# Ecological site F094BY002MI
# Mucky Swamp

Last updated: 11/16/2023
Accessed: 04/26/2024

## 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, 2017): Picea-Larix/Nemopanthus (PmLNe)

Biophysical Settings (Landfire, 2014): Laurentian-Acadian Alkaline Conifer-Hardwood Swamp, Laurentian-Acadian Wet Meadow

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

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

The Mucky Swamp ecological site accounts for approximately 26,000 acres in MLRA 94B, or about 2.5% of total land area. Organic lowlands are found throughout the MLRA in depressions and drainageways on moraines, outwash plains, lake plains, and floodplains. Mucky Swamp sites are characterized by very deep, very poorly drained soils that formed in thick organic deposits, sometimes underlain by glacial till or outwash. Sites are subject to frequent ponding or flooding in the spring and fall. Soils remain saturated during the growing season and meet hydric soil requirements. Precipitation, runoff from adjacent uplands, groundwater inflow, and stream inflow are the primary sources of water. These are wetlands.

Mucky Swamp sites have a higher pH (euic) than poor fen sites, their herbaceous organic counterparts, due to increased interaction with groundwater containing dissolved carbonates. They have improved growing conditions (nutrient availability) over Poor Fen sites.

## Associated sites

| | |
|---|---|
| F094BY004MI | **Wet Sandy Lowland**<br>Wet Loamy Lowland sites are wetland sites that occupy landscape depressions on moraines, lake plains, or outwash plains. They are very poorly to poorly drained. They are found in higher positions along the same drainage sequence as Mucky Swamp sites. