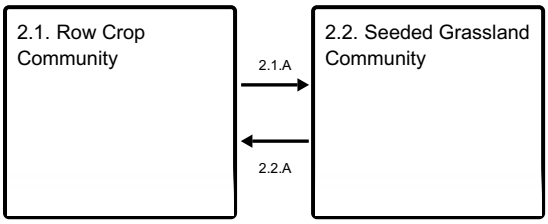
State 1 submodel, plant communities



1.1A - Fire return interval 3-5 years.

1.2A - Fire return interval less than 3 years

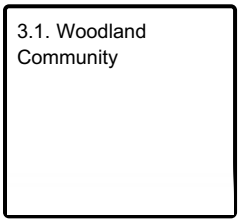
State 2 submodel, plant communities



2.1.A - Grass seeding; grassland management

2.2.A - Tillage; crop production

State 3 submodel, plant communities



State 1
Reference State

The Clayey Wet Prairies reference state is a native prairie that has a diversity of wet-tolerant grasses and forbs. Community phases within the Reference State are dependent upon the influences of fire and grazing. Fire is a key trigger that promotes continued herbaceous vegetation dominance and removes dense thatch thereby allowing for seedling regeneration. Frequent fire maintains the community in a grassland state, by keeping fire-sensitive woody species from proliferating and gaining dominance. A secondary trigger is grazing. Intensive grazing reduces palatable species thereby allowing an increase in less desirable plants. Today, high-quality, unplowed areas are extremely uncommon. Most remaining natural areas that are managed for tallgrass prairie were once tilled and utilized for agricultural production. It is therefore likely that many historically present species are extirpated even from these sites.

Resilience management. Prescribed fire and managed grazing are key resilience management practices. Managed grazing incorporates periods of grazing rest during the growing season which benefits tallgrass maintenance.

Dominant plant species

- prairie cordgrass (*Spartina pectinata*), grass
- woolly sedge (*Carex pellita*), grass

Community 1.1
High Diversity Prairie

This plant community consists of native wet-tolerant native grasses and forbs. The vegetative composition is

influenced by fire return intervals of less than 3 years. Fire reduces woody species and maintains the natural diversity. Fire stimulates seed regeneration and reduces the amount of thatch.

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

Dominant plant species

- prairie cordgrass (*Spartina pectinata*), grass
- big bluestem (*Andropogon gerardii*), grass
- sedge (*Carex*), grass
- fourflower yellow loosestrife (*Lysimachia quadriflora*), other herbaceous
- swamp milkweed (*Asclepias incarnata*), other herbaceous

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. Grass species are still dominant, but more woody species are present.

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

Dominant plant species

- willow (*Salix*), 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 1.1A consists of a fire free period of 3 to 5 years. It allows an increase in woody species, an increase in dead plant material, and a reduced rate of seedling regeneration. Encroachment by woody species will continue in the absence of fire. Although fire frequency is the main driver of community change, secondary 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 thatch is reduced.

State 2
Tillage State

Tillage is the primary mechanism affecting the transition to this state. In this state, dynamic soil properties such as bulk density, structure, organic carbon content, and saturated hydraulic conductivity are altered by agricultural practices. Hydrological modifications (tiling and ditching) are commonly installed to improve drainage. Most areas in this state will remain in use for crop production in the foreseeable future – primarily in an intensive corn and soybean rotation. Certain 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 protect water quality. A small percentage of sites have been seeded back to warm-season grasses. Some previously tilled areas have been converted as part of the NRCS conservation program. Cool-season grasses are also feasible. Although seeded grasslands are not as biologically diverse as the reference state, they still offer various soil health benefits and some ecological benefits for grassland bird species. Some tilled sites may revert to a woodland through abandonment; however, this is a small percentage of acres within MLRA 103 so is not

currently given a community in 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 community consists of intensively produced row crops. Tillage and intentional plant establishment (crop seeding) are the primary triggers. A secondary trigger is hydrological modifications (ditching and tiling) installed to improve soil drainage. Common crops are corn and soybeans on an annual rotation.

Resilience management. Disturbance management and harvest management are resilience management practices. The maintenance of the desired vegetation community requires management of the intensity, frequency, duration, and timing of disturbances caused by agricultural practices.

Dominant plant species

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

Community 2.2
Seeded Grassland Community

This community is on areas that were previously tilled and used for agricultural production but have been transitioned to either warm-season or cool-season grasses. Warm-season grasses are commonly planted through NRCS conservation programs. Species selection depends on landowner objectives and site-specific characteristics. Cool-season grass species are also feasible. Common species include reed canarygrass and Kentucky bluegrass.

Resilience management. Disturbance management and harvest management are resilience management practices on pastures. Practices include seeding and controlling weeds and brush. 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

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

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.

State 3
Woodland State

In the absence of a natural fire regime or management, this site will transition towards a wooded community. Unmanaged grazing and invasive species may impact this site. Community composition and characteristics will vary depending on the type and severity of disturbances. Dominant tree species will vary but often include eastern cottonwood, black willow, green ash, and boxelder. Reed canarygrass may be dense on sites with open areas. Cool-season grasses are often present. Few acres within MLRA 103 are in this State. Some remaining areas are conservation easements. Areas not in a conservation programs are likely to be jurisdictional wetlands, making it very unlikely they will be transitioned to State 2 due to various wetland programs and laws, including the Swampbuster provision of the Food Security Act of 1985 (P.L. 99-198, as amended by P.L. 115-25) and the Minnesota Wetland Conservation Act (WCA) of 1991 (M.R. 8420.0100, as amended in 2009).

Dominant plant species

- black willow (*Salix nigra*), tree
- eastern cottonwood (*Populus deltoides*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- boxelder (*Acer negundo*), tree
- willow (*Salix*), shrub
- dogwood (*Cornus*), shrub
- reed canarygrass (*Phalaris arundinacea*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Community 3.1
Woodland Community

This site is a woodland plant community usually consisting of various species of trees, shrubs, and often, non-native species. Common trees include eastern cottonwood, willows, green ash, boxelder, and dogwood. Open areas may be dominated by reed canarygrass and other cool-season, non-native grasses. Non-native herbaceous species are often present. Plant community composition will be determined by past disturbances, seed sources, any management inputs, and current disturbances.

Dominant plant species

- black willow (*Salix nigra*), tree
- eastern cottonwood (*Populus deltoides*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- boxelder (*Acer negundo*), tree
- willow (*Salix*), shrub
- dogwood (*Cornus*), shrub
- reed canarygrass (*Phalaris arundinacea*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

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

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. Some tilled areas may be abandoned and return to woodland, but this is a small percentage of acres and not currently given a community in this model. Most acres converted to agriculture will stay as such for the foreseeable future.

Conservation practices

Conservation Cover
Range Planting

Transition T1B
State 1 to 3

Plant community succession via the lack of fire, grazing, or management. Woody species will increase and community structure will begin to move from a prairie to a woodland. Disturbances such as overgrazing and non-native vegetation may influence community composition and structure.

Restoration pathway R3A
State 3 to 1

Sites that have not been tilled and still have natural hydrologic functions may be feasible to restore. Soil structure is intact and remnant plant communities may still exist. Previously tilled sites (State 2) may revert to a woodland through abandonment; however, the soil function has been altered through tillage and intensive crop production. This site will not be the same ecologically as a true reference site.

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

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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)	
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:

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:**
