

Ecological site F094BY004MI Wet Sandy Lowland

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General information

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

MLRA notes

Major Land Resource Area (MLRA): 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 northern 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): *Tsuga/Maianthemum-Coptis* (TMC), *Abies-Thuja-Acer/Acer* (AbThArAsp), *Acer-Abies/Vaccinium-Coptis* (ArAbVC), *Acer-Tsuga/Athyrium-Onoclea* (ATAtOn)

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

WDNR Natural Communities (WDNR, 2015): Northern Hardwood Swamp

Hierarchical Framework Relationships:

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

USFS Subregions: Athelstane Sandy Outwash and Moraines (212Tc)

Wisconsin DNR Ecological Landscapes: Northeast Sands

Ecological site concept

The Wet Sandy Lowland ecological site accounts for approximately 12,000 acres in MLRA 94B, or about 1.1% of total land area. It is found in depressions and drainageways primarily on pitted outwash plains.

This site is characterized by very deep, poorly drained, sandy soils. Some sites are subject to frequent ponding in the spring and fall. Soils remain saturated for long periods during the growing season and meet hydric soil requirements. Precipitation, runoff from adjacent uplands, groundwater discharge, and stream inflow are the primary sources of water. These sites are wetlands.

Associated sites

F094BY001MI	<p>Poor Fen</p> <p>Poor Fen are wetland sites occupying landscape depressions and drainageways. They form in deep, herbaceous organic deposits and are very poorly drained. These sites have limited interaction with groundwater and are very acidic (dysic). They are found in lower positions along the same drainage sequence as Wet Sandy Lowland.</p>
F094BY006MI	<p>Moist Sandy Lowland</p> <p>Moist Sandy Lowland are found in lower landscape positions on outwash plains. They are somewhat poorly drained. They are found in higher positions along the same drainage sequence as Wet Sandy Lowland.</p>
F094BY008MI	<p>Sandy Upland</p> <p>Sandy Upland 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 found in higher positions along the same drainage sequence as Wet Sandy Lowland.</p>

F094BY011MI	<p>Dry Upland</p> <p>Dry Upland are found in upland landscape positions on outwash plains and stream terraces. They are excessively drained. They occupy the highest positions along the same drainage sequence as Wet Sandy Lowland.</p>
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Similar sites

F094BY003MI	<p>Floodplain</p> <p>These sites are found on floodplains adjacent to streams and rivers. They form in sandy to loamy alluvium deposits. They are seasonally flooded with flooding durations lasting up to a month. They are poorly to moderately well drained. Some sites are wetlands. They sometimes support vegetative communities similar to those supported by Wet Sandy Lowland.</p>
F094BY005MI	<p>Wet Loamy Lowland</p> <p>Wet Loamy Lowland are wetland sites that occupy landscape depressions on moraines, lake plains, or outwash plains. They are very poorly to poorly drained. They are very similar to West Sandy Lowland except have finer textures and a high nutrient status.</p>

Table 1. Dominant plant species

Tree	(1) <i>Acer rubrum</i> (2) <i>Abies balsamea</i>
Shrub	(1) <i>Corylus cornuta</i>
Herbaceous	(1) <i>Maianthemum canadense</i> (2) <i>Pteridium aquilinum</i>

Physiographic features

This site is found in depressions and drainageways on outwash plains, moraines, and lake plains. Slopes range from 0 to 2 percent. Elevation of the landform ranges from 557 to 972 feet above sea level.

Some sites are subject to frequent ponding. Ponding may last between 7 and 30 days. The soil has an apparent seasonally-high water table (endosaturation) at the surface. The water table may drop in dry conditions. Runoff potential is negligible to low.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope
Slope shape across	(1) Concave
Slope shape up-down	(1) Concave
Landforms	(1) Depression (2) Drainageway (3) Moraine (4) Lake terrace (5) Outwash plain
Runoff class	Negligible to low
Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	170–296 m
Slope	0–2%

Ponding depth	0–30 cm
Water table depth	0 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. This site occurs on landscape depressions and may have a microclimate with shorter freeze-free and frost-free periods than what is represented by the weather station data.

