Ecological site R115XC018IL
Wet Floodplain Sedge Meadow

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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.

MLRA notes

Major Land Resource Area (MLRA): 115X–Central Mississippi Valley Wooded Slopes

This MLRA is characterized by deeply dissected, loess-covered hills bordering well defined valleys of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers and their tributaries. It is used to produce cash crops and livestock. About one-third of the area is forested, mostly on the steeper slopes. This area is in Illinois (50 percent), Missouri (36 percent), Indiana (13 percent), and Iowa (1 percent) in two separate areas. It makes up about 25,084 square miles (64,967 square kilometers).

Most of this area is in the Till Plains section and the Dissected Till Plains section of the Central Lowland province of the Interior Plains. The Springfield-Salem plateaus section of the Ozarks Plateaus province of the Interior Highlands occurs along the Missouri River and the Mississippi River south of the confluence with the Missouri River. The nearly level to very steep uplands are dissected by both large and small tributaries of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers. The Ohio River flows along the southernmost boundary of this area in Indiana. Well defined valleys with broad flood plains and numerous stream terraces are along the major streams and rivers. The flood plains along the smaller streams are narrow. Broad summits are nearly level to undulating. Karst topography is common in some parts along the Missouri and Mississippi Rivers and their tributaries. Well-developed karst areas have hundreds of sinkholes, caves, springs, and losing streams. In the St. Louis area, many of the karst features have been obliterated by urban development.

Elevation ranges from 90 feet (20 meters) on the southernmost flood plains to 1,030 feet (320 meters) on the highest ridges. Local relief is mainly 10 to 50 feet (3 to 15 meters) but can be 50 to 150 feet (15 to 45 meters) in the steep, deeply dissected hills bordering rivers and streams. The bluffs along the major rivers are generally 200 to 350 feet (60 to 105 meters) above the valley floor.

The uplands in this MLRA are covered almost entirely with Peoria Loess. The loess can be more than 7 feet (2 meters) thick on stable summits. On the steeper slopes, it is thin or does not occur. In Illinois, the loess is underlain mostly by Illinoian-age till that commonly contains a paleosol. Pre-Illinoian-age till is in parts of this MLRA in Iowa and Missouri and to a minor extent in the western part of Illinois. Wisconsin-age outwash, alluvial deposits, and sandy eolian material are on some of the stream terraces and on dunes along the major tributaries. The loess and glacial deposits are underlain by several bedrock systems. Pennsylvanian and Mississippian bedrock are the most extensive. To a lesser extent are Silurian, Devonian, Cretaceous, and Ordovician bedrock. Karst areas have formed where limestone is near the surface, mostly in the southern part of the MLRA along the Mississippi River and some of its major tributaries. Bedrock outcrops are common on the bluffs along the Mississippi, Ohio, and Wabash Rivers and their major tributaries and at the base of some steep slopes along minor streams and drainageways.

The annual precipitation ranges from 35 to 49 inches (880 to 1,250 millimeters) with a mean of 41 inches (1,050 millimeters). The annual temperature ranges from 48 to 58 degrees F (8.6 to 14.3 degrees C) with a mean of 54 degrees F (12.3 degrees C). The freeze-free period ranges from 150 to 220 days with a mean of 195 days.

Soils The dominant soil orders are Alfisols and, to a lesser extent, Entisols and Mollisols. The soils in the area have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed or smectitic mineralogy. They are shallow to very deep, excessively drained to poorly drained, and loamy, silty, or clayey.

The soils on uplands in this area support natural hardwoods. Oak, hickory, and sugar maple are the dominant species. Big bluestem, little bluestem, and scattered oak and eastern redcedar grow on some sites. The soils on flood plains support mixed forest vegetation, mainly American elm, eastern cottonwood, river birch, green ash, silver maple, sweetgum, American sycamore, pin oak, pecan, and willow. Sedge and grass meadows and scattered trees are on some low-lying sites. (United States Department of Agriculture, Natural Resources Conservation Service, 2022)

LRU notes

The Central Mississippi Valley Wooded Slopes, Northern part (Land Resource Unit (LRU) 115XC) encompasses the Wyaconda River Dissected Till Plains, Mississippi River Hills, and Mississippi River Alluvial Plain (Schwegman et al. 1973; Nelson 2010). It spans three states – Illinois (73 percent), Iowa (6 percent), and Missouri (21 percent) – comprising about 13,650 square miles (Figure 1). The elevation ranges from 420 feet above sea level (ASL) along the Mississippi River floodplains to 885 feet on the upland ridges. Local relief varies from 10 to 20 feet but can be as high as 50 to 100 feet along drainageways and streams and the bluffs on the major rivers reaching 250 feet above valley floors. Wisconsin-aged loess covers the uplands, while Illinoian glacial drift lies directly below. The loess and drift deposits are underlain by several bedrock systems, including the Cretaceous, Pennsylvania, Mississippian, Silurian, Devonian, and Ordovician Systems. Wisconsin outwash deposits and sandy eolian material occur along stream terraces of major tributaries (USDA-NRCS 2006).

The vegetation across the region has undergone drastic changes over time. At the end of the last glacial episode – the Wisconsinan glaciation – the evolution of vegetation began with the development of tundra habitats, followed by a phase of spruce and fir forests, and eventually spruce-pine forests. Not until approximately 9,000 years ago did the climate undergo a warming trend which prompted the development of deciduous forests dominated by oak and hickory. As the climate continued to warm and dry, prairies began to develop approximately 8,300 years ago. Another shift in climate that resulted in an increase in moisture prompted the emergence of savanna-like habitats from 8,000 to 5,000 years before present (Taft et al. 2009). During the most recent climatic shifts, forested ecosystems maintained footholds on steep valley sides and wet floodplains. Due to the physiography of the MLRA, forests were the dominant ecosystems and were affected by such natural disturbances as droughts, wind, lightning, and occasional fire (Taft et al. 2009).

