

Ecological site R104XY001IA Organic 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.



Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 104X–Eastern Iowa and Minnesota Till Prairies

The Eastern Iowa and Minnesota Till Prairies (MLRA 104) includes the Iowan Surface, Oak Savanna, and Western Coulee and Ridges landforms (Prior 1991; MDNR 2005; WDNR 2015). It spans three states (Iowa, 74 percent; Minnesota, 22 percent; Wisconsin, 4 percent), encompassing approximately 9,660 square miles (Figure 1). The elevation ranges from approximately 1,310 feet above sea level (ASL) on the highest ridges to about 985 feet ASL in the lowest valleys. Local relief is mainly 10 to 20 feet. Glacial till and outwash deposits cover the uplands of the MLRA with recent alluvium located in the major river valleys. Paleozoic bedrock sediments, comprised primarily of shale and limestone, lies beneath the glacial material. The depth to limestone is shallow, resulting in karst topography across much of the area (USDA-NRCS 2006).

The vegetation in the MLRA has undergone drastic changes over time. Spruce forests dominated the landscape 30,000 to 21,500 years ago. As the last glacial maximum peaked 21,500 to 16,000 years ago, they were replaced with open tundras and parklands. The end of the Pleistocene Epoch saw a warming climate that initially prompted the return of spruce forests, but as the warming continued, spruce trees were replaced by deciduous trees (Baker et al. 1990). Not until approximately 9,000 years ago did the vegetation transition to prairies as climatic conditions continued to warm and subsequently dry. Between 4,000 and 3,000 years ago, oak savannas began intermingling within the prairie landscape, while the more wooded and forested areas maintained a foothold in sheltered areas. This prairie-forest transition ecosystem formed the dominant landscapes until the arrival of European settlers (Baker

et al. 1992).

Classification relationships

USFS Subregions: North Central U.S. Driftless and Escarpment (222L), Minnesota and Northeast Iowa Morainal-Oak Savannah (222M), Central Dissected Till Plains (251C) Sections; Menominee Eroded Pre-Wisconsin Till (222La), Oak Savannah Till and Loess Plains (222Me), Southeast Iowa Rolling Loess Hills (251Ch) Subsections (Cleland et al. 2007)

U.S. EPA Level IV Ecoregion: Eastern Iowa and Minnesota Drift Plains (47c), Rolling Loess Prairies (47f), Lower St. Croix and Vermillion Valleys (47g), Rochester/Paleozoic Plateau Upland (52c) (USEPA 2013)

National Vegetation Classification - Plant Associations: Carex stricta – Valeriana edulis – Parnassia palustris Fen (CEGL005241) (Nature Serve 2015)

Biophysical Settings: Central Interior and Appalachian Shrub-Herbaceous Wetland Systems (BpS 4314930) (LANDFIRE 2009)

Natural Resources Conservation Service – Iowa Plant Community Species List: Fen, Tussock Sedge (USDA-NRCS 2007)

Iowa Department of Natural Resources: Sedge Fen (INAI 1984)

Minnesota Department of Natural Resources: OPp93c Calcareous Fen (Southeastern) (MDNR 2005)

U.S. Army Corps of Engineers: Calcareous Fens (Eggers and Reed 2015)

Ecological site concept

Organic Sedge Meadows are located within the green areas on the map (Figure 1). They occur on upland backslopes. The soils are Histosols that are very poorly-drained and deep, formed in organic material. A shallow depth to the water table results in saturated soil conditions throughout the year.

The historic pre-European settlement vegetation on this ecological site was dominated by highly-diverse hydrophytic herbaceous vegetation. Upright sedge (Carex stricta Lam.) and eastern marsh fern (Thelypteris palustris Schott) are the dominant species of Organic Sedge Meadows. Other monocots likely to be present include bluejoint (Calamagrostis canadensis (Michx.) P. Beauv), spiked muhly (Muhlenbergia glomerata (Willd.) Trin.), and numerous sedges. Other vascular plants typical of an undisturbed plant community associated with this ecological site include yellow marsh marigold (Caltha palustris L.), fen grass of Parnassus (Parnassia glauca Raf.), and tobacco root (Valeriana edulis Nutt. ex Torr. & A. Gray) (Drobney et al. 2001). Constant groundwater discharge is the primary disturbance factor that maintains this site, while occasional fire and drought are secondary disturbances (LANDFIRE 2009).

