USDA Natural Resources
Conservation Service

Ecological site F089XY001WI
Acidic Poor Fen

Last updated: 9/27/2023
Accessed: 11/04/2024

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): 089X–Wisconsin Central Sands

The Wisconsin Central Sands (MLRA 89) corresponds closely to Central Sand Plains Ecological Landscape published by the Wisconsin Department of Natural Resources (WDNR, 2015). Much of the following brief overview of this MLRA is borrowed from that publication.

The Wisconsin Central Sands MLRA is entirely in Wisconsin. The total land area is 2,187,100 acres (3,420 square miles, 8858 square kilometers). It is bordered to the east by Johnstown-Hancock end moraines, which were pushed to their extent by the west side of the Green Bay Lobe (Clayton & Attig, 1999). It is bordered to the southwest by highly eroded, unglaciated valleys and ridges. The dominant feature of this MLRA is the remarkably flat, sandy plain, composed of lacustrine deposits and outwash sand, that was once the main basin of Glacial Lake Wisconsin. It also features extensive pine and oak barrens and wetland complexes.

Glacial Lake Wisconsin was fed primarily by glacial meltwater from the north and east. The lake deposited silt overlain by tens of meters of sand (Clayton & Attig, 1989). The silty layers are closer to the surface in some areas, where they impede drainage and contribute to the formation of extensive wetland complexes. It is believed that Glacial Lake Wisconsin drained within several days after a breach in the ice dam that supported it. The catastrophic flood that followed flowed to the south and carved the scattered buttes and mesas protruding from the sandy plain in the southern portion of this MLRA. Before vegetation established after glacial recession, strong winds formed aeolian sand dunes that now support xeric pine and oak stands within the Wisconsin Central Sands.

The surface of the northwestern portion is mostly undulating. The sandy surface sediment was mostly deposited by meltwater during the Wisconsin glaciation. Gentle hills are a result of underlying bedrock topography. Valleys and floodplains are formed by stream action. The underlying bedrock controls the water table elevation and contributes to the formation of numerous wetlands.

Historically, the Wisconsin Central Sands were dominated by large wetland complexes, sand prairies, and oak forests, savannas, and barrens. Some pine and hemlock forests were found in the northwest portion. The Wisconsin Central Sands was subject to frequent fires, leading to today’s need for prescribed burns to maintain the area.

Classification relationships

Major Land Resource Area (MLRA): Wisconsin Central Sands (89)
USFS Subregions: Neillsville Sandstone Plateau (222Rb) and Central Wisconsin Sand Plain (222Ra)

Small sections occur in the Lincoln Formation Till Plain - Mixed Hardwoods (212Qb) and Central Wisconsin Sand Plain (222Ra) Subregions
Ecological Landscapes of Wisconsin (WDNR, 2015): Central Sand Plains

Relationship to Established Framework and Classification Systems:
The Wetland Forest Habitat Type Classification System for Northern Wisconsin (Kotar and Burger, 2017). In the absence of a wetland forest habitat type classification system for Southern Wisconsin, we have utilized the information for the adjacent Habitat Type Region 5, in this publication. The study sites of ES1 keyed out to two wetland forest habitat types: PArGy (*Pinus strobus*-Acer rubrum/Gaylussacia) and PmLLe-An (*Picea mariana*-Larix/Ledum, Aronia variant).

Biophysical Settings (Landfire, 2014): This site is largely mapped as Boreal Acidic Peatland Forest, Boreal Acidic Peatland Shrubland, Laurentian Shrubland Barrens, and Central Interior and Appalachian Swamp Forest.

WDNR Natural Communities (WDNR, 2015): This ES is most similar to Central Poor Fen and Sedge Meadow.

Ecological site concept

The Acidic Poor Fen ecological site is found in poor fens on outwash plains and pediments in the west-central portion of MLRA 89. These sites occur where adjacent parent materials are sandy. They are characterized by very poorly drained soils that have formed in moderate to deep organic materials of herbaceous origin. Some sites are underlain by sandy outwash material or bedrock. The sites receive water primarily through precipitation and runoff from adjacent uplands that tend to be sandy and acidic. The input from stream or groundwater flow is limited. The soils remain saturated throughout the year and meet hydric-soil criteria. The water levels are strongly influenced by precipitation and runoff and soil reaction ranges from very strongly acid to extremely acid.