Classification relationships

USFS Subregions: Central Dissected Till Plains (251C)Section; Western Mississippi River Hills (251Ce), Mississippi River and Illinois Alluvial Plains (251Cf), Eastern Mississippi River Hills (251Ci), Galesburg Dissected Till Plain (251Cj), and Wyaconda River Dissected Till Plain (251Cm) Subsections (Cleland et al. 2007)

U.S. EPA Level IV Ecoregion: Upper Mississippi River Alluvial Plain (72d), River Hills (72f), and Western Dissected Illinoian Till Plain (72i) (USEPA 2013)

National Vegetation Classification – Ecological Systems: North-Central Interior Floodplain (CES202.033) (NatureServe 2015)

National Vegetation Classification - Plant Associations: Carex spp. – (Carex pellita, Carex vulpinoidea) Wet Meadow (CEGL005272) (Nature Serve 2015)

Biophysical Settings: Eastern Great Plains Floodplain Systems (BpS 4214710) (LANDFIRE 2009)

Natural Resources Conservation Service – Iowa Plant Community Species List: Sedge Meadow, Central Midwest (USDA-NRCS 2007)

Illinois Natural Areas Inventory: Sedge meadow (White and Madany 1978)

Iowa Department of Natural Resources: Wet Meadow (INAI 1984)

Missouri Terrestrial Natural Communities: Wet bottomland prairie (Nelson 2010)

Ecological site concept

Wet Floodplain Sedge Meadows are located within the green areas on the map. They occur on floodplains in river valleys. The soils are Alfisols, Mollisols, Inceptisols, and Entisols that are very poorly to poorly drained and very deep, formed in alluvium.

The historic pre-European settlement vegetation on this ecological site was dominated by hydrophytic herbaceous vegetation. Crested sedge (Carex cristatella Britton) and bald spikerush (Eleocharis erythropoda Steud.) are the dominant species on Wet Floodplain Sedge Meadows. Other monocots that may occur include fox sedge (Carex vulpinoidea Michx.), shortbeak sedge (Carex brevior (Dewey) Mack.), green bulrush (Scirpus atrovirens Willd.), bluejoint (Calamagrostis canadensis L.), and rice cutgrass (Leersia oryzoides (L.) Sw.). Species typical of an undisturbed plant community associated with this ecological site include quill sedge (Carex tenera Dewey) and prairie straw sedge (Carex suberecta (Olney) Britton) (Drobney et al. 2001). Flooding and periodic fire are the primary disturbance factors that maintain this site, while drought is a secondary factor (LANDFIRE 2009; NatureServe 2015).

Associated sites

R115XC017IL	**Floodplain Prairie** Alluvial parent materials that are not shallow to a high-water table including Dupo, Psamments, and Raveenwash soils

Similar sites

R115XC015IL	**Wet Terrace Sedge Meadow** Wet Terrace Sedge Meadows support a sedge meadow community, but occur on low stream terraces

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Carex cristatella* (2) *Eleocharis erythropoda*

Physiographic features

Wet Floodplain Sedge Meadows occur on floodplains in river valleys. They are situated on elevations ranging from approximately 341 to 1499 feet ASL. The site experiences rare to frequent flooding that can last up to 30 days.

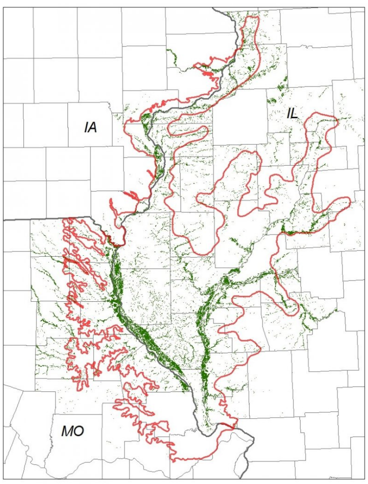


Figure 1. Location of Wet Floodplain Sedge Meadow ecological site within LRU 115XC.

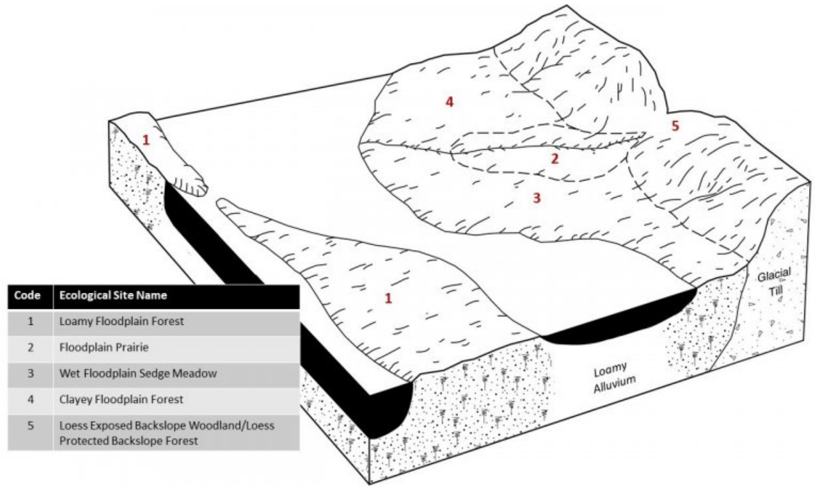


Figure 2. Representative block diagram of Wet Floodplain Sedge Meadow and associated ecological sites.

Table 2. Representative physiographic features

Slope shape across	(1) Linear
Slope shape up-down	(1) Linear
Landforms	(1) River valley > Flood plain
Runoff class	Low to high
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	Rare to frequent
Ponding frequency	None
Elevation	341–1,499 ft
Slope	0–2%
Water table depth	0–12 in
Aspect	Aspect is not a significant factor

Climatic features

The Central Mississippi Valley Wooded Slopes, Northern Part falls into the humid subtropical (Cfa) and hot-summer humid continental climate (Dfa) Köppen-Geiger climate classifications (Peel et al. 2007). The two main factors that drive the climate of the MLRA are latitude and weather systems. Latitude, and the subsequent reflection of solar input, determines air temperatures and seasonal variations. Solar energy varies across the seasons, with summer receiving three to four times as much energy as opposed to winter. Weather systems (air masses and cyclonic storms) are responsible for daily fluctuations of weather conditions. High-pressure systems are responsible for settled weather patterns where sun and clear skies dominate. In fall, winter, and spring, the polar jet stream is responsible for the creation and movement of low-pressure systems. The clouds, winds, and precipitation associated with a low-pressure system regularly follow high-pressure systems every few days (Angel n.d.).

