Ecological site F089XY002WI
Mucky Swamps

Last updated: 9/27/2023
Accessed: 05/11/2025

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), Central Wisconsin Sand Plain (222Ra), and Lincoln Formation Till Plain - Mixed Hardwoods (212Qb)
Small sections occur in the Central Wisconsin Moraines and Outwash (222Kb) subregion

Ecological site concept

The Mucky Swamps ecological site is most common on the eastern portion of MLRA 89, located in depressions and drainageways on outwash and lake plains. The sites form in low positions on the landscape where bedrock is deep. These sites are characterized by very deep, very poorly drained soils that formed in deep organic deposits of primarily herbaceous origin. Some sites have underlying sandy outwash or loamy alluvium mineral deposits. These soils remain saturated throughout the year and meet hydric requirements.

Precipitation, runoff from adjacent uplands, stream inflow, and groundwater discharge are the primary sources of water. These sites range from strongly acid to slightly alkaline. Many of these sites have carbonates. These sites are wetlands.

Mucky Swamps sites have a higher pH Acidic Poor Fens, meaning they support different vegetative communities. The higher pH is a result of increased interaction with groundwater that may contain dissolved carbonates. In addition, some of these sites have carbonates present in the underlying loamy material. Acidic Poor Fens also interact with groundwater, but the groundwater moves through surrounding acidic materials and does not provide a buffer or raise pH.

Associated sites

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. These sites are primarily found in the eastern half of the Wisconsin Central Sands MLRA. They occur slightly higher on the drainage sequence than Mucky Swamps sites and are often directly adjacent.
F089XY011WI	**Moist Sandy Outwash Uplands** Moist Sandy Outwash Uplands consist of deep sandy deposits derived from a mixture of outwash, alluvium, and lacustrine sources. They are somewhat poorly drained and are subject to neither flooding nor ponding. They occur higher on the drainage sequence than Mucky Swamps 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 occur much higher on the drainage sequence than Mucky Swamps sites.

Similar sites

F089XY001WI	**Acidic Poor Fen** Acidic Poor Fens consist of deep herbaceous organic materials. These sites are wetlands. Like Mucky Swamps, they are very poorly drained and remain saturated throughout the year. Unlike Mucky Swamps, they are strongly to extremely acidic and, as a result, the vegetative communities on these two sites are quite different.

Table 1. Dominant plant species

Tree	(1) *Larix laricina* (2) *Picea mariana*
Shrub	(1) *Ledum*
Herbaceous	(1) *Sphagnum* (2) *Vaccinium*

Physiographic features

This site occurs in depressions and drainageways on outwash plains, lake plains, flood plains, and stream terraces. Slopes range from 0 to 2 percent. Sites are in toeslope positions. Elevation ranges from 170 to 500 meters above sea level.

These sites are subject to frequent ponding throughout the year. The ponding duration ranges from brief (2 to 7 days) to very long (more than 30 days) with depths up to 11.8 inches (30 cm) below the soil surface. Most sites do not flood, but few sites have frequent flooding with brief to long (7 to 30 days) duration. Sites have an apparent seasonally high water table (endosaturation) at the soil surface, but it can drop during dry conditions. Runoff is negligible to very low.

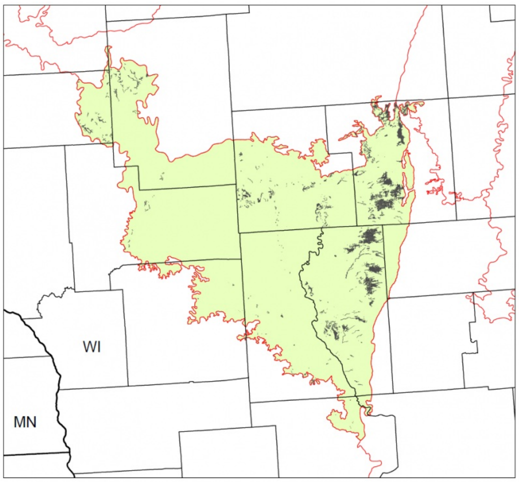


Figure 1. Distribution of Mucky Swamps sites in the Wisconsin Central Sands MLRA (89).