Associated sites

R104XY006IA	Wet Loamy Upland Prairie Wet Loamy Upland Prairie
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Similar sites

R104XY012IA	Wet Upland Drainageway Sedge Meadow Wet Upland Drainageway Sedge Meadow
R104XY013IA	Ponded Upland Depression Sedge Meadow Ponded Upland Depression Sedge Meadow

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Carex stricta</i> (2) <i>Thelypteris palustris</i>

Physiographic features

Organic Sedge Meadows occur on upland backslopes. They are situated on elevations ranging from approximately 249 to 1499 feet ASL. The site does not experience flooding, but rather is continuously saturated due to groundwater discharge moving laterally throughout the soil and discharging along hillsides.

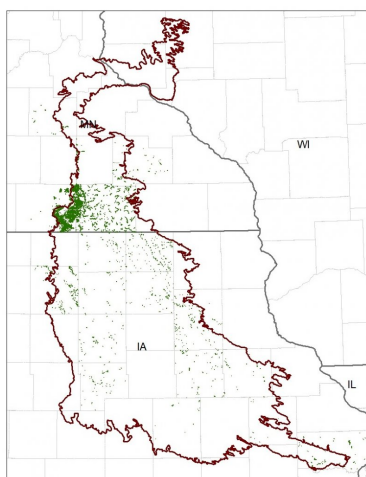


Figure 2. Figure 1. Location of Organic Sedge Meadow ecological site within MLRA 104.

Table 2. Representative physiographic features

Slope shape across	(1) Concave (2) Convex
Slope shape up-down	(1) Concave (2) Convex
Hillslope profile	(1) Backslope
Landforms	(1) Upland
Runoff class	Negligible to very low
Ponding frequency	Rare to occasional
Elevation	76–457 m
Slope	0–6%
Aspect	Aspect is not a significant factor

Climatic features

The Eastern Iowa and Minnesota Till Prairies falls into the hot-summer humid continental climate (Dfa) and warm-summer humid continental climate (Dfb) Köppen-Geiger climate classifications (Peel et al. 2007). In winter, dry, cold air masses periodically shift south from Canada. As these air masses collide with humid air, snowfall and rainfall result. In summer, moist, warm air masses from the Gulf of Mexico migrate north, producing significant frontal or convective rains. Occasionally, hot, dry winds originating from the Desert Southwest will stagnate over the region, creating extended droughty periods in the summer from unusually high temperatures. Air masses from the Pacific Ocean can also spread into the region and dominate producing mild, dry weather in the autumn known as Indian Summers (NCDC 2006).

The soil temperature regime of MLRA 104 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 153 days, while the frost-free period is about 129 days. The majority of the precipitation occurs as rainfall in the form of convective thunderstorms during the growing season. Average annual precipitation is approximately 36 inches, which includes rainfall plus the water equivalent from snowfall. The average annual low and high temperatures are 35 and 55°F, respectively.

Climate data and analyses are derived from 30-year averages gathered from five National Oceanic and Atmospheric Administration (NOAA) weather stations contained within the range of this ecological site.