These conditions negatively affect plant growth and distinguish Poor Fen from the Mucky Swamps ecological site. The main distinguishing characteristic is the strong presence of sphagnum mosses, indicating a long-term transition of this Ecological Site from Fen to Bog. In addition to Sphagnum species, characteristic ground-layer plants include swamp dewberry (Rubus hispidus), marsh marigold (Caltha palustris), steeplebush (Spirea tomentosa) and wild cranberry (Vaccinium macrocarpon). The ES can be wooded, or unwooded, or some of both. The most common shrubs are speckled alder (Alnus crispa), bog birch (Betula pumila) and currants (Ribes spp.). Typical early colonizing trees are paper birch (B. Papyrifera), tamarack (*Larix laricina*), jack pine (P. banksiana) and white pine (*P. strobus*).

Associated sites

F089XY017WI	**Sandy Outwash Uplands** Sandy Outwash Uplands primarily consist of deep sandy outwash deposits. Soils are somewhat excessively to excessively drained and are primarily found east of the Yellow River. They are much drier and occur higher on the drainage sequence than Acidic Poor Fens.
F089XY006WI	**Wet Sandy Outwash Lowlands** Wet Sandy Outwash Lowlands consist of deep sandy deposits derived from a mixture of outwash, alluvium, and lacustrine sources. They are very poorly to poorly drained, remain saturated for much of the growing season, and are subject to frequent ponding. They are drier and occur higher on the drainage sequence than Acidic Poor Fens.

Similar sites

F089XY002WI	**Mucky Swamps** Mucky Swamps sites consist of herbaceous organic materials sometimes underlain by sandy to loamy mineral soil. They are very poorly drained and remain saturated throughout much of the year. Like Acidic Poor Fens, these sites are permanently saturated wetland. These sites receive more stream and groundwater and the parent materials of adjacent upland sites are more calcareous, resulting in more alkaline wetlands with improved growing conditions.

Table 1. Dominant plant species

Tree	(1) *Picea mariana* (2) *Larix laricina*
Shrub	Not specified

Herbaceous	(1) *Sphagnum* (2) *Rubus hispidoides*

Physiographic features

This site occurs as a fen on outwash plains and pediments. Slopes range from 0 to 1 percent. Elevation ranges from 656 to 1411 feet (200 to 430 meters) above sea level. These sites are subject to frequent ponding throughout much of the year. The ponding duration ranges from long (7 to 30 days) to very long (more than 30 days) with depths up to 12.8 inches (30 cm) above the soil surface. Typically, these sites do not flood. The soil has an apparent seasonally high water table (endosaturation) at the soil surface but it can drop to 35.4 inches (90 cm) during drought conditions. Runoff is negligible to medium.

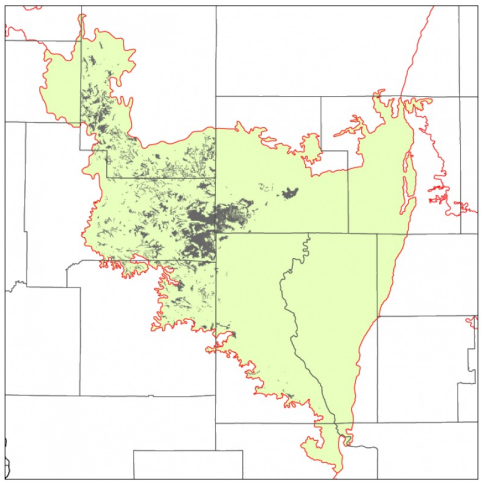


Figure 1. Distribution of Acidic Poor Fen sites in the Wisconsin Central Sands MLRA (89).