Table 2. Representative physiographic features

Slope shape up-down	(1) Concave
Geomorphic position, flats	(1) Dip
Landforms	(1) Outwash plain > Depression (2) Lake plain > Drainageway (3) Outwash plain > Drainageway (4) Lake plain > Depression
Runoff class	Negligible to very low
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	Occasional to frequent
Ponding duration	Brief (2 to 7 days) to very long (more than 30 days)
Ponding frequency	Occasional to frequent
Elevation	558–1,640 ft
Slope	0–2%
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 33 inches. The average annual snowfall is 46 inches. The annual average maximum and minimum temperatures are 55°F and 34°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	107-125 days
Freeze-free period (characteristic range)	130-145 days
Precipitation total (characteristic range)	33-34 in
Frost-free period (actual range)	81-125 days
Freeze-free period (actual range)	103-149 days
Precipitation total (actual range)	32-34 in
Frost-free period (average)	111 days
Freeze-free period (average)	134 days
Precipitation total (average)	33 in

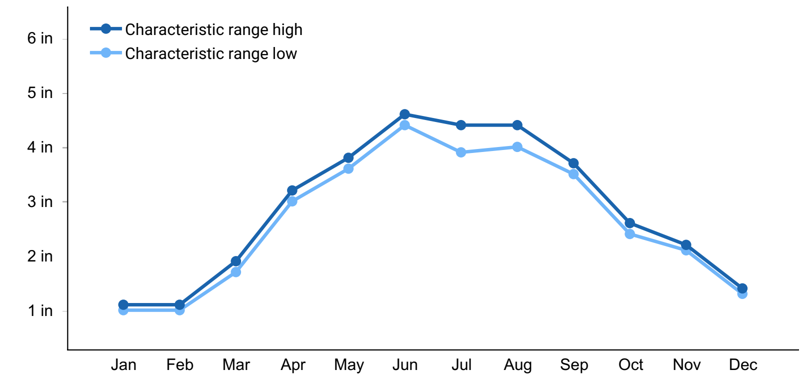


Figure 2. Monthly precipitation range

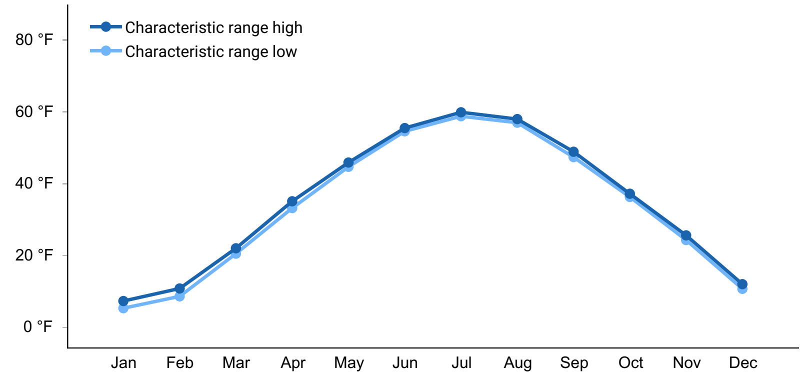


Figure 3. Monthly minimum temperature range

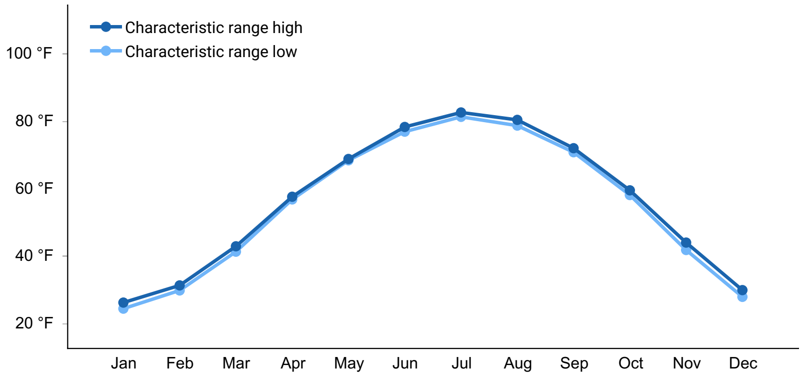


Figure 4. Monthly maximum temperature range

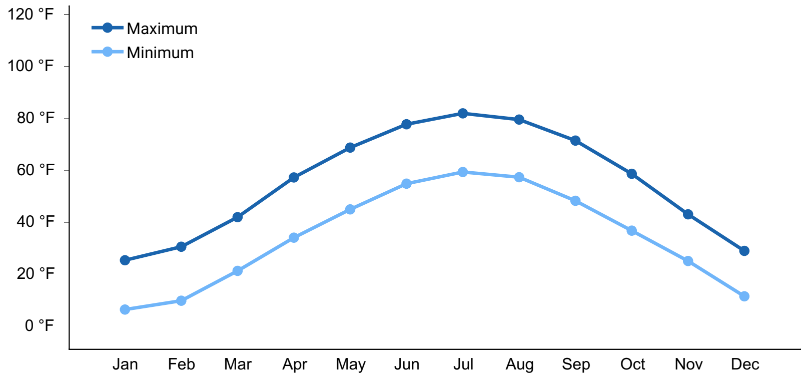


Figure 5. Monthly average minimum and maximum temperature

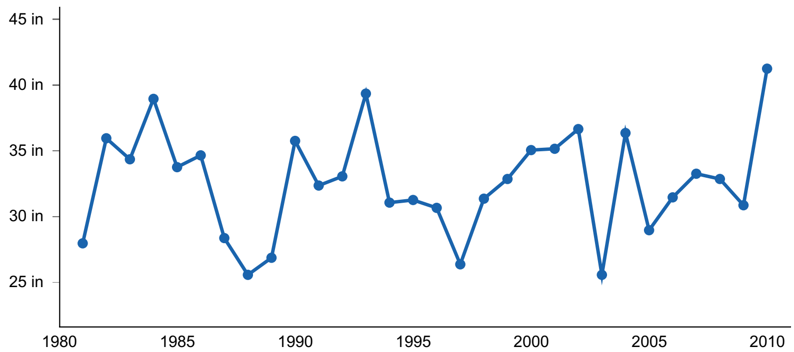


Figure 6. Annual precipitation pattern

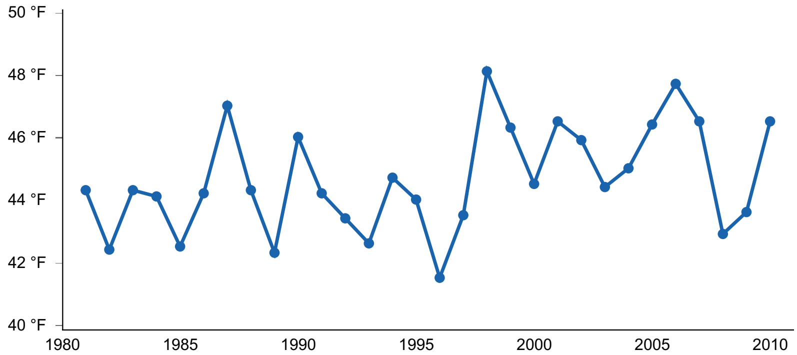


Figure 7. Annual average temperature pattern

Climate stations used

- (1) HATFIELD [USC00473471], Merrillan, WI
- (2) WISCONSIN RAPIDS [USC00479335], Wisconsin Rapids, WI
- (3) HANCOCK EXP FARM [USC00473405], Hancock, WI
- (4) FRIENDSHIP [USC00472973], Adams, WI
- (5) NECEDAH 5 WNW [USW00054903], Necedah, WI
- (6) STEVENS POINT [USC00478171], Stevens Point, WI
- (7) MAUSTON 1 SE [USC00475178], Mauston, WI

Influencing water features

Water is received through precipitation, runoff from adjacent uplands, stream inflow, and groundwater discharge. Water levels are greatly influenced by precipitation rates and runoff from upland sites. Water is discharged from the site primarily through stream outflow, subsurface outflow, evapotranspiration, and ground water recharge. These sites are wetlands.

