Ecological site F094BY003MI
Floodplain

Last updated: 11/16/2023
Accessed: 05/19/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 094B–Michigan Eastern Upper Peninsula Sandy Glacial Deposits

The Michigan Eastern Upper Peninsula MLRA (94B) corresponds closely with the Northwestern Sands Ecological Landscape. Some of the following brief overview is borrowed from the Wisconsin Department of Natural Resources ecological landscape publication (2015).

The Michigan Eastern Upper Peninsula MLRA is in northeast Wisconsin on the border of the Upper Peninsula of Michigan, with a very small portion on the Lake Michigan coast disjoined from the rest of the MLRA. The Wisconsin portion of the MLRA is a bit shy of 1.1 million acres (1,668 square miles). This region, which was covered entirely by the Green Bay Lobe in Wisconsin's most recent glaciation, has a unique glacial landscape defined by intermingled loamy moraines and sandy heads-of-outwash. Extensive pitted outwash plains dominate the region, with significant glaciolacustrine sediments in the southeast portion of this region.

A prominent landform in this MLRA is the hummocky ridges of intermingled loamy moraines and sandy heads-of-outwash that protrude from extensive pitted outwash plains. These north-south trending, loamy morainal ridges were deposited as the Green Bay Lobe was stagnant—the rate of melting was relatively equal to the rate of advancement. This stagnation allowed the deposition of a ridge of sandy loam materials. Supraglacial till was deposited unevenly, and buried ice blocks melted and collapsed the surface to form hummocky topography on the moraines. The heads-of-outwash formed while the ice was melting and thinning rapidly. Large amounts of sand and gravel outwash materials, and some till and loamy debris-flow sediment, were deposited on top of the thin edge of ice. They, too, have hummocky topography resulting from the collapse of buried ice. The topographically similar appearances of the moraines and heads-of-outwash make them difficult to distinguish superficially, but they are formed in different-textured materials and the vegetation divergence is often evident. These moraines and heads-of-outwash mark the western extent of the Green Bay Lobe and are sometimes referred to as the Athelstane Moraines.

As the Green Bay Lobe receded, meltwaters carried sand and gravel outwash sediments to lower-lying areas. The outwash buried broken ice that melted, collapsed the surface, and created extensive pitted outwash plains that occur between the high elevation moraines and heads-of-outwash. More than 50% of this land region is covered in outwash sediments, and most of the outwash is pitted or collapsed.

The southeast portions of this MLRA are dominated by glacial lake sediments. Glacial Lake Oshkosh covered a portion of this MLRA when it was at its largest extent (1.4 million acres). The lake deposited silts and clays along the southeast portion of the inland section of this MLRA. Beach terraces, ridges, and dunes were also formed by the lake. In the Lake Michigan coastal section of this MLRA, Glacial Lake Nipissing deposited a level lake plain full of sandy lacustrine material that overlies dolomite and limestone bedrock. Glacial Lake Nipissing was a postglacial lake that occurred in the Lake Michigan Basin as the Lake Michigan Lobe was receding. Wetlands are abundant in this area of the MLRA. In the north section, Glacial Lake Dunbar formed when ice dams impounded glacial meltwater between the Athelstane Moraine and the Inner Athelstane Moraine. This glacial lake deposited small areas of level sandy lacustrine materials.

The northeast section of this MLRA is a till plain that formed in later advances of the Green Bay Lobe. Some pitted outwash is present, but the till plain is much more exposed here than elsewhere in the MLRA. The till deposited throughout 94B is primarily sandy, dolomitic till. The dolomite was scraped off the Niagara Escarpment as the Green Bay Lobe moved across it. In some areas, the carbonates are deeply leached.

Historically, this MLRA was dominated by a mixture of northern hardwood forests, Jack pine-scrub oak barrens, and forested coniferous wetlands at 30%, 29%, and 20%, respectively. White pine (Pinus strobus) and red pine (Pinus resinosa) were dominant tree species and covered an estimated 15% of the area. Northern hardwood forests were dominated by eastern white pine, eastern hemlock (Tsuga canadensis), and American beech (Fagus grandifolia). The Jack pine-scrub oak barrens were dominant in the sandy portions of this MLRA. Forested coniferous wetlands were occupied by norther white-cedar (Thuja occidentalis), black spruce (Picea mariana), and tamarack (Larix laricina).