Table 2. Representative physiographic features

Slope shape across	(1) Concave
Slope shape up-down	(1) Linear
Landforms	(1) Outwash plain > Outwash plain (2) Outwash plain > Fen
Runoff class	Negligible to medium
Flooding frequency	None
Ponding duration	Long (7 to 30 days) to very long (more than 30 days)
Ponding frequency	Frequent
Elevation	656–1,411 ft
Slope	0–1%
Ponding depth	0–12 in
Water table depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

The continental climate of the Wisconsin Central Sands is typical of the southern half of the state – cold winters and warm summers. Precipitation is well-distributed throughout the year with a slight peak in the summer months. Snowfall covers the ground from late fall to early spring. The soil moisture regime of MLRA 89 is udic (humid climate). The soil temperature regime is mostly frigid, with a small portion of mesic in the southern tip. Neither precipitation nor temperature vary greatly across this MLRA. More so than latitude, local topography seems to be an important predictor of growing season length, with fewer growing degree days in lower-lying areas.

This site occurs on landscape depressions and its local topography is expected to influence its growing season length. The freeze-free and frost-free periods may be shorter than what is represented here.

The average annual precipitation for this site is 34 inches. The average annual snowfall is 47 inches. The annual average maximum and minimum temperatures are 55°F and 33°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	89-121 days
Freeze-free period (characteristic range)	116-150 days
Precipitation total (characteristic range)	34 in
Frost-free period (actual range)	77-124 days
Freeze-free period (actual range)	100-150 days
Precipitation total (actual range)	34 in
Frost-free period (average)	104 days
Freeze-free period (average)	131 days
Precipitation total (average)	34 in