Table 3. Representative climatic features

Frost-free period (characteristic range)	127-134 days
Freeze-free period (characteristic range)	143-163 days
Precipitation total (characteristic range)	889-965 mm
Frost-free period (actual range)	123-135 days
Freeze-free period (actual range)	142-168 days
Precipitation total (actual range)	864-965 mm
Frost-free period (average)	129 days
Freeze-free period (average)	153 days
Precipitation total (average)	914 mm

Climate stations used

- (1) GRAND MEADOW [USC00213290], Grand Meadow, MN
- (2) AUSTIN WWT FAC [USC00210355], Austin, MN
- (3) NEW HAMPTON [USC00135952], New Hampton, IA
- (4) ALLISON [USC00130157], Allison, IA
- (5) FAYETTE [USC00132864], Fayette, IA

Influencing water features

Organic Sedge Meadows are classified as a SLOPE: groundwater influenced, discharge, herbaceous wetland under the Hydrogeomorphic (HGM) classification system (Smith et al. 1995; USDA-NRCS 2008) and as a Palustrine, Persistent, Emergent, Continuously Saturated wetland under the National Wetlands Inventory (FGDC 2013). Groundwater discharge from a perched water table is the main source of water for this ecological site (Smith et al. 1995). Infiltration is very slow (Hydrologic Group D) for undrained soils, and surface runoff is negligible to very low (Figure 4).

Primary wetland hydrology indicators for an intact Organic Sedge Meadow may include: A2 High water table and A3 Saturation. Secondary wetland hydrology indicators may include: C2 Dry-season water table and D5 FAC-neutral test (USACE 2010).

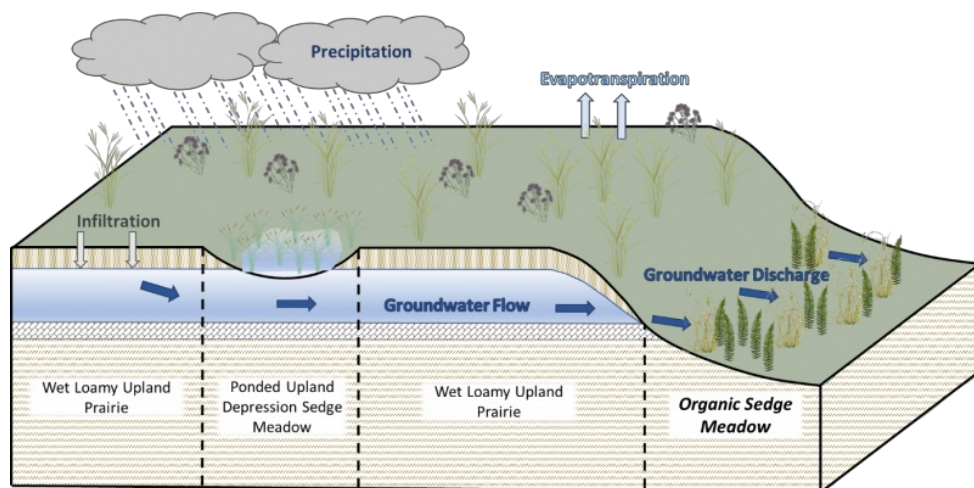


Figure 9. Figure 4. Hydrologic cycling in Organic Sedge Meadow ecological site.

Soil features

Soils of Organic Sedge Meadows are in the Histosols order, further classified as Terric Haplosaprists and Typic Haplosaprists with very slow infiltration and negligible to very low runoff potential. The soil series associated with this site includes Houghton, Klossner, Medo, and Palms and muck soils. The parent material is organic material, and the soils are very poorly-drained and deep. A shallow water table results in saturated soils conditions throughout the year. 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 1 of the hydric soils list (77 FR 12234).

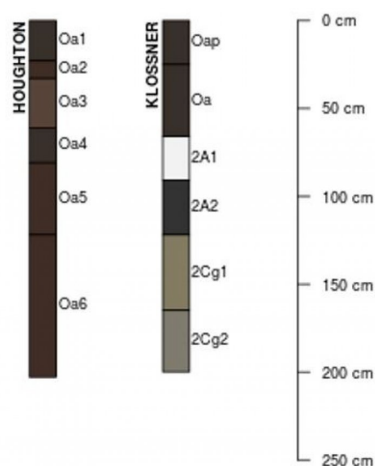


Figure 10. Figure 5. Profile sketches of soil series associated with Organic Sedge Meadow.