Table 3. Representative climatic features

Frost-free period (characteristic range)	102-110 days
Freeze-free period (characteristic range)	126-140 days
Precipitation total (characteristic range)	762-787 mm
Frost-free period (actual range)	99-111 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

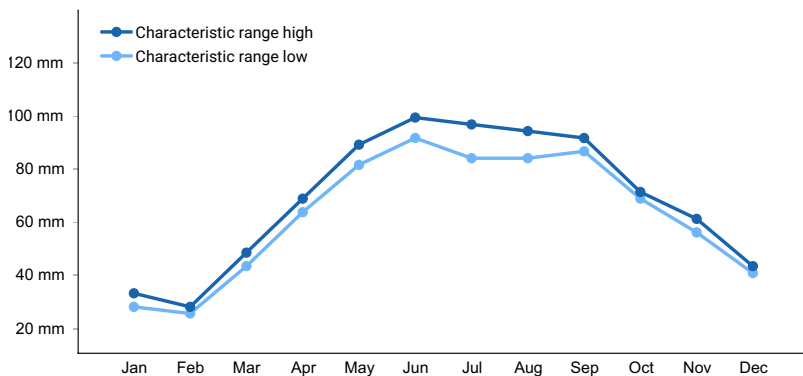


Figure 1. Monthly precipitation range

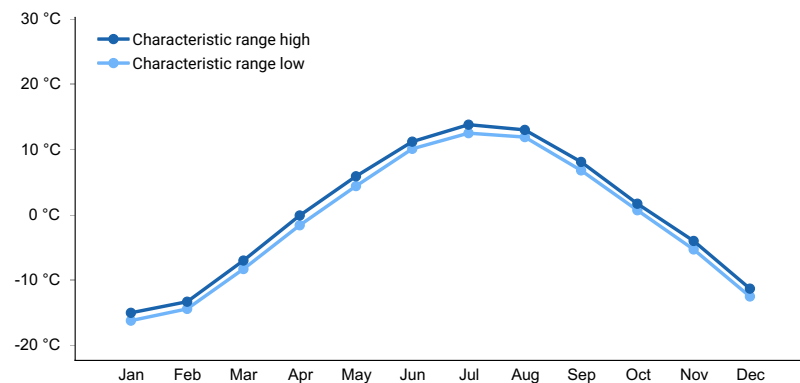


Figure 2. Monthly minimum temperature range

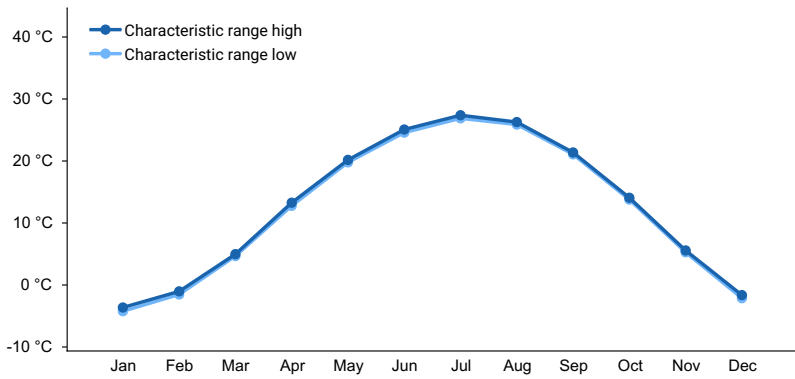


Figure 3. Monthly maximum temperature range

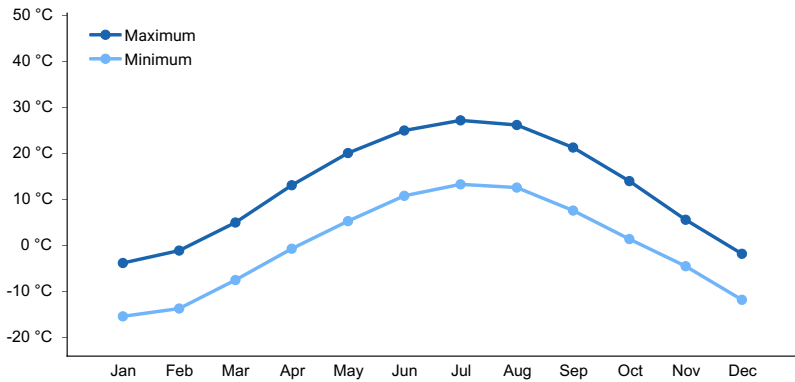


Figure 4. Monthly average minimum and maximum temperature

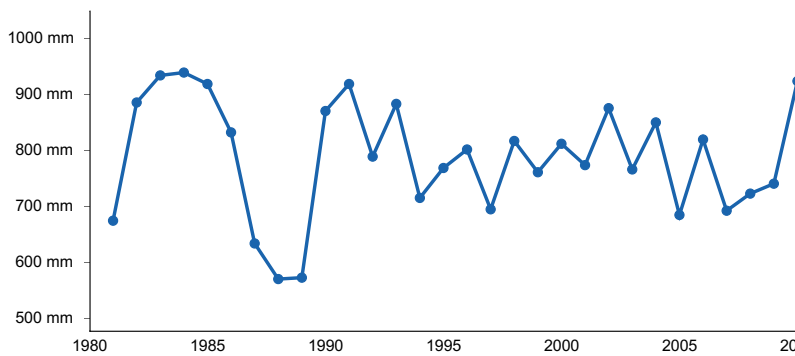


Figure 5. Annual precipitation pattern

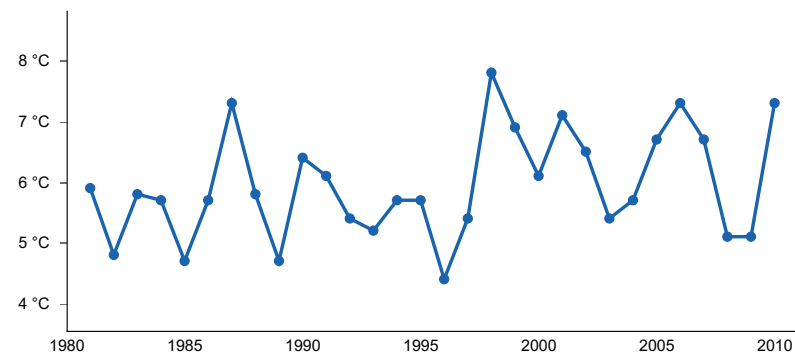


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CRIVITZ HIGH FALLS [USC00471897], Crivitz, WI
- (2) SURING [USC00478376], Suring, WI
- (3) BREED 6 SSE [USC00471044], Suring, WI

Influencing water features

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

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 the soils is impermeable to moderately rapid.

Hydrologic Group: A/D, C/D

Hydrogeomorphic Wetland Classification: Depressional, forested/organic; Depressional, scrub-shrub/organic

Cowardin Wetland Classification: PFO1B, PSS1B, PEM1B

Soil features

The soils of this site are represented by the Deford, Kinross, Pinconning, and Roscommon soil series, classified as Typic Psammaquents, Mollic Psammaquents, Typic Endoaquods, and Mollic Epiaquents, respectively. Psammaquents make up 84% of the acreage of this site.

These sites primarily form in sandy outwash deposits. They lack bedrock within 6.5 feet (two meters). They are poorly drained and meet hydric soil requirements.