The hydrology of Mucky Swamps sites significantly impacts their ecological development. Groundwater and stream water are periodically exposed to surrounding parent materials that may contain calcareous deposits and deliver dissolved carbonates to landscape depressions occupied by this site, effectively preventing severe drops in pH. In addition, carbonates are present in the loamy substratum of some of these sites. The Mucky Swamps sites have a higher pH and improved growing conditions over the other two herbaceous organic ecological sites within this MLRA.

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, forested, needle-leaved evergreen, saturated, or
3) Palustrine, scrub-shrub, broad-leaved deciduous, saturated, or
4) Palustrine emergent, persistent, saturated

Under the Hydrogeomorphic Classification System (HGM), the wetlands can be classified as:

1) Depressional, forested/organic, or
2) Depressional, scrub-shrub/organic

Permeability of the soil is very slow or slow. The hydrologic group of this site is A/D or B/D.

Soil features

These sites are represented by the Adrian, Cathro, Houghton, Markey, Palms, and Seelyeville soil series, all of which are classified as Terric Haplosaprists.

These soils formed in herbaceous organic material. Many sites have underlying mineral soil derived from sandy outwash, glacial lake deposits, or alluvium. Depth of organic material ranges from 16.1 inches (41 cm) to over 78.7 inches (200 cm). These sites are very poorly drained and remain saturated throughout the year. They meet hydric soil requirements.

The surface of these soils is muck or mucky peat. Subsurface horizons are primarily muck—highly decomposed organic materials—but also include sand, loamy sand, and loam in the mineral deposits. Soil pH ranges from strongly acid to slightly alkaline with values of 5.8 to 7.5. Surface fragments are absent. Subsurface fragments less than 3 inches can be present up to 12 percent volume, and fragments greater than 3 inches can be present up to 2 percent. Carbonates are absent in most sites, but can be present up to 15 percent beginning at 20 inches (51 cm).