Table 4. Representative soil features

Parent material	(1) Organic material
Drainage class	Very poorly drained
Permeability class	Slow
Depth to restrictive layer	203 cm
Soil depth	203 cm

Ecological dynamics

The MLRA lies within the transition zone between the eastern deciduous forests and the tallgrass prairies. The heterogeneous topography of the area results in variable microclimates and fuel matrices that in turn support prairies, savannas, woodlands, and forests. Organic Sedge Meadow form an aspect of this vegetative continuum. This ecological site occurs on upland backslopes on very poorly-drained organic soils. A shallow water table results in saturated soil conditions throughout the year. Species characteristic of this ecological site consist of hydrophytic herbaceous vegetation.

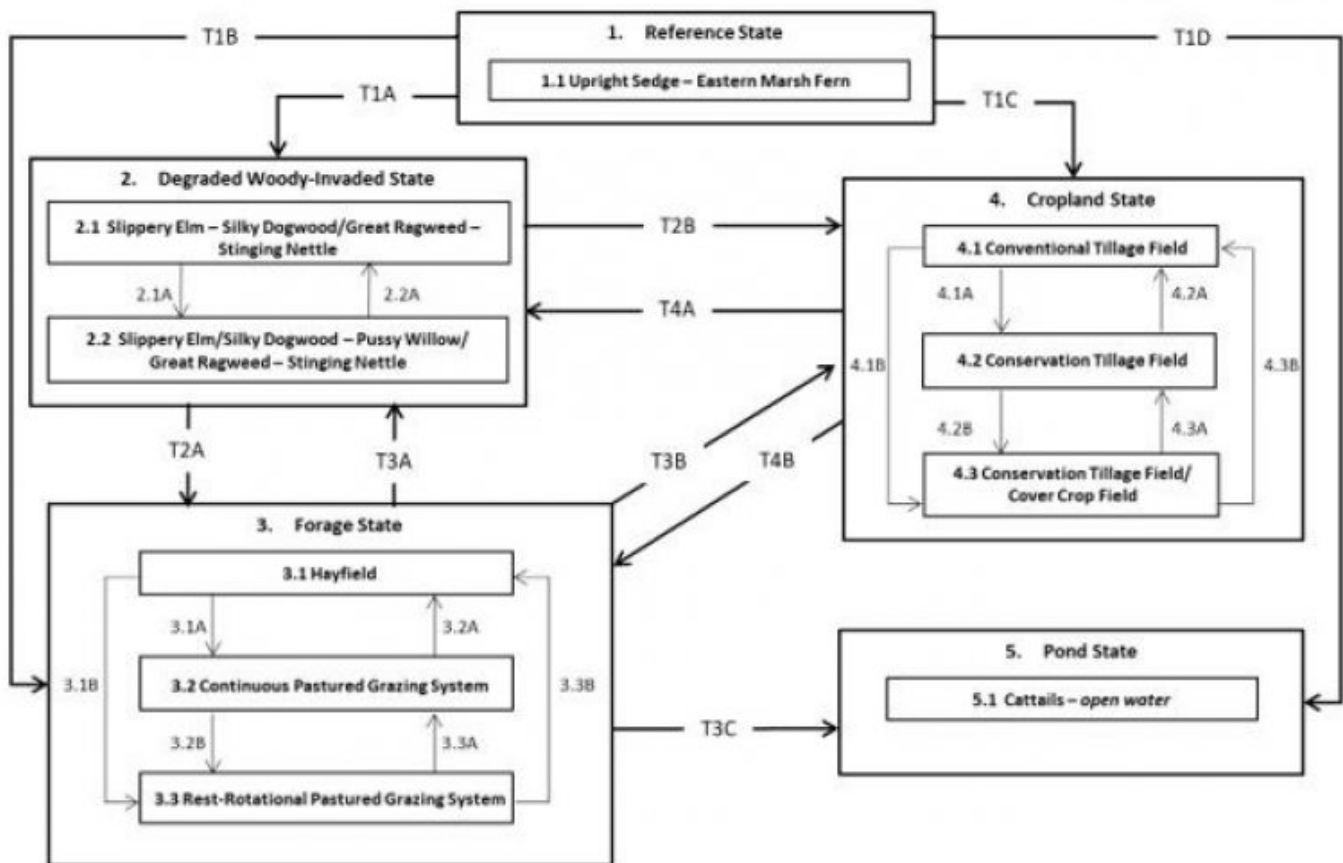
Organic Sedge Meadows are dependent on consistent groundwater discharge. These conditions are present where surface slopes intersect a perched water table, allowing the groundwater to slowly seep from the hillside (Richardson and Brinson 2001; Dixon 2014). While water levels may fluctuate throughout the year, they generally remain at or near the soil surface (LANDFIRE 2009). The near-constant anaerobic conditions maintain the herbaceous wetland plant community and prevent woody species from encroaching.