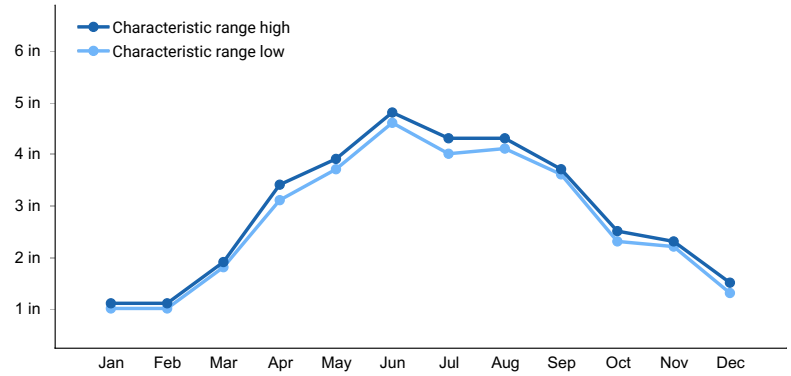


Figure 2. Monthly precipitation range

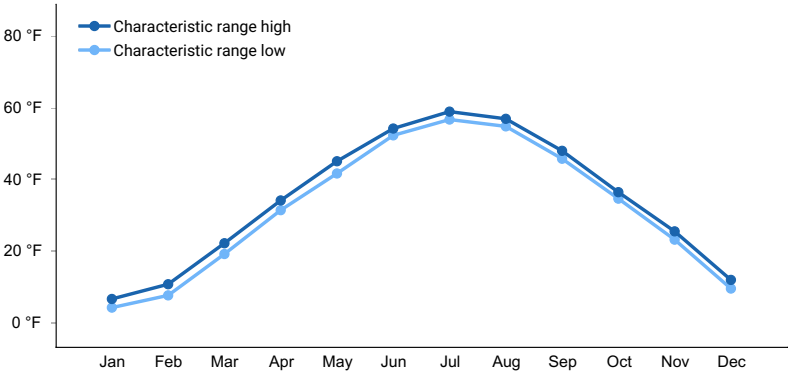


Figure 3. Monthly minimum temperature range

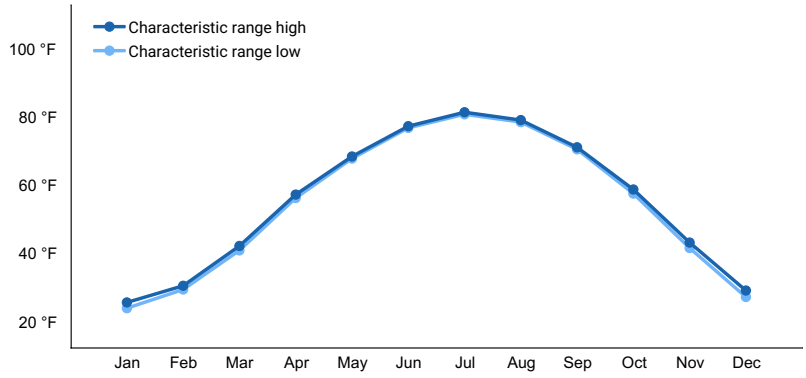


Figure 4. Monthly maximum temperature range

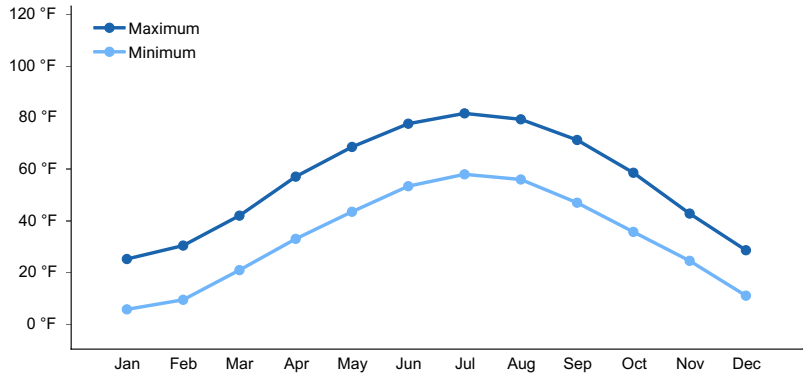


Figure 5. Monthly average minimum and maximum temperature

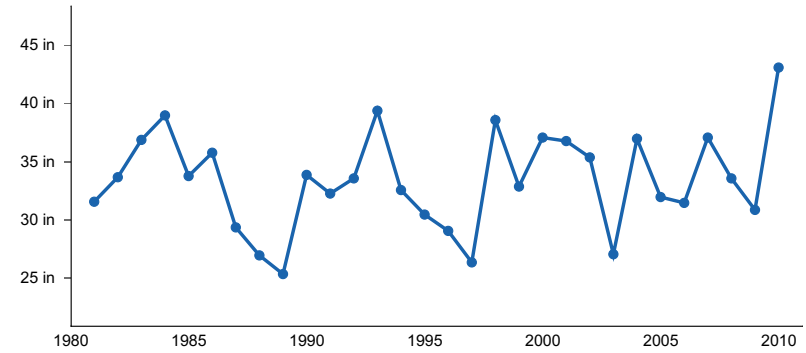


Figure 6. Annual precipitation pattern

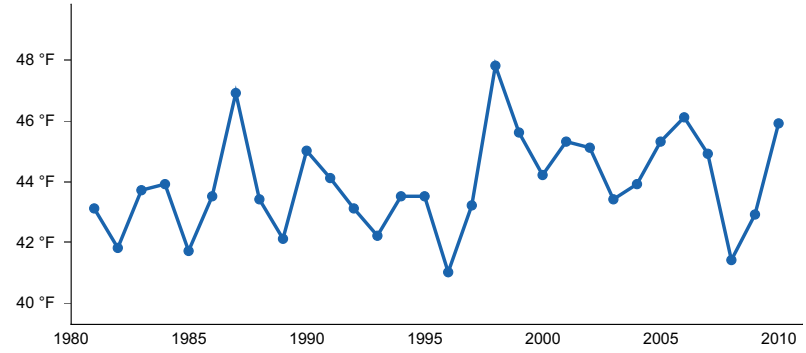


Figure 7. Annual average temperature pattern

Climate stations used

- (1) HATFIELD [USC00473471], Merrillan, WI
- (2) MATHER 3 NW [USC00475164], Warrens, WI
- (3) MAUSTON 1 SE [USC00475178], Mauston, WI

Influencing water features

Water is received through precipitation, runoff from adjacent uplands, and groundwater. Water levels are greatly influenced by precipitation rates and runoff from upland sites. Water leaves the site primarily through evapotranspiration, groundwater recharge, and less often, stream outflow. These sites are wetlands.