The surfaces of these soils are sand to loamy sand, sometimes mucky. The substratum is generally sand or loamy sand, though a few sites in northwestern Marinette county have subsurface horizons composed of clayey lacustrine deposits. Small fragments (gravel) may occupy up to 5 percent of the substratum. Soils are extremely acid to moderately alkaline. Secondary carbonates may occupy up to 19 percent volume.



Figure 7. Kinross Soil Series sample taken in Marinette County, WI on 06/25/2020. Courtesy of UWSP.

Table 4. Representative soil features

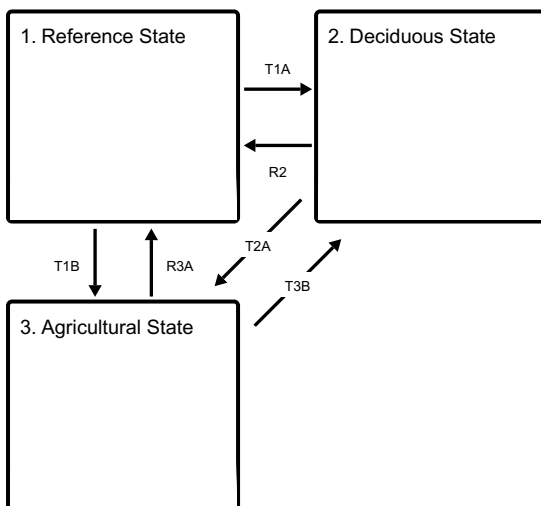
Parent material	(1) Outwash (2) Lacustrine deposits
Surface texture	(1) Mucky sand (2) Mucky loamy sand
Drainage class	Poorly drained
Permeability class	Very slow to moderately rapid
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-152.4cm)	10.41–14.73 cm
Calcium carbonate equivalent (0-101.6cm)	0–19%
Soil reaction (1:1 water) (0-101.6cm)	4–7.9
Subsurface fragment volume <=3" (0-2.5cm)	0–5%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

In pre-European settlement time wildfire was the main controlling factor of forest community dynamics. Following a severe, stand-replacing fire, any of the species present on the landscape could become established, depending on seed source availability and specific conditions of post-fire seedbed. The newly established young stands of any species were easily eliminated by recurring fires, but differences in fire-resisting properties among the species began to play a role in any species' survival success. Many pine and oak species were dominant in the region because of their fire-resistant properties and successful regeneration post-fire. With clear cutting and continued fire suppression, many of the species that are fire-tolerant and intolerant of shade, are replaced by other species. Species such as white pine and red oak are still common on the landscape based on their tolerance to some shade; these species may establish under a canopy, and in time, may become a component of the canopy. Red maple is sensitive to fire, but in its absence, it has the ability to dominate sites based on its shade tolerance and prolific seed production.

State and transition model

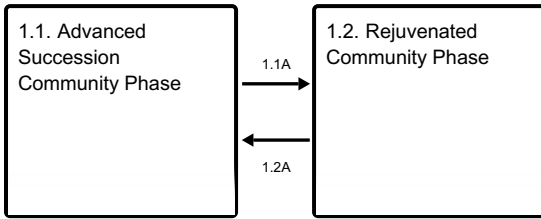
Ecosystem states



T1A - Stand replacing disturbance that includes fire.

- T1B** - Removal of forest cover and tilling for agricultural crop production.
- R2** - Deciduous forest community is slowly invaded by conifers.
- T2A** - Removal of forest cover and tilling for agricultural crop production.
- R3A** - Cessation of agricultural practices leads to natural reforestation, or site is replanted.
- T3B** - Cessation of agricultural practices leads to natural reforestation, or site is replanted.

State 1 submodel, plant communities



- 1.1A** - Light to moderate intensity fires, blow-downs, ice storms.
- 1.2A** - Disturbance-free period for 30+ years.

State 1 Reference State



Figure 8. Photo courtesy of UWSP taken on 06/30/2020 in Marinette County, WI.