Drought and fire have also played a role in shaping this ecological site. The periodic episodes of reduced soil moisture in conjunction with the very poorly-drained soils have favored the proliferation of plant species tolerant of such conditions. Drought can also slow the growth of plants and result in dieback of certain species. Occasional fires reduced plant litter and aided in preventing declines in species richness. Drought coupled with fire would keep woody plants from encroaching (LANDFIRE 2009).

Today, Organic Sedge Meadows have been greatly reduced as sites have been converted to agricultural production lands or converted to ponds. Sites that have not been directly altered show evidence of indirect anthropogenic influences from hydrologic alterations, fire suppression, and non-native species invasion (Pearson and Leoschke 1992). These land conversions and alterations to the natural groundwater flow are considered irreversible, making restoration an improbability. 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

R104XY001IA ORGANIC SEDGE MEADOW



Code	Process
T1A, T3A, T4A	Changes to natural hydroperiod and/or land abandonment
2.1A	Natural succession following continuing landscape alterations
2.2A	Limited woody species removal
T1B, T2A, T4B	Cultural treatments are implemented to increase forage quality and yield
3.1A	Mechanical harvesting is replaced with domestic livestock and continuous grazing
3.1B	Mechanical harvesting is replaced with domestic livestock and rest-rotational grazing
3.2A, 3.3B	Tillage, forage crop planting, and mechanical harvesting replace grazing
3.2B	Implementation of rest-rotational grazing
3.3A	Implementation of continuous grazing
T1C, T2B, T3B	Agricultural conversion via tillage, seeding, and non-selective herbicide
4.1A	Less tillage, residue management
4.1B	Less tillage, residue management, and implementation of cover cropping
4.2B	Implementation of cover cropping
4.2A, 4.3B	Intensive tillage, remove residue, and reinitiate monoculture row cropping
T1D, T3C	Native vegetation removal and impoundment or excavation

State 1 Reference State

The reference plant community is categorized as a groundwater-fed slope wetland community, dominated by hydrophytic herbaceous vegetation. The one community phase within the reference state is dependent on consistent groundwater seepage to maintain the plant community. Drought and occasional fires have more localized impacts in the reference state, but do contribute to overall species composition, diversity, cover, and productivity.

Community 1.1

Upright Sedge – Eastern Marsh Fern

Sites in this reference community phase are dominated by hydrophytic herbaceous vegetation. Upright sedge and eastern marsh fern are dominant species on the site, but other frequently encountered ones include bluejoint, spiked muhly, and sensitive fern (*Onoclea sensibilis* L.). Forb species richness is often very high in these unique communities and typically includes many species with high conservative values, e.g. yellow marsh marigold, fen grass of Parnassus, tobacco root, and marsh bellflower (*Campanula aparinoides* Pursh).

State 2

Degraded Woody-invaded State

The expansion of ruderal woody and herbaceous species into Organic Sedge Meadows can arise due to a complex interaction of fire suppression, hydrological alterations, and edge effects. Subsurface water reduction from agricultural tiling, ditching, or off-site development in conjunction with the removal of periodic fires allows woody species to encroach, casting shade on the native plant community and altering the natural light regime. In addition, edge effects can arise from indirect land management practices (e.g., cropping, herbicide drift) on directly adjacent sites that lead to a transition in the herbaceous species composition to taller, ruderal species (Pearson and Leoschke 1992; NatureServe 2015).