The soil temperature regime of LRU 115XC 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 184 days, while the frost-free period is about 152 days. The majority of the precipitation occurs as rainfall in the form of convective thunderstorms during the growing season. Average annual precipitation is 38 inches, which includes rainfall plus the water equivalent from snowfall. The average annual low and high temperatures are 42 and 62°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	141-168 days

Freeze-free period (characteristic range)	170-196 days
Precipitation total (characteristic range)	35-40 in
Frost-free period (actual range)	140-170 days
Freeze-free period (actual range)	169-203 days
Precipitation total (actual range)	35-40 in
Frost-free period (average)	152 days
Freeze-free period (average)	184 days
Precipitation total (average)	38 in

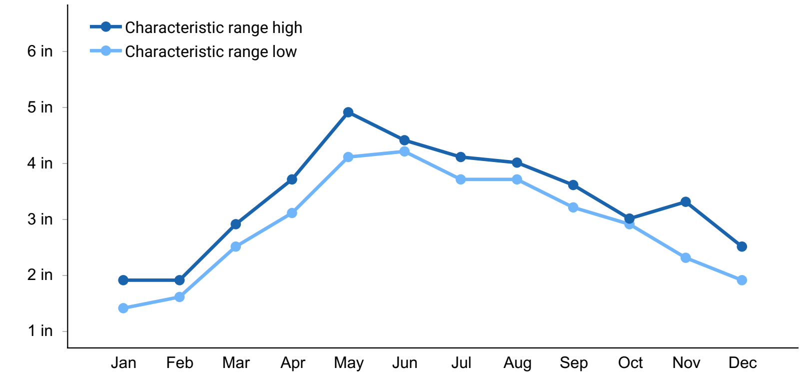


Figure 3. Monthly precipitation range

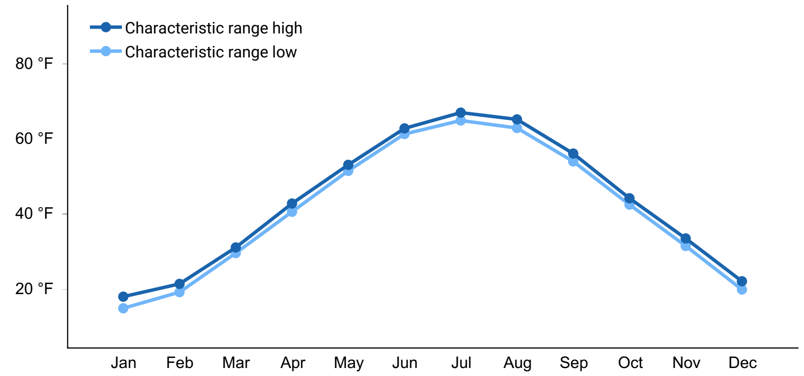


Figure 4. Monthly minimum temperature range

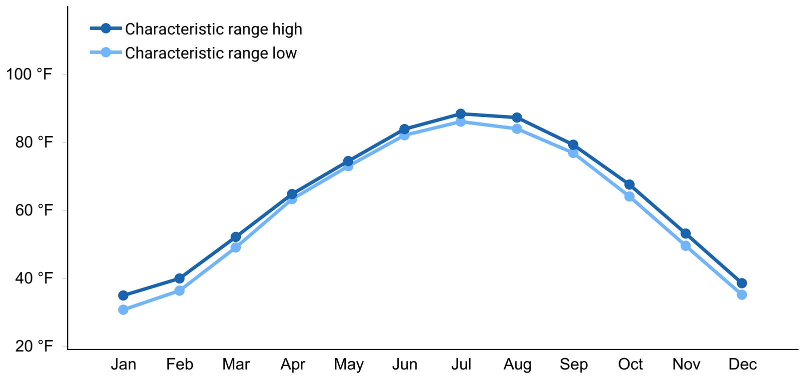


Figure 5. Monthly maximum temperature range

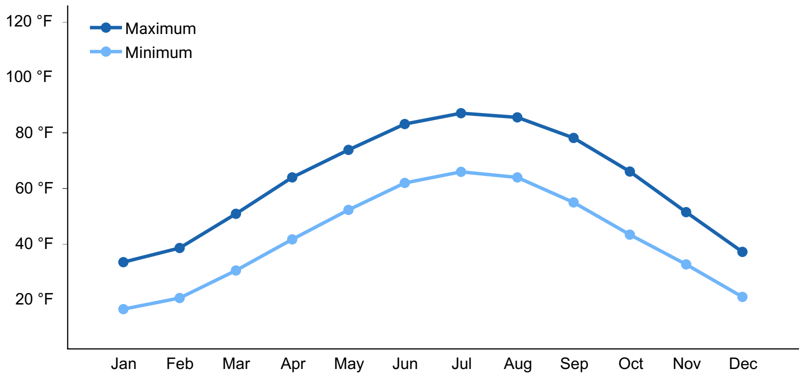


Figure 6. Monthly average minimum and maximum temperature

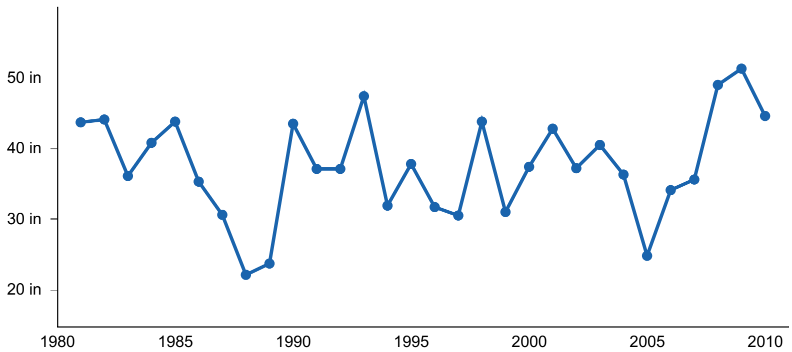


Figure 7. Annual precipitation pattern

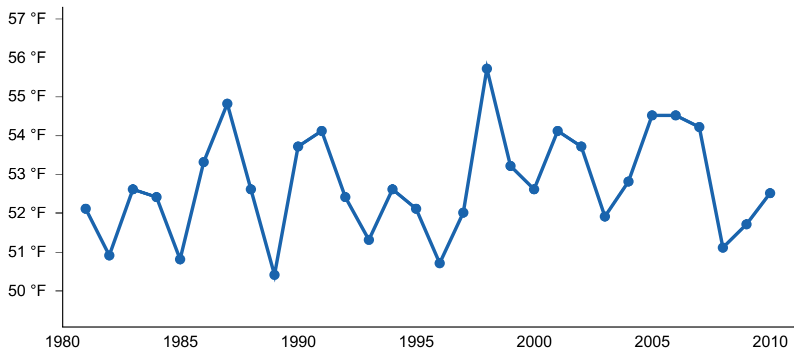


Figure 8. Annual average temperature pattern

Climate stations used

- (1) CLINTON #1 [USC00131635], Camanche, IA
- (2) NEW BOSTON DAM 17 [USC00116080], Wapello, IL
- (3) CANTON L&D 20 [USC00231275], Canton, MO
- (4) CLARKSVILLE L&D 24 [USC00231640], Clarksville, MO
- (5) HAVANA [USC00113940], Lewistown, IL

Influencing water features

Wet Floodplain Sedge Meadows are classified as a RIVERINE: bottomland, flooded, herbaceous wetland under the Hydrogeomorphic (HGM) classification system (Smith et al. 1995; USDA-NRCS 2008) and as a Palustrine, Persistent Emergent, Seasonally Flooded Wetland under the National Wetlands Inventory (FGDC 2013). Overbank flow