Classification relationships

Relationship to Established Framework and Classification Systems:

Habitat Types of N. Wisconsin (Kotar, 2002): Acer-Tsuga/Dryopteris-Hydrophyllum (ATDH), Acer-Tsuga/Athyrium-Onoclea (ATAtOn)

Biophysical Settings (Landfire, 2014): Laurentian-Acadian Floodplain Forest, Laurentian-Acadian Alkaline Conifer-Hardwood Swamp

WDNR Natural Communities (WDNR, 2015): Floodplain Forest

Hierarchical Framework Relationships:

Major Land Resource Area (MLRA): Michigan Eastern Upper Peninsula MLRA (94B)

USFS Subregions: Athelstane Sandy Outwash and Moraines (212Tc), Green Bay Sandy Lake Plain (212Te)

Wisconsin DNR Ecological Landscapes: Northeast Sands, Northern Lake Michigan Coastal

Ecological site concept

Floodplain ecological site accounts for approximately 21,000 acres in MLRA 94B, or about 2% of total land area. Sites are located on floodplains throughout the MLRA. These sites are characterized by very deep, poorly to moderately well drained soils that form in sandy to loamy alluvium. Sites are subject to flooding in spring and fall. Soils remain saturated for long duration during growing season and some sites meet hydric soil requirements. Stream inflow, precipitation, runoff from adjacent uplands, and groundwater discharge are the primary sources of water. Soils range from slightly acid to neutral. Some sites may be wetlands. Vegetation supported by these sites must be tolerant of frequent floods.

Associated sites

F094BY011MI	**Dry Upland** Dry Upland sites are found in upland landscape positions on outwash plains and stream terraces. They are excessively drained. They are often found directly adjacent to Floodplain sites.
F094BY008MI	**Sandy Upland** Sandy Upland sites are found in upland landscape positions on outwash plains, stream terraces, sandy lake plains, and moraines. They are moderately well to somewhat excessively drained. They are often found directly adjacent to Floodplain sites.
F094BY009MI	**Loamy Upland** Loamy Upland sites are found in upland landscape positions on moraines, lake plains, and outwash plains. They are moderately well to somewhat excessively drained. They are often found directly adjacent to Floodplain sites.

Similar sites

F094BY004MI	**Wet Sandy Lowland** Wet Sandy Lowland sites are wetland sites that occupy landscape depressions in sandy landscapes, often sandy pitted outwash plains. They are poorly drained. They support vegetative communities that are sometimes similar to those supported by Floodplain sites.

Table 1. Dominant plant species

Tree	(1) *Acer saccharum* (2) *Acer rubrum*
Shrub	Not specified
Herbaceous	(1) *Onoclea sensibilis* (2) *Maianthemum canadense*

Physiographic features

This site is found on outwash plains in landscape depressions that receive little to no water from stream or groundwater flow. Slopes range from 0 to 1 percent.

These sites are subject to occasional ponding. Ponding duration may be long (7 to 30 days) to very long (greater than 30 days). These soils have an apparent seasonally-high water table (endosaturation) at the surface. Runoff potential is negligible.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope
Slope shape across	(1) Concave
Slope shape up-down	(1) Linear
Landforms	(1) Outwash plain (2) Flood plain
Runoff class	Negligible to high
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	Rare
Ponding frequency	None
Elevation	209–271 m
Slope	0–2%
Water table depth	0–193 cm
Aspect	Aspect is not a significant factor

Climatic features

The continental climate of the Michigan Eastern Upper Peninsula MLRA is typical of northern Wisconsin: cooler summers, colder winters, and shorter growing seasons.