Community 2.1

Slippery Elm – Silky Dogwood/Great Ragweed – Stinging Nettle

This community phase represents the initial changes to the natural community following hydroperiod alterations and adjacent land management actions. Reduction in the water table allows woody species, such as slippery elm (*Ulmus rubra* Muhl.), silky dogwood (*Cornus obliqua* Raf.), and pussy willow (*Salix discolor* Muhl.), to establish a significant shrub cover. The herbaceous layer shifts to disturbance-tolerant, opportunistic species including great ragweed (*Ambrosia trifida* L.), stinging nettle (*Urtica dioica* L.), Canada lettuce (*Lactuca canadensis* L.), common milkweed (*Asclepias syriaca* L.), and common evening primrose (*Oenothera biennis* L.). Non-native invasive species, including reed canarygrass (*Phalaris arundinacea* L.), redtop (*Agrostis gigantea* Roth), and Kentucky bluegrass (*Poa pratensis* L.), begin to encroach as well (Pearson and Leoschke 1992).

Community 2.2

Slippery Elm/Silky Dogwood – Pussy Willow/Great Ragweed – Stinging Nettle

Sites falling into this community phase represent the natural succession as a result of continuing changes to the hydroperiod and adjacent lands. Slippery elm can mature into a tree canopy, and silky dogwood and pussy willow continue to form the dominant shrubs. The herbaceous layer continues to be simplified and inhabited by ruderal and non-native species.

Pathway 2.1A

Community 2.1 to 2.2

Natural succession as a result of continuing landscape changes.

Pathway 2.2A

Community 2.2 to 2.1

Limited woody species removal.

State 3

Forage State

The forage state arises when the site is converted to a farming operation that emphasizes domestic livestock production, known as grassland agriculture. Fire suppression, periodic cultural treatments (e.g., clipping, drainage, soil amendment applications, planting new species and/or cultivars, mechanical harvesting) and grazing by domesticated livestock transition and maintain this state (USDA-NRCS 2003). Early settlers seeded non-native species, such as smooth brome (*Bromus inermis* Leyss.) and Kentucky bluegrass (*Poa pratensis* L.), to help extend the grazing season (Smith 1998). Over time, as lands were continuously harvested or grazed by herds of cattle,

these species were able to spread and expand across the landscape, reducing the native species diversity and ecological function.

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). This phase may not be prevalent on this ecological site due to the high soil moisture making it difficult to run large equipment across it.

Community 3.2 Continuous Pastured Grazing

This community phase is characterized by continuous grazing where domestic livestock are allowed to graze a pasture for the entire season. Depending on stocking density, this can result in lower forage quality and productivity, weed invasions, and uneven pasture use. Continuous grazing can also increase the amount of bare ground and erosion and reduce soil organic matter, cation exchange capacity, water-holding capacity, and nutrient availability and retention (Bharati et al. 2002; Leake et al. 2004; Teague et al. 2011). Smooth brome, Kentucky bluegrass, and white clover (*Trifolium repens* L.) are common pasture species used in this phase. Their tolerance to continuous grazing has allowed these species to dominate, greatly reducing the native species diversity to only low palatability species such as woolly sedge and sawtooth sunflower (*Helianthus grosseserratus* M. Martens) (Pearson and Leoschke 1992).