from the stream and subsurface hydraulic connections are the main sources of water for this ecological site, but additional sources can include overland flow from adjacent uplands and precipitation (Smith et al. 1995). Infiltration is very slow (Hydrologic Group D) for undrained soils, and surface runoff is low to high.

Wetland description

Primary wetland hydrology indicators for an intact Wet Floodplain Sedge Meadow may include: A1 Surface water, A2 High water table, A3 Saturation, and B10 Drainage patterns. Secondary wetland hydrology indicators may include: C2: Dry-season water table, D5 FAC-neutral test (USACE 2010).

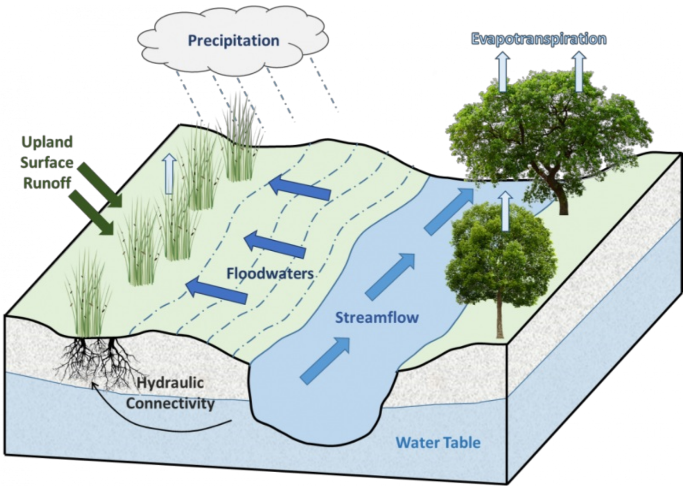


Figure 9. Hydrologic cycling in Wet Floodplain Sedge Meadow ecological site.

Soil features

Soils of Wet Floodplain Sedge Meadows are in the Alfisols, Mollisols, Inceptisols, and Entisols orders, further classified as Chromic Vertic Albaqualfs, Argiaquic Argialbolls, Cumulic Endoaquolls, Cumulic Vertic Endoaquolls, Fluvaquentic Endoaquolls, Fluventic Vertic Endoaquolls, Typic Endoaquolls, Fluventic Endoaquepts, Aeric Fluvaquents, Mollic Fluvaquents, Typic Fluvaquents with very slow infiltration and low to high runoff potential. The soil series associated with this site includes Ambraw, Beaucoup, Birds, Blackoar, Calco, Caneek, Comfrey, Darwin, Gorham, Millington, Okaw, Otter, Petrolia, Quiver, Sawmill, Sepo, Toolesboro, Vesser, and Zook. The parent material is alluvium, and the soils are very poorly to poorly drained and very deep with seasonal high-water tables. Soil pH classes are strongly acid to moderately alkaline. No rooting restrictions are noted for the soils of this ecological site (Table 5).

Some soil map units in this ecological site, if not drained, may meet the definition of hydric soils and are listed as meeting criteria 2,3, or 4 of the hydric soils list (77 FR 12234).

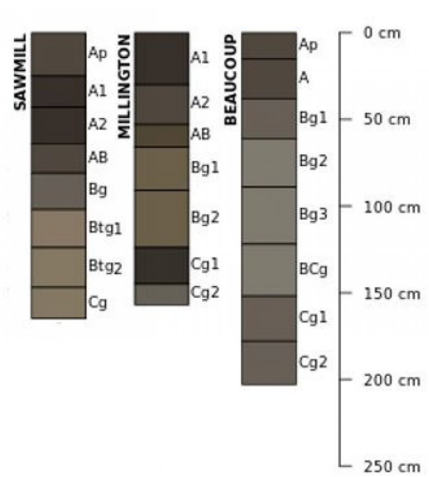


Figure 10. Profile sketches of soil series associated with Wet Floodplain Sedge Meadow.