Table 3. Representative climatic features

Frost-free period (characteristic range)	101-108 days
Freeze-free period (characteristic range)	126-139 days
Precipitation total (characteristic range)	762-813 mm
Frost-free period (actual range)	99-110 days
Freeze-free period (actual range)	122-143 days

Precipitation total (actual range)	762-813 mm
Frost-free period (average)	100 days
Freeze-free period (average)	125 days
Precipitation total (average)	787 mm

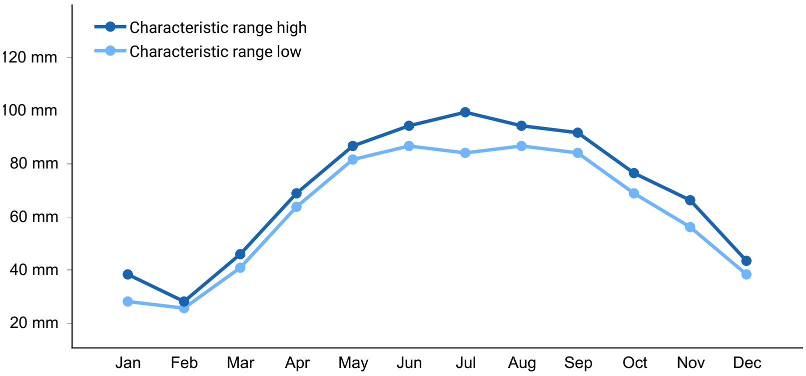


Figure 1. Monthly precipitation range

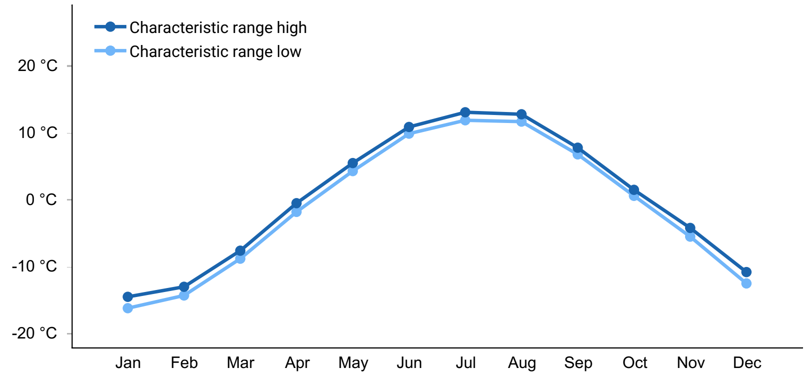


Figure 2. Monthly minimum temperature range

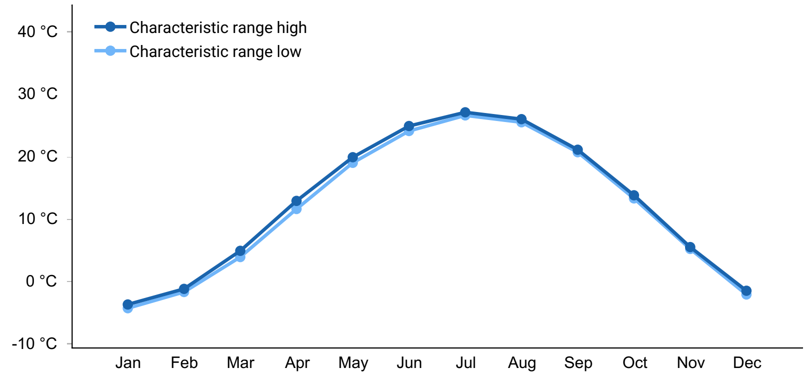


Figure 3. Monthly maximum temperature range

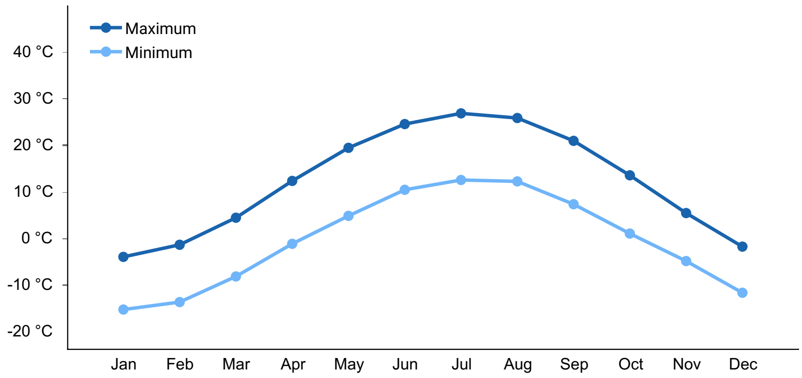


Figure 4. Monthly average minimum and maximum temperature

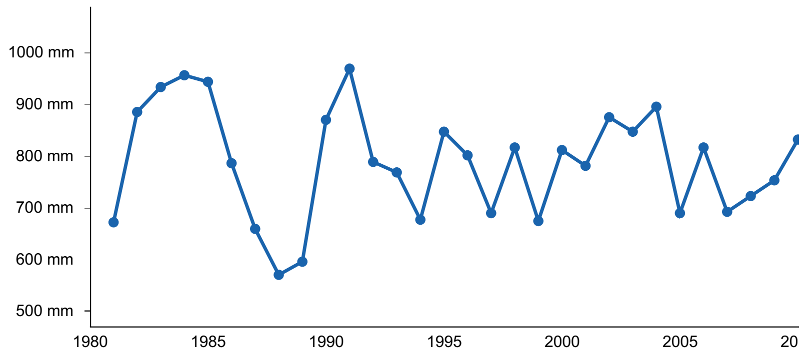


Figure 5. Annual precipitation pattern

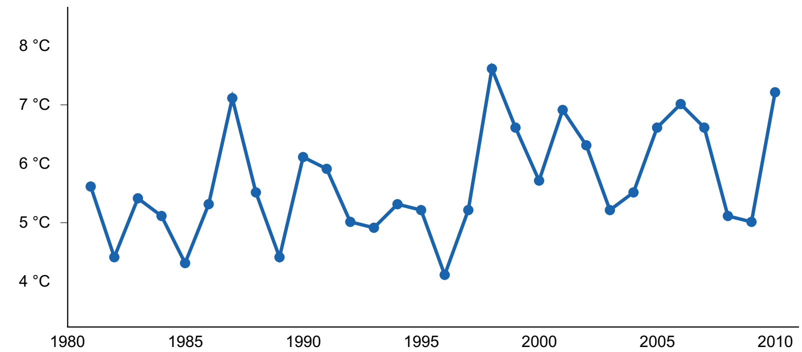


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CRIVITZ HIGH FALLS [USC00471897], Crivitz, WI
- (2) SURING [USC00478376], Suring, WI
- (3) PESHTIGO [USC00476510], Peshtigo, WI

Influencing water features

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

Frequent flooding from stream inflow is a significant factor in the ecological development of the Floodplains ecological site. The vegetation must be tolerant of frequent flooding that may persist for up to a month.

Wetland description

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 deciduous, saturated, or
3) 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 these sites is slow to moderate.