Community 3.3 Periodic-rest Pastured Grazing

This community phase is characterized by periodic-rest grazing where the pasture has been subdivided into several smaller paddocks. Subdividing the pasture in this way allows livestock to utilize one or a few paddocks, while the remaining area is rested allowing plants to restore vigor and energy reserves, deepen root systems, develop seeds, as well as allow seedling establishment (Undersander et al. 2002; USDA-NRCS 2003). Periodic-rest pastured grazing includes deferred periods, rest periods, and periods of high intensity – low frequency, and short duration methods. Vegetation is generally more diverse and can include orchardgrass (*Dactylis glomerata* L.), timothy (*Phleum pratense* L.), red clover (*Trifolium pratense* L.), and alfalfa (*Medicago sativa* L.). The addition of native prairie species can further bolster plant diversity and, in turn, soil function. This community phase promotes numerous ecosystem benefits including increasing biodiversity, preventing soil erosion, maintaining and enhancing soil quality, sequestering atmospheric carbon, and improving water yield and quality (USDA-NRCS 2003).

Pathway 3.1A Community 3.1 to 3.2

Mechanical harvesting is replaced with domestic livestock utilizing continuous grazing.

Pathway 3.1B Community 3.1 to 3.3

Mechanical harvesting is replaced with domestic livestock utilizing periodic-rest grazing.

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

Periodic-rest grazing replaces continuous grazing.

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

Continuous grazing replaces periodic-rest grazing.

State 4

Cropland State

The cropland state is the dominant land condition throughout the MLRA today. Agricultural tile drains used to lower the water table and the continuous use of tillage, row-crop planting, and chemicals (i.e., herbicides, fertilizers, etc.) have effectively eliminated the reference community and many of its natural ecological functions in favor of crop production. Corn and soybeans are the dominant crops for the site, and oats (*Avena L.*) and alfalfa (*Medicago sativa L.*) may be rotated periodically. These areas are likely to remain in crop production for the foreseeable future.

Community 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 alternating periods of corn and soybean crops. The frequent use of deep tillage, low crop diversity, and bare soil conditions during the non-growing season negatively impacts soil health. Under these practices, soil aggregation is reduced or destroyed, soil organic matter is reduced, erosion and runoff are increased, and infiltration is decreased, which can ultimately lead to undesirable changes in the hydrology of the watershed (Tomer et al. 2005).

Community 4.2

Conservation Tillage Field

This community phase is characterized by periodically alternating crops and utilizing 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 operations. 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 operations 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 operations, conservation tillage methods can improve soil ecosystem function by reducing soil erosion, increasing organic matter and water availability, improving water quality, and reducing soil compaction.

Community 4.3

Conservation Tillage with Cover Crop Field

This community phase applies conservation tillage methods as described above as well as adds cover crop practices. Cover crops typically include nitrogen-fixing species (e.g., legumes), small grains (e.g., rye, wheat, oats), or forage covers (e.g., turnips, radishes, rapeseed). The addition of cover crops not only adds plant diversity but also promotes soil health by reducing soil erosion, limiting nitrogen leaching, suppressing weeds, increasing soil organic matter, and improving the overall soil ecosystem. In the case of small grain cover crops, surface cover and

water infiltration are increased, while forage covers can be used to graze livestock or support local wildlife. Of the three community phases for this state, this phase promotes the greatest soil sustainability and improves ecological functioning within a row crop operation.

Pathway 4.1A

Community 4.1 to 4.2

Tillage operations are greatly reduced, alternating crops 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, alternating crops 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, monoculture row-cropping is established on a more-or-less continuous basis.

Pathway 4.3A

Community 4.3 to 4.2

Cover crop practices are abandoned.

State 5

Pond State

A small percentage of historic Organic Sedge Meadows in the MLRA have been impounded or excavated for ponds in order to support watering livestock, creating waterfowl habitat, and establishing fisheries (Pearson and Leoschke 1992). Through excavation, the native vegetation is removed, and groundwater seepage can rapidly fill the exposed area and transition the diverse organic sedge meadow into an open water habitat. Over time, sediments may accumulate along the edges of the pond where emergent vegetation, introduced by wind or wildlife, can germinate and establish.

Community 5.1

Cattail – open water

This community phase is characterized mostly by open water. Along the shallow edges of the water, a limited diversity of emergent vegetation may establish. Cattails (*Typha* L.) and bulrushes (*Scirpus* L., *Bolboschoenus* (Asch.) Palla) are the most commonly encountered species.