The hydrology of Acidic Poor Fen sites significantly impacts their ecological development. Groundwater discharge on these sites brings in water that is exposed to surrounding acidic parent materials, such as sand deposits. This interaction keeps the soils acidic, but less acidic than if sites receive no groundwater discharge, as is in the case of acid bogs.
Under the Cowardin System of Wetland Classification, or National Wetlands Inventory (NWI), the wetlands can be classified as:
1) Palustrine, forested, broad-leaved deciduous, saturated, or
2) Palustrine, scrub-shrub, broad-leaved evergreen, saturated, or
3) Palustrine emergent, persistent, saturated

Under the Hydrogeomorphic Classification System (HGM), the wetlands can be classified as:
1) Depressional, acid, forested/organic, or
2) Depressional, acid, scrub-shrub/organic
Permeability of the soil is moderately rapid to moderately slow. The hydrologic group of this site is A/D or B/D.

Soil features

The soils of these sites are represented by Dawson, Dawsil, Loxley, and Citypoint soil series. Dawson and Dawsil are classified as Terric Haplosaprists. Loxley and Citypoint are classified as a Typic Haplosaprists.

These soils are formed in shallow to very deep, highly decomposed organic material primarily of herbaceous origin. Some soils have mineral contact within 78.7 inches (200 cm) of the surface. Some have bedrock contact within 78.7 inches (200 cm). Soils are very poorly drained and remain saturated throughout the year. They meet hydric soil requirements.

The surface horizon of these soils is often dominated by sphagnum moss with some fibric materials directly underlying. The subsurface horizons are composed of highly decomposed organic muck, or sapric materials. Soil pH is extremely acid to strongly acid with a range from 4.0 to 5.5. Fragments are primarily absent throughout the profile, but up to 2 percent of volume of fragments less than 3 inches may be found in the mineral portion of the soils. Sites are absent of carbonates within 78.7 inches (200 cm)

Figure 8. Dawsil soil series sampled in Jackson County, WI.

Table 4. Representative soil features

Parent material	(1) Organic material

Surface texture	(1) Mucky peat (2) Peat
Family particle size	(1) Sandy or sandy-skeletal (2) Not used
Drainage class	Very poorly drained
Permeability class	Slow
Soil depth	31–80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-60in)	12.58–25.24 in
Calcium carbonate equivalent (0-40in)	0%
Soil reaction (1:1 water) (0-40in)	3.9–5.5
Subsurface fragment volume <=3" (0-80in)	0–13%
Subsurface fragment volume >3" (0-80in)	0%

Table 5. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Soil depth	31–80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-60in)	Not specified
Calcium carbonate equivalent (0-40in)	Not specified
Soil reaction (1:1 water) (0-40in)	Not specified
Subsurface fragment volume <=3" (0-80in)	Not specified
Subsurface fragment volume >3" (0-80in)	Not specified

Ecological dynamics

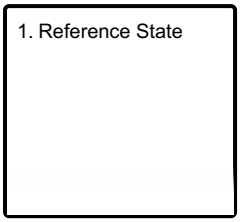
Plant community dynamics are driven by two primary processes: A cyclical and relatively short term effect of ponding and a slow, long-term progression of sphagnum moss accumulation and its acidifying effect on the site. Since the Ecological Site itself is a result of herbaceous peat accumulation, the earliest emergent communities are dominated by sedges, grasses and some facultative-wetland herbaceous species. (‘Facultative-wetland’ species are those that occur primarily in wetlands, but also on some non-wetland sites, as opposed to ‘obligate wetland’ species, which occur only in wetlands). With time, herbaceous peat becomes firm enough to support some woody species such as speckled alder (Alnus crispa), black ash (*Fraxinus nigra*) and tamarack (*Larix laricina*), These early woody communities tend to be unstable. Prolonged ponding, due either to compression of the substrate by increasing tree weight, or by rising water table, may cause partial, or complete mortality of the tree layer and the entire colonization cycle begins anew. Eventually, sphagnum mosses begin to colonize the community, causing pronounced shift in community composition. Sphagnum peat is highly acidic and low in available nutrients. This

condition is unfavorable to early-colonizing deciduous trees and more suited to conifers, such as tamarack, black spruce (*Picea mariana*), balsam fir (Abies balsamifera) and, to some extent, white pine (*Pinus strobus*).