Hydrologic Group: A, C, A/D, B/D
Hydrogeomorphic Wetland Classification: Depressional, acid, forested/organic; Depressional, acid, scrub-shrub/organic
Cowardin Wetland Classification: PFO1B, PSS1B, PEM1B

Soil features

The soils of this site are represented by the Arnheim, Moquah, and Winterfield, classified as Typic Fluvaquents, Typic Udifluvents, and Aquic Udipsamments, respectively. 68% of the acreage of this site is Typic Fluvaquents.

These sites form in sandy to loamy alluvium. Most of the sandy sites are found in floodplains amid sandy glacial lake deposits in northwestern Oconto county. Soils lack bedrock contact within two meters of the surface. They are poorly to moderately well drained. Some sites meet hydric soil requirements.

Small fragments (gravels) may occupy up to 2 percent volume of the substratum in some sites. Soils are slightly acid to neutral. Some sites have secondary carbonates occupying up to 3 percent volume starting at the soil surface.

Figure 7. Moquah Soil Series sample taken in Marinette County, WI on 06/17/2020. Courtesy of UWSP.

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Sandy loam
Drainage class	Poorly drained to moderately well drained
Permeability class	Slow to moderate
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-152.4cm)	13.97–21.84 cm

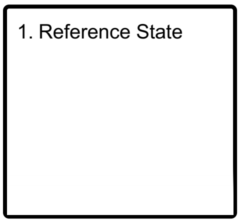
Calcium carbonate equivalent (0-101.6cm)	0–3%
Soil reaction (1:1 water) (0-101.6cm)	6.2–6.7
Subsurface fragment volume <=3" (Depth not specified)	0–2%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