Table 4. Representative soil features

Parent material	(1) Alluvium

Surface texture	(1) Silty clay loam (2) Silt loam (3) Clay loam (4) Loam (5) Silty clay
Family particle size	(1) Fine (2) Fine-silty (3) Fine-loamy
Drainage class	Very poorly drained to poorly drained
Permeability class	Very slow to moderate
Depth to restrictive layer	80 in
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	5–9 in
Calcium carbonate equivalent (Depth not specified)	0–40%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	5.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–9%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The MLRA lies within the tallgrass prairie ecosystem of the Midwest, but a variety of environmental and edaphic factors resulted in a landscape that historically supported upland hardwood forests, lowland mixed forests, and scattered grass and sedge meadows. Wet Floodplain Sedge Meadows form an aspect of this vegetative continuum. This ecological site occurs on floodplains on very poorly to poorly drained alluvial soils. Species characteristic of this ecological site consist of hydrophytic herbaceous vegetation.

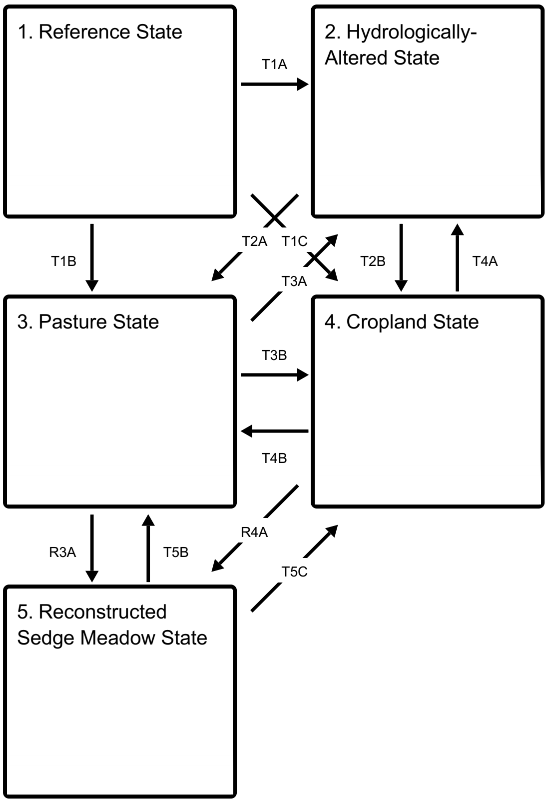
Flooding and fire are the most important ecosystem drivers for maintaining this ecological site. The frequency and duration of flooding affect species composition, cover, and vegetative production due to alternating aerobic and anaerobic surface substrate conditions. Fires are likely occurred on a regular rotation interval and helped to reduce the accumulation of peat. The combination of fire and saturated soil conditions prevented the establishment of shrubs for any significant amount of time.

Drought has also played a role in shaping this ecological site. The periodic episodes of reduced soil moisture in conjunction with the poorly-drained soils have favored the proliferation of plant species tolerant of such conditions. Drought can slow the growth of plants and result in dieback of certain species. When coupled with fire, periods of drought can eliminate or greatly reduce the occurrence of woody vegetation, substantially altering the extent of shrubs and trees (Pyne et al. 1996).

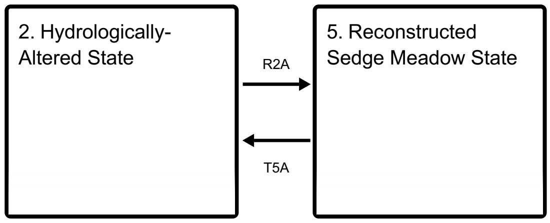
Today, Wet Floodplain Sedge Meadows have been greatly reduced as the land has mostly been converted to agricultural production. Corn (*Zea mays* L.) and soybeans (*Glycine max* (L.) Merr.) are the dominant crops grown, but patches of forage land are also present on the landscape. A return to the historic plant community is likely not possible due to significant hydrologic and water quality changes in the watershed, but long-term conservation agriculture or habitat reconstruction efforts can help to restore some natural diversity and ecological functioning. 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

Ecosystem states



States 2 and 5 (additional transitions)



T1A - Changes to natural hydroperiod and/or land abandonment

T1B - Cultural treatments are implemented to increase forage quality and yield

T1C - Agricultural conversion via tillage, seeding, and non-selective herbicide

T2A - Cultural treatments are implemented to increase forage quality and yield

T2B - Agricultural conversion via tillage, seeding, and non-selective herbicide

R2A - Site preparation, non-native species control, and native seeding

T3A - Changes to natural hydroperiod and/or land abandonment

T3B - Agricultural conversion via tillage, seeding, and non-selective herbicide

R3A - Site preparation, non-native species control, and native seeding

T4A - Changes to natural hydroperiod and/or land abandonment

T4B - Cultural treatments are implemented to increase forage quality and yield

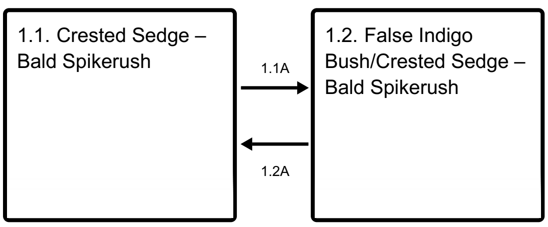
R4A - Site preparation, non-native species control, and native seeding