Table 4. Representative soil features

Parent material	(1) Organic material
Surface texture	(1) Mucky peat (2) Muck
Drainage class	Very poorly drained
Permeability class	Very slow to slow
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-60in)	10.37–23.62 in
Calcium carbonate equivalent (0-40in)	0–15%
Soil reaction (1:1 water) (0-40in)	5.8–7.5
Subsurface fragment volume <=3" (0-80in)	0–12%

Subsurface fragment volume >3" (0-80in)	0%

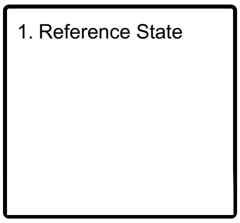
Ecological dynamics

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 black ash (*Fraxinus nigra*), red elm (*Ulmus rubra*), American elm (U. Americana) and red maple (*Acer rubrum*). 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 tree species and more suited to conifers, such as tamarack (*Larix laricina*), 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 (Arecaceae) 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.

1.1B - Large-scale natural disturbance or tree harvesting, causing swamping of the site.

1.2A - Slow accumulation of living and dead sphagnum moss layer.

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

1.3A - Colonization by trees with tolerance for prolonged flooding.

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
- sphagnum (*Sphagnum*), other herbaceous

Community 1.1
Conifer Forest Phase

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 Tree Colonizing Phase

Figure 8. A Mucky Swamps ecological site in State 1, community phase 1.2 (Initial Tree Colonizing Phase), 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 9. Mucky Swamps ecological site in State 1, Community phase 1.3 (open wetland phase), 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 show 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

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

Pathway 1.1B
Community 1.1 to 1.3

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 removed woody vegetation, cause the return of community to Open Wetland Phase (Community Phase 1.3).

Pathway 1.2A
Community 1.2 to 1.1

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 Tree 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 removed woody vegetation, cause the return of community to Open Wetland Phase (Community Phase 1.3).

Pathway 1.3A
Community 1.3 to 1.2

Open Wetland Phase

Initial Tree Colonizing Phase

Colonization by trees with tolerance for prolonged flooding.

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

Clayton, L., & Attig, J. W. (1989). Glacial Lake Wisconsin (Vol. 173). Geological Society of America.

Clayton, L., Attig, J. W., & Mickelson, D. M. (1999). Tunnel channels formed in Wisconsin during the last glaciation. Special Papers-Geological Society of America, 69-82.

Cleland, D.T.; Avers, P.E.; McNab, W.H.; Jensen, M.E.; Bailey, R.G., King, T.; Russell, W.E. 1997. National Hierarchical Framework of Ecological Units. Published in, Boyce, M. S.; Haney, A., ed. 1997. Ecosystem Management Applications for Sustainable Forest and Wildlife Resources. Yale University Press, New Haven, CT. pp. 181-200.

Curtis, J.T. 1959. Vegetation of Wisconsin: an ordination of plant communities. University of Wisconsin Press, Madison. 657 pp.

Finley, R. 1976. Original vegetation of Wisconsin. Map compiled from U.S. General Land Office notes. U.S. Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

NatureServe. 2018. International Ecological Classification Satandard: Terrestrial Ecological Classifications. NautreServe Centreal Databases. Arlington, VA. U.S.A. Data current as of 28 August 2018.

Kotar, J., J. A. Kovach, and T. L. Burger. 2002. A Guide to Forest Communities and Habitat Types of Northern Wisconsin. Second edition. University of Wisconsin-Madison, Department of Forest Ecology and Management, Madison.

Kotar, J., and T. L. Burger. 2017. Wetland Forest Habitat Type Classification System for Northern Wisconsin: A Guide for Land Managers and landowners. Wisconsin Department of Natural Resources, PUB-FR-627 2017, Madison.

Schulte, L.A., and D.J. Mladenoff. 2001. The original U.S. public land sur¬vey records: their use and limitations in reconstructing pre-European settlement vegetation. Journal of Forestry 99:5–10.

Schulte, L.A., and D.J. Mladenoff. 2005. Severe wind and fire regimes in northern forests: historical variability at the regional scale. Ecology 86(2):431–445.

Schulte, L.A., and D.J. Mladenoff. 2005. Severe wind and fire regimes in northern forests: historical variability at the regional scale. Ecology 86(2):431–445.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource and Major Land Resource Areas of the United Sates, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Wisconsin Department of Natural Resources. 2015. The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management. Wisconsin Department of Natural Resources, PUB-SS-1131 2015, Madison.

Contributors

Jacob Prater, Associate Professor at University of Wisconsin Stevens Point
John Kotar, Ecological Specialist, independent contract
Bryant Scharenbroch, Assistant Professor at University of Wisconsin Stevens Point
Joel Gebhard, University of Wisconsin Stevens Point
Shelly Stein, University of Wisconsin Stevens Point

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:**