Transition T1A

State 1 to 2

Changes to the natural hydroperiod and edge effects from adjacent land uses transition this site the degraded woody-invaded state (2).

Transition T1B
State 1 to 3

Cultural treatments to enhance forage quality and yield transition the site to the forage state (3).

Transition T1C
State 1 to 4

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

Transition T1D
State 1 to 5

Removal of natural vegetation and excavation transition the site to the pond state (5).

Transition T2A
State 2 to 3

Cultural treatments to enhance forage quality and yield transition the site to the forage state (3).

Transition T2B
State 2 to 4

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

Transition T3A
State 3 to 2

Land is abandoned and left fallow; natural succession by opportunistic species transition this site the degraded woody-invaded state (2).

Transition T3B
State 3 to 4

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

Transition T3C
State 3 to 5

Removal of natural vegetation and excavation transition the site to the pond state (5).

Transition T4A
State 4 to 2

Agricultural production abandoned and left fallow; natural succession by opportunistic species transition this site to the degraded woody-invaded state (2).

Transition T4B
State 4 to 3

Cultural treatments to enhance forage quality and yield transition the site to the forage state (3).

Additional community tables

Inventory data references

Tier 3 Sampling Plots used to develop the reference state, community phase 1.1:

State County Ownership Easting Northing

Iowa Buchanan Rowley Fen – Buchanan County Conservation Board 594031 4559424

Iowa Marshall Marietta Sand Prairie Preserve – Marshall County Conservation Board 497148 4660971

Iowa Black Hawk Cedar Hills Sand Prairie – The Nature Conservancy 536713 4715854

Iowa Fayette Kauten Fen – The Kauten Family 599089 4737395

Iowa Butler Leeper Prairie Preserve – Butler County Conservation Board 525123 4731466

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Contributors

Lisa Kluesner
Ryan Dermody

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Drake University:

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

Iowa Department of Natural Resources:

John Pearson, Ecologist, Des Moines, IA

Greg Schmitt, Private Lands Biologist, West Union, IA

Conservation Districts of Iowa:

Sean Kluesner, Private Lands Wetland Easement Team Specialist, New Hampton, IA

LANDFIRE (The Nature Conservancy):

Randy Swaty, Ecologist, Evanston, IL

Natural Resources Conservation Service :

Rick Bednarek, Iowa State Soil Scientist, Des Moines, IA

Scott Brady, Acting Regional Ecological Site Specialist, Havre, MT

Leland Camp, Soil Scientist, Waverly, IA

Patrick Chase, Area Resource Soil Scientist, Fort Dodge, IA

Stacey Clark, Regional Ecological Site Specialist, St. Paul, MN

James Cronin, State Biologist, Des Moines, IA

Ryan Dermody, Soil Survey Leader, Waverly, IA
Tonie Endres, Senior Regional Soil Scientist, Indianapolis, IN
Gregg Hadish, GIS Specialist, Des Moines, IA
John Hammerly, Soil Data Quality Specialist, Indianapolis, IN
Lisa Kluesner, Ecological Site Specialist, Waverly, IA
Jeff Matthias, State Grassland Specialist, Des Moines, IA
Louis Moran, Area Resource Soil Scientist, Sioux City, IA
Kevin Norwood, Soil Survey Regional Director, Indianapolis, IN
James Phillips, GIS Specialist, Des Moines, IA
Neil Sass, Area Resource Soil Scientist, West Union, IA
Jason Steele, Area Resource Soil Scientist, Fairfield, IA

Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	05/19/2024
Approved by	Chris Tecklenburg
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

-
8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**
-
9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**
-
10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**
-
11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**
-
12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**
- Dominant:
- Sub-dominant:
- Other:
- Additional:
-
13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**
-
14. **Average percent litter cover (%) and depth (in):**
-
15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**
-
16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**
-
17. **Perennial plant reproductive capability:**