T5A - Changes to natural hydroperiod and/or land abandonment

T5B - Cultural treatments are implemented to increase forage quality and yield

T5C - Agricultural conversion via tillage, seeding, and non-selective herbicide

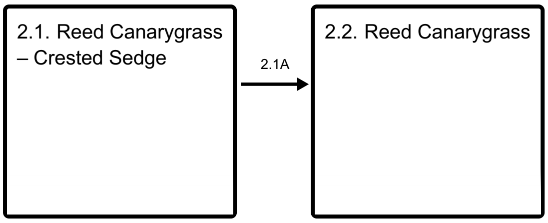
State 1 submodel, plant communities



1.1A - Extended period of no fires

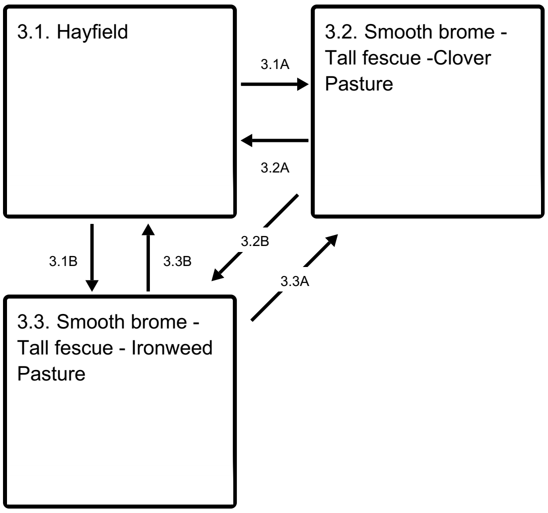
1.2A - Fire disturbance on site

State 2 submodel, plant communities



2.1A - Altered hydrology; sedimentation

State 3 submodel, plant communities



3.1A - Grazing; animal to forage balance

3.1B - Grazing; forage plants are overutilized

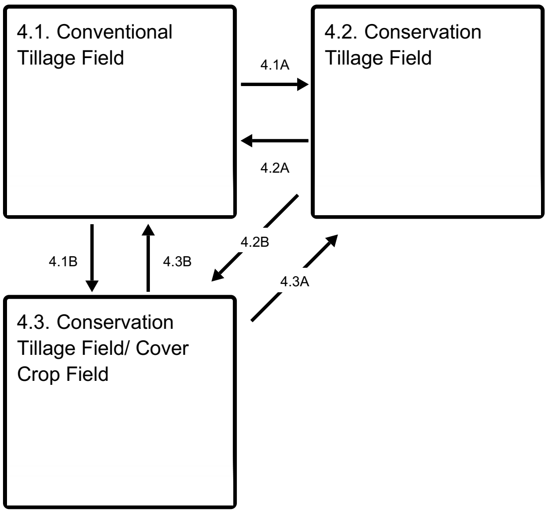
3.2A - Mechanical harvesting

3.2B - Grazing; overutilization of forage

3.3B - Mechanical harvesting

3.3A - Grazing; proper forage-to-animal balance

State 4 submodel, plant communities

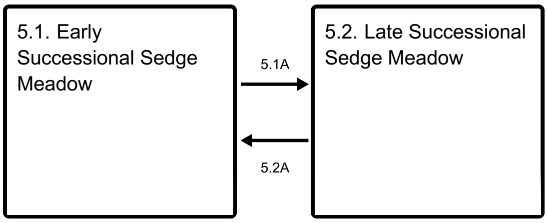


4.1A - Less tillage, residue management

4.1B - Less tillage, residue management, and implementation of cover cropping

4.2A - Intensive tillage, remove residue, and reinitiate monoculture row cropping
4.2B - Implementation of cover cropping
4.3B - Intensive tillage, remove residue, and reinitiate monoculture row cropping
4.3A - Cover crop practices are abandoned.

State 5 submodel, plant communities



5.1A - Proper hydrology and nutrient balances
5.2A - Reconstruction setback

State 1
Reference State

The reference plant community is categorized as a sedge meadow community, dominated by hydrophytic, herbaceous vegetation. The two community phases within the reference state are dependent on flooding and periodic fire. The frequency and duration of flooding alter species composition, cover, and extent, while periodic fires prevent woody species from dominating. Drought and herbivory have more localized impacts in the reference phases, but do contribute to overall species composition, diversity, cover, and productivity.

Dominant plant species

- crested sedge (*Carex cristatella*), grass
- bald spikerush (*Eleocharis erythropoda*), grass

Community 1.1
Crested Sedge – Bald Spikerush

Sites in this reference community phase are dominated by sedges and rushes. Vegetative cover is generally continuous and dense with plants reaching heights between 1.5 and 5 feet tall (NatureServe 2015). Crested sedge and bald spikerush are dominant species, but other monocots are present and can include shortbeak sedge, prairie straw sedge, quill sedge, eastern fox sedge, green bulrush, bluejoint, and rice cutgrass. Common forbs include swamp milkweed (*Asclepias incarnata* L.), common sneezeweed (*Helenium autumnale* L.), American water horehound (*Lycopus americanus* Muhl. ex W.P.C. Barton), and wild mint (*Mentha arvensis* L.). Seasonal flooding maintains the wetland plant community, while periodic fires maintain the herbaceous dominance. However, an extended fire return interval allows some wetland shrubs to establish shifting the community to phase 1.2.

Dominant plant species

- crested sedge (*Carex cristatella*), grass
- spikerush (*Eleocharis*), grass

Community 1.2
False Indigo Bush/Crested Sedge – Bald Spikerush

This reference community phase represents natural succession as a result of an extended fire return interval. Shrubs, such as false indigo bush (*Amorpha fruticosa* L.) and white meadowsweet (*Spiraea alba* Du Roi), can form a scattered canopy across the sedge meadow. The prolonged absence of fire will maintain this state, but a fire will shift the community back to phase 1.1.

Dominant plant species

- false indigo bush (*Amorpha fruticosa*), shrub

- white meadowsweet (*Spiraea alba*), shrub
- crested sedge (*Carex cristatella*), grass
- spikerush (*Eleocharis*), grass

Pathway 1.1A
Community 1.1 to 1.2

Extended fire return interval.

Pathway 1.2A
Community 1.2 to 1.1

Fire transitions site back to Community 1.1.

State 2
Hydrologically-Altered State

Hydrology is the most important determinant of wetlands and wetland processes. Hydrology modifies and determines the physiochemical environment (i.e., sediments, soil chemistry, water chemistry) which in turn directly affects the vegetation, animals, and microbes (Mitsch and Gosselink 2007). Human activities on landscape hydrology have greatly altered Wet Floodplains Sedge Meadows. Alterations such as agricultural tile draining and conversion to cropland on adjacent lands have changed the natural hydroperiod, increased the rate of sedimentation, and intensified nutrient pollution (Werner and Zedler 2003; Mitsch and Gosselink 2007).