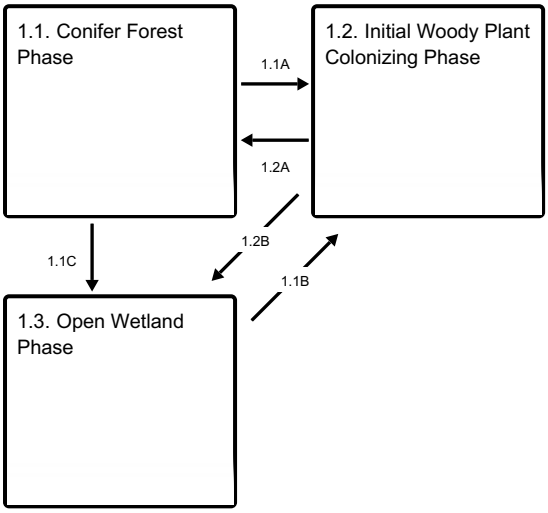
Species composition of the ground layer also changes, mainly by increase of members of heath family (Ericaceae) and many facultative upland species.

State and transition model

Ecosystem states



State 1 submodel, plant communities



1.1A - Periodic small-scale canopy disturbances provide adequate light for regeneration of canopy species, thus perpetuating the existing community.

1.1C - Large-scale canopy disturbance, mortality in canopy layer.

1.2A - Slow accumulation of living and dead sphagnum moss layer, dominance of tree species.

1.2B - Large-scale natural disturbance or tree harvesting, causing swamping of the site.

1.1B - Colonization by trees with tolerance for prolonged ponding.

State 1
Reference State

The Reference State of this Ecological Site may be represented by any of three distinct community Phases, each reflecting the process of wetland formation, the history of natural disturbances and associated vegetation dynamics.

Dominant plant species

- tamarisk (*Tamarix*), tree
- black spruce (*Picea mariana*), tree

Community 1.1
Conifer Forest Phase

Figure 9. An Acidic Poor Fen ecological site in State 1, Community Phase 1.1(Conifer Forest Phase) taken on 06/21/2019, Courtesy of UWSP

This Phase develops over long periods of time, on geological time scale, as sphagnum mosses colonize peatlands that originally formed in herbaceous plant material. At this stage, the acidifying action of sphagnum moss limits long-term occupancy of the site only to two tree species, tamarack and black spruce. Other conifers, such as balsam fir, white pine and eastern hemlock (*Tsuga canadensis*), as well as some deciduous species such as red maple, paper birch and elms, often occur as temporary associates, but they lack longevity under these soil conditions.

Dominant plant species

- tamarack (*Larix laricina*), tree
- black spruce (*Picea mariana*), tree
- sphagnum (*Sphagnum*), other herbaceous

Community 1.2
Initial Woody Plant Colonizing Phase

Figure 10. An Acidic Poor Fen ecological site in State 1, Community Phase 1.2(Initial Woody Plant Phase) taken on 05/23/2019, Courtesy of UWSP

When in the process of wetland formation, the herbaceous plant peat accumulation eventually reaches critical density and seasonal water table recedes enough to permit development of aerated rooting zone, a number of tree and shrub species find conditions suitable for growth. Early colonizing shrubs typically include tag alder (*Alnus incana*), willows (Salix spp.), steeplebush (*Spiraea tomentosa*) and chokecherry (*Prunus virginiana*). The most common colonizing trees are elms (Ulmus spp.), red maple (A. rubrum) and black and green ash (*Fraxinus nigra*, F pensylvanica). This condition is also achieved through community pathway 1.1B described above.