Reference state is a forest community dominated by red maple (*Acer rubrum*) with groups of balsam fir (*Abies balsamea*) and occasionally hemlock, white pine, sugar maple, and yellow birch. Wetter sites within this ES may also include black ash and/or white cedar. Depending on history of disturbance, two community phases can be distinguished largely by differences in dominance of tree species and community age structure.

Community 1.1 Advanced Succession Community Phase

In the absence of major disturbance—particularly fire—these sites are dominated by a canopy of red maple and balsam fir. Sites may have a super-canopy of large white pine that might be able to maintain itself in few numbers through regeneration in gaps. White pine (*Pinus strobus*) has a moderate shade tolerance and grow to be much larger than red maple and balsam fir at maturity and typically live longer. The shrub layer is not well developed (particularly less so when Hemlock is in the canopy) and dominated by red maple sapling and beaked hazelnut. The ground layer is covered by Canada mayflower (*Maianthemum canadense*), Bracken fern (*Pteridium aquilinum*), and American starflower (*Trientalis borealis*).

Resilience management. Absence of major land disturbance such as fires or farming practices.

Dominant plant species

- red maple (*Acer rubrum*), tree

- balsam fir (*Abies balsamea*), tree
- beaked hazelnut (*Corylus cornuta*), shrub
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- western brackenfern (*Pteridium aquilinum*), other herbaceous
- starflower (*Trientalis*), other herbaceous

Community 1.2 Rejuvenated Community Phase



Figure 9. Photo courtesy of UWSP taken on 06/30/2020 in Marinette County, WI.

The canopy of the rejuvenated community is still dominated by original species, but the understory now also includes a well-established younger cohort and perhaps a few additional seedlings and saplings of less shade tolerant species. White spruce (*Picea glauca*) may occur sporadically on sites, but is unable to compete with red maple and balsam fir with the lack of fire or other disturbance.

Resilience management. Mild disturbances such as light intensity fires, ice storms, or blow downs.

Dominant plant species

- red maple (*Acer rubrum*), tree
- balsam fir (*Abies balsamea*), tree
- white spruce (*Picea glauca*), tree

Pathway 1.1A Community 1.1 to 1.2

Light intensity fires, crown breakage from ice and snow and small scale blow-downs create canopy openings, releasing advanced regeneration and stimulating new seedling establishment. Some additional less shade tolerant species such as red oak may be able to enter the community along with white spruce.

Pathway 1.2A Community 1.2 to 1.1

A long period without major canopy disturbance allows gradual replacement of oldest canopy trees by younger cohorts. Small scale disturbances may still occur periodically, but once second or third canopies are established there is minimal new regeneration taking place and the forest gradually returns to mature state.

State 2 Deciduous State



Figure 10. Photo courtesy of UWSP taken on 06/25/2020 in Marinette County, WI.

Pure, or mixed, aspen – paper birch community replaces the reference state community. If seed source is present, red maple and young cohorts of balsam fir readily becomes member of this community.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- birch (*Betula*), tree
- red maple (*Acer rubrum*), tree

**State 3
Agricultural State**

Hay or cultivated crops. Once forested areas tilled for agricultural crop production.

**Transition T1A
State 1 to 2**



Reference State



Deciduous State

Stand replacing disturbance that must include fire to create conditions for aspen and paper birch to colonize the site.

**Transition T1B
State 1 to 3**

Removal of forest cover and tilling for agricultural crop production.

**Restoration pathway R2
State 2 to 1**



Deciduous State



Reference State

Deciduous forest community is slowly invaded by conifers.

Transition T2A

State 2 to 3

Removal of forest cover and tilling for agricultural crop production.

Restoration pathway R3A

State 3 to 1

Cessation of agricultural practices leads to natural reforestation, or site is replanted.

Transition T3B

State 3 to 2

Cessation of agricultural practices leads to natural reforestation, or site is replanted.

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, Relevé 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 Standard: Terrestrial Ecological Classifications. NatureServe Central 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 States, 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.

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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):**
-
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:**