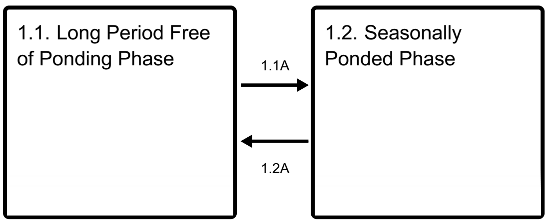
Because floodplain sites are subject to seasonal, yearly and long-term variation in hydrological conditions, it is not possible to speak of any directional, community-driven plant succession, as is typical of more environmentally-stable upland plant communities. Instead, individual hydrologic events create conditions temporarily favorable to a given species, or groups of species, and unfavorable to other species or groups. Species differ greatly in their ability to tolerate frequency of flooding and duration of ponding. Silver maple (*Acer saccharinum*) is best adapted species to colonize freshly deposited sediment. It is a prolific seed producer and germinates immediately upon maturing, without the need of undergoing a cold period. Once established, seedlings, as well as mature trees, tolerate repeated flooding and prolonged ponding. Black ash (*Fraxinus nigra*) is well adapted to growing in saturated conditions, allowing it to grow commonly in seasonally flooded habitats. Other species that may become established in periods without major flooding or ponding include sugar maple (*Acer saccharum*) red maple (*Acer rubrum*), Balsam fir (Abies, balsamia), white oak (*Quercus alba*), swamp white oak (*Q. bicolor*), and white ash (*Fraxinus americana*).

State and transition model

Ecosystem states



State 1 submodel, plant communities



1.1A - Major flooding event depositing new sediment.

1.2A - Long period without major flooding.

State 1
Reference State

Figure 8. Photo courtesy of UWSP taken on 06/17/2020 in Marinette County, WI.

Because of the dynamic nature of hydrological events affecting this Ecological Site, many different plant communities can be found at any given time. We chose two distinct community phases to represent the Reference state: 1, a long period free of extended ponding community phase and 2, frequently flooded and ponded community phase.

Community 1.1
Long Period Free of Ponding Phase

Figure 9. Photo courtesy of UWSP taken on 06/17/2020 in Marinette County, WI.

Periods of several decades, or longer, without prolonged ponding allow for the development of forest communities closely resembling the upland mesic or wet-mesic communities. Such forests are characterized by strong presence, or dominance of any of the following species: white and swamp white oak, white ash, and other mesic hardwoods like red and sugar maple (*Acer saccharum*), and basswood (TIlia americana). Some of these mesic hardwoods are sensitive to saturated soils and are quickly elimanted by major flooding or extended ponding events. Characteristic understory plants Sensitive fern (*Onoclea sensibilis*), Canada mayflower (Mainathemum canadense), bedstraws (Gallium, spp.), and meadow rue (*Thalictrum dioicum*). Small scale canopy disturbances may occur, e.g., snow/ice breakage and individual tree mortality, increase light on forest floor and stimulate regeneration of canopy species. Through this process the relative importance of different species varies, but the basic mesic community is perpetuated.

Resilience management. The long period free of ponding phase is driven by lack of ponding for decades or longer.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- red maple (*Acer rubrum*), tree
- balsam fir (*Abies balsamea*), tree
- white oak (*Quercus alba*), tree
- swamp white oak (*Quercus bicolor*), tree
- white ash (*Fraxinus americana*), tree
- American basswood (*Tilia americana*), tree
- sensitive fern (*Onoclea*), other herbaceous
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- early meadow-rue (*Thalictrum dioicum*), other herbaceous
- bedstraw (*Galium*), other herbaceous

Community 1.2
Seasonally Ponded Phase

Silver maple is a well-adapted species to frequently flooded conditions. On such sites it typically occurs in pure stands, or with only sporadic association of other species that become established on micro-sites with less frequent, or shorter duration ponding. Such associates are black ash, red maple, swamp white oak, elms (Ulmus spp.) and occasionally yellow birch. Understory vegetation is sparse, consisting mostly of grasses, sedges, and ferns. Seasonal flooding with fresh sediment deposition may occur.

Resilience management. The seasonally ponded phase is driven by frequently flooded conditions.

Dominant plant species

- silver maple (*Acer saccharinum*), tree
- sedge (*Carex*), grass
- sensitive fern (*Onoclea*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

Major flooding event deposits new sediment that causes mortality of some of the canopy trees and provides germination and seedling establishment conditions for some species, most frequently silver maple.

Pathway 1.2A
Community 1.2 to 1.1

Long periods, usually decades, without major flooding or ponding. Woody encroachment from less water tolerant species allows for the development of forest communities closely resembling the upland mesic or wet-mesic communities.