Dominant plant species

- elm (*Ulmus*), tree
- red maple (*Acer rubrum*), tree

- black ash (*Fraxinus nigra*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- alder (*Alnus*), shrub
- willow (*Salix*), shrub
- steeplebush (*Spiraea tomentosa*), shrub
- chokecherry (*Prunus virginiana*), shrub
- sphagnum (*Sphagnum*), other herbaceous

Community 1.3
Open Wetland Phase

Figure 11. An Acidic Poor Fen ecological site in State 1, Community Phase 1.3(Open Wetland Phase) taken on 05/21/2019, Courtesy of UWSP

This community phase represents a transition in wetland formation where obligatory wetland species are being replaced, or outnumbered by the combined facultative wetland and facultative upland species. Sedges and grasses predominate, but characteristic species also include steeplebush (Spiraea palustris), jewelweed (*Impatiens capensis*), sensitive fern (*Onoclea sensibilis*), and marsh dock (*Rumex palustris*). Trees and tall shrubs are absent, or showing up only as sporadic seedlings or saplings. This condition also occurs through community phase pathways 1.1C and 1.2B described above.

Dominant plant species

- steeplebush (*Spiraea tomentosa*), shrub
- jewelweed (*Impatiens capensis*), other herbaceous
- sensitive fern (*Onoclea*), other herbaceous
- marsh dock (*Rumex palustris*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

Conifer Forest Phase

Initial Woody Plant Colonizing Phase

Periodic small-scale canopy disturbances provide adequate light for regeneration of canopy species, thus perpetuating the existing community.

Pathway 1.1C
Community 1.1 to 1.3

Conifer Forest Phase

Open Wetland Phase

Major disturbances, such as blow-downs, tree harvesting, or fire, promote decomposition of surface layers of peat, while swamping, resulting from reduced transpiration due to removal of woody vegetation, cause the return of community to Open Wetland Phase (Community Phase 1.3).

Pathway 1.2A
Community 1.2 to 1.1

Initial Woody Plant Colonizing Phase

Conifer Forest Phase

Very long periods without major disturbances facilitate continuous growth of sphagnum mosses and formation of sphagnum peat and leading community development toward conifer-forest phase (Community Phase1.1).

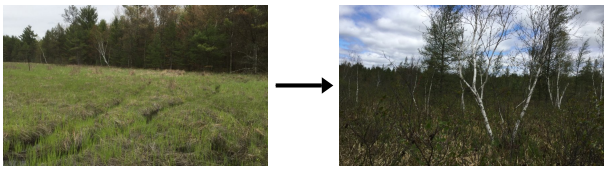
Pathway 1.2B
Community 1.2 to 1.3

Initial Woody Plant Colonizing Phase

Open Wetland Phase

Major disturbances, such as blow-downs, tree harvesting, or fire, promote decomposition of surface layers of peat, while swamping, resulting from reduced transpiration due to removal of woody vegetation, cause the return of community to Open Wetland Phase (Community Phase 1.3).

Pathway 1.1B
Community 1.3 to 1.2



Open Wetland Phase

Initial Woody Plant Colonizing Phase

Large scale disturbance, such as major blow-down, tree harvesting, or fire, cause major changes in the substrate. Increased light and soil-surface temperature promote faster decomposition of sphagnum peat, increasing nutrient availability, thus making conditions suitable again for colonization by deciduous species.

Additional community tables

Inventory data references

Plot and other supporting inventory data for site identification and community phases is located on a NRCS North Central Region shared and one drive folder. University Wisconsin-Stevens Point described soils, took photographs, and inventoried vegetation data at community phases within the reference state. The data sources include WI ESD

Plot Data Collection Form - Tier 2, Releve Method, NASIS pedon description, NRCS SOI 036, photographs, and Kotar Habitat Types.

Other references

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Approval

Suzanne Mayne-Kinney, 9/27/2023

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community

cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	09/27/2023
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:**

17. **Perennial plant reproductive capability:**