Community 2.1
Reed Canarygrass – Crested Sedge

This community phase represents the early changes to the natural wetland hydroperiod, sedimentation, and nutrient runoff. Sedimentation results in a reduction of soil organic matter and high dry bulk density. It also leads to a homogenization of the local microtopography, reducing the surface area and associated species diversity (Green and Galatowitsch 2002; Werner and Zedler 2002). Native sedges continue to form a component of the herbaceous layer, but the highly-invasive reed canarygrass (*Phalaris arundinacea* L.) co-dominates. This community phase represents the early changes to the natural wetland hydroperiod, sedimentation, and nutrient runoff. Sedimentation results in a reduction of soil organic matter and high dry bulk density. It also leads to a homogenization of the local microtopography, reducing the surface area and associated species diversity (Green and Galatowitsch 2002; Werner and Zedler 2002). Native sedges continue to form a component of the herbaceous layer, but the highly-invasive reed canarygrass (*Phalaris arundinacea* L.) co-dominates.

Dominant plant species

- reed canarygrass (*Phalaris arundinacea*), grass
- crested sedge (*Carex cristatella*), grass

Community 2.2
Reed Canarygrass

Sites falling into this community phase have experienced significant sedimentation and are dominated by a monoculture of reed canarygrass (NatureServe 2015). Reed canarygrass stands can significantly alter the physiochemical environment as well as the biotic communities, making the site only suitable to reed canarygrass. These monotypic stands create a positive feedback loop that perpetuates increasing sedimentation, altered hydrology, and dominance by this non-native species, especially in sites affected by nutrient enrichment from agricultural runoff (Vitousek 1995; Bernard and Lauve 1995; Green and Galatowitsch 2002; Werner and Zedler 2002; Kercher et al. 2007; Waggy 2010).

Dominant plant species

- reed canarygrass (*Phalaris arundinacea*), grass

Pathway 2.1A
Community 2.1 to 2.2

Continuing alterations to the natural hydrology and increasing sedimentation.

State 3
Pasture State

The Pasture State occurs when the reference state 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.), tall fescue (Festuca arundinacea) and Kentucky bluegrass (*Poa pratensis* L.), to help extend the grazing season. 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 landscape, reducing the native species diversity and ecological function.

Dominant plant species

- fescue (*Festuca*), grass
- bluegrass (*Poa*), grass
- bromelia (*Bromelia*), grass
- alfalfa (*Medicago*), other herbaceous
- clover (*Trifolium*), other herbaceous

Community 3.1
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). Many species may be planted depending on the landowner's objectives.

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- timothy (*Phleum pratense*), grass
- alfalfa (*Medicago*), other herbaceous
- clover (*Trifolium*), other herbaceous

Community 3.2
Smooth brome -Tall fescue -Clover Pasture

This community is characterized by seeded cool-season grass and forbs. Species will depend upon landowner goals and objectives and may include many different grasses and forbs. Common species include smooth brome (*Bromus inermis*), tall fescue (Festuca arundinacea), Kentucky bluegrass (*Poa pratensis*), timothy (*Phleum pratense*), red clover (*Trifolium pratense*) and white clover (*Trifolium repens* L.). Management inputs include control of weeds and brush. These sites are managed to ensure a proper forage/animal balance. Plants are not overutilized and have adequate rest and recovery.

Dominant plant species

- smooth brome (*Bromus inermis*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

- white clover (*Trifolium repens*), other herbaceous
- red clover (*Trifolium pratense*), other herbaceous

Community 3.3
Smooth brome -Tall fescue - Ironweed Pasture

Overutilization of the pasture will result in a shift to include more undesirable species such as ironweed (*Vernonia gigantea*), knotweed (Polygonum spp.) buttercup (Ranunculus spp.), ragweed (Ambrosia spp.) and shrubs. Many woody and weed species may be present depending on seed sources and level of soil disturbance. This community reflects an improper forage-to-animal balance which will negatively impact forage productivity and reproduction, soil health, and water quality. Ecological resiliency is compromised under these conditions.

Dominant plant species

- smooth brome (*Bromus inermis*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- giant ironweed (*Vernonia gigantea*), other herbaceous
- knotweed (*Polygonum*), other herbaceous
- ragweed (*Ambrosia*), other herbaceous
- buttercup (*Ranunculus*), other herbaceous

Pathway 3.1A
Community 3.1 to 3.2

Mechanical harvesting is replaced with domestic livestock grazing.

Pathway 3.1B
Community 3.1 to 3.3

Mechanical harvesting is replaced with domestic livestock grazing. Forage plants are overutilized.

Pathway 3.2A
Community 3.2 to 3.1

Domestic livestock are removed, and mechanical harvesting is implemented.

Pathway 3.2B
Community 3.2 to 3.3

Grazing of livestock with overutilization of the forage plants.

Pathway 3.3B
Community 3.3 to 3.1

Domestic livestock are removed, and mechanical harvesting is implemented.

Pathway 3.3A
Community 3.3 to 3.2

Forage plants are not overutilized and the site has a proper forage-to-animal balance.

State 4
Cropland State

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.

Dominant plant species

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

Community 4.1
Conventional Tillage Field

Sites in this community phase typically consist of monoculture row-cropping maintained by conventional tillage practices. They are cropped in either continuous corn or corn-soybean rotations. The frequent use of deep tillage, low crop diversity, and bare soil conditions during the non-growing season negatively 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).

Dominant plant species

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

Community 4.2
Conservation Tillage Field

This community phase is characterized by rotational crop production that utilizes various conservation tillage methods to promote soil health and reduce erosion. Conservation tillage methods include strip-till, ridge-till, vertical-till, or no-till planting systems. Strip-till keeps seedbed preparation to narrow bands less than one-third the width of the row where crop residue and soil consolidation are left undisturbed in-between seedbed areas. Strip-till planting may be completed in the fall and nutrient application either occurs simultaneously or at the time of planting. Ridge-till uses specialized equipment to create ridges in the seedbed and vegetative residue is left on the surface in between the ridges. Weeds are controlled with herbicides and/or cultivation, seedbed ridges are rebuilt during cultivation, and soils are left undisturbed from harvest to planting. Vertical-till systems employ machinery that lightly tills the soil and cuts up crop residue, mixing some of the residue into the top few inches of the soil while leaving a large portion on the surface. No-till management is the most conservative, disturbing soils only at the time of planting and fertilizer application. Compared to conventional tillage 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.