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
Habitat Types of N. Wisconsin (Kotar, 2002): Acer-Tsuga/Dryopteris-Hydrophyllum (ATDH), Acer-Tsuga/Athyrium-Onoclea (ATAtOn)
Biophysical Settings (Landfire, 2014): Laurentian-Acadian Floodplain Forest, Laurentian-Acadian Alkaline Conifer-Hardwood Swamp
WDNR Natural Communities (WDNR, 2015): Floodplain Forest

Other references

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.

County Soil Surveys from St. Croix, Polk, Barron, Rusk, Chippewa, Clark, Marathon, Taylor, Price, Sawyer, Burnett, Washburn, Douglas, Bayfield, Ashland, Lincoln, Oneida, Langlade, Shawano, Menominee, Forest, Florence, Marinette, and Pierce Counties.

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

Davis, R.B. 2016. Bogs and Fens, A Guide to the Peatland Plants of Northeastern United States and Adjacent Canada. University Press of New England, Hanover and London. 296 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.

Hvizdak, David. Personal knowledge and field experience.

Jahnke, J. and Gienccke, A. 2002. MLRA 92 Clay Till Field Investigations. Summary of field day investigations by Region 10 Soil Data Quality Specialists.

Kotar, J. 1986. Soil – Habitat Type relationships in Michigan and Wisconsin. J. For. and Water Cons. 41(5): 348-350.

Kotar, J., J.A. Kovach and G. Brand. 1999. Analysis of the 1996 Wisconsin Forest Statistics by Habitat Type. U.S.D.A. For. Serv. N.C. Res. Stn. Gen. Tech. Rept. NC-207.

Kotar, J., J.A. Kovach and T. L. Burger. 2002. A Guide to Forest Communities and Habitat Types of Northern Wisconsin. 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.

Martin, L. 1965. The physical geography of Wisconsin. Third edition. The University of Wisconsin Press, Madison.

McNab, W.H. and P.W. Avers. 1994. Ecological Subregions of the United States: Section Descriptions. USDA For. Serv. Pun. WO-WSA-5, Washington, D.C.

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

Radeloff, V.C., D.J. Mladenoff, H.S. He and M.S. Boyce. 1999. Forest landscape change in Northwestern Wisconsin Pine Barrens from pre-European settlement to the present. Can. J. For. Res. 29: 1649-1659.

Schulte, L.A., and D.J. Mladenoff. 2001. The original U.S. public land survey 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.

Soil Survey Staff. Input based on personal experience. Tim Miland, Scott Eversoll, Ryan Bevernitz, and Jason Nemecek.

Stearns, F. W. 1949. Ninety years change in a northern hardwood forest in Wisconsin. Ecology, 30: 350-58.

United States Department of Agriculture, Forest Service. 1989. Proceedings – Land Classification Based on Vegetation: Applications for Management. Gen. Tech. Report INT-527.

United States Department of Agriculture, Forest Service. 1990. Silvics of North America, Vol. 1, Hardwoods. Agricultural Handbook 654, Washington, D.C.

United States Department of Agriculture, Forest Service. 1990. Silvics of North America, Vol. 2, Conifers. Agricultural Handbook 654, Washington, D.C.

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.

United States Department of Agriculture, Natural Resources Conservation Service. 2008. Hydrogeomorphic Wetland Classification System: An Overview and Modification to Better Meet the Needs of the Natural Resources Conservation Service. Technical Note No. 190-8-76. Washington D.C.

Wilde, S.A. 1933. The relation of soil and forest vegetation of the Lake States Region. Ecology 14: 94-105.

Wilde, S.A. 1976. Woodlands of Wisconsin. University of Wisconsin Cooperative Extension, Pub. G2780, 150 pp.

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

Bryant Scharenbroch, Assistant Professor at University of Wisconsin Stevens Point
Jacob Prater, Associate Professor at University of Wisconsin Stevens Point
John Kotar, Ecological Specialist, independent contractor

Approval

Suzanne Mayne-Kinney, 11/16/2023

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NRCS contracted UWSP to write ecological sites in MLRA 94B, completed in 2021.

Rangeland health reference sheet

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

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

Indicators

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

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

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

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

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

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

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