Dominant plant species

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

Community 4.3
Conservation Tillage Field/ 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.

Dominant plant species

- oat (*Avena*), grass

- rye (*Secale*), grass
- wheat (*Triticum*), grass
- corn (*Zea mays*), other herbaceous
- soybean (*Glycine max*), other herbaceous
- radish (*Raphanus*), other herbaceous

Pathway 4.1A
Community 4.1 to 4.2

Tillage operations are greatly reduced, crop rotation occurs on a regular interval, and crop residue remains on the soil surface.

Pathway 4.1B
Community 4.1 to 4.3

Tillage operations are greatly reduced or eliminated, crop rotation occurs on a regular interval, crop residue remains on the soil surface, and cover crops are planted following crop harvest.

Pathway 4.2A
Community 4.2 to 4.1

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

Pathway 4.2B
Community 4.2 to 4.3

Cover crops are implemented to minimize soil erosion.

Pathway 4.3B
Community 4.3 to 4.1

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

Pathway 4.3A
Community 4.3 to 4.2

Cover crop practices are abandoned.

State 5
Reconstructed Sedge Meadow State

Sedge meadow habitats provide multiple ecosystem services including flood abatement, water quality improvement, and biodiversity support. However, many sedge meadow communities have been stressed from watershed-scale changes in hydrology or eliminated as a result of type conversions to agricultural production, thereby significantly reducing these services (Zedler 2003). The extensive alterations of lands adjacent to these sites may not allow for restoration back to the historic reference condition. However, ecological reconstruction can aim to aid the recovery of degraded, damaged or destroyed functions. A successful reconstruction 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; Mitsch and Jørgensen 2004).

Dominant plant species

- hairy sedge (*Carex lacustris*), grass
- broadleaf arrowhead (*Sagittaria latifolia*), other herbaceous

Community 5.1

Early Successional Sedge Meadow

This community phase represents the early community assembly from sedge meadow reconstruction and is highly dependent on seed viability, hydroperiod, soil organic matter content, and site preparation. Successful establishment of sedges can be maximized by using seed collected during the same growing season, utilizing genotypes adapted to the environmental location, ensuring soil moisture is saturated at the time of seeding, and improving the water holding capacity and fertility of the soil (Budelsky and Galatowitsch 1999; van der Valk et al. 1999; Mitsch and Gosselink 2007; Hall and Zedler 2010). In addition, suppression and removal of non-native species is essential for reducing competition (Perry and Galatowitsch 2003).

Dominant plant species

- crested sedge (*Carex cristatella*), grass
- bald spikerush (*Eleocharis erythropoda*), grass

Community 5.2
Late Successional Sedge Meadow

Appropriately timed disturbance regimes (e.g., hydroperiod, prescribed fire) and nutrient management applied to the early successional community phase can help increase the species richness, pushing the site into a late successional community phase over time (Mitsch and Gosselink 2007).

Dominant plant species

- crested sedge (*Carex cristatella*), grass
- bald spikerush (*Eleocharis erythropoda*), grass
- swamp milkweed (*Asclepias incarnata*), other herbaceous
- American water horehound (*Lycopus americanus*), other herbaceous

Pathway 5.1A
Community 5.1 to 5.2

Maintenance of proper hydrology and nutrient balances in line with a developed wetland management plant.

Pathway 5.2A
Community 5.2 to 5.1

Reconstruction experiences a setback from extreme weather event or improper timing of management actions.

Transition T1A
State 1 to 2

Transition 1A – Direct and indirect alterations to the landscape hydrology from human-induced land development transition the site to the hydrologically-altered state (2).

Transition T1B
State 1 to 3

Transition 1B – Cultural treatments to enhance forage quality and yield transitions the site to the Pasture state (3).

Transition T1C
State 1 to 4

Transition 1C – Tillage, seeding of agricultural crops, and non-selective herbicide transition this site to the cropland state (4).

Transition T2A
State 2 to 3

Transition 2A – Cultural treatments to enhance forage quality and yeild transitions the site to the pasture state (3)

Restoration pathway T2B
State 2 to 4

Transition 2B – Installation of drain tiles, seeding of agricultural crops, and non-selective herbicide transition the site to the cropland state (4).

Restoration pathway R2A
State 2 to 5

Restoration 2A – Hydroperiod restoration, site preparation, non-native species control, and seeding native species transition the site to the reconstructed sedge meadow state (5).

Transition T3A
State 3 to 2

Transition 3A – Land abandonment transitions the site to the hydrologically-altered (2).

Restoration pathway T3B
State 3 to 4

Transition 3B – Tillage, seeding of agricultural crops, and non-selective herbicide transition this site to the cropland state (4).

Restoration pathway R3A
State 3 to 5

Restoration 3A – Site preparation, tree planting, invasive species control, and seeding native species transition this site to the reconstructed sedge meadow state (5).

Transition T4A
State 4 to 2

Transition 4A – Land abandonment transitions the site to the hydrologically-altered state (2).

Transition T4B
State 4 to 3

Transition 4B – Cultural treatments to enhance forage quality and yield transitions the site to the pasture state (3).

Restoration pathway R4A
State 4 to 5

Restoration 4A – Site preparation, tree planting, invasive species control, and seeding native species transition this site to the reconstructed sedge meadow state (5).

Transition T5A
State 5 to 2

Transition 5A – Fire suppression and removal of active management transitions this site to the fire-suppressed state (2).

Transition T5B
State 5 to 3

Transition 5B – Cultural treatments to enhance forage quality and yield transition the site to the pasture state (3).

Transition T5C
State 5 to 4

Transition 5C – Tillage, seeding of agricultural crops, and non-selective herbicide transition this site to the cropland state (4).

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 this ecological site description.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Lisa Kluesner
Contact for lead author	
Date	01/07/2025
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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2. **Presence of water flow patterns:**

---

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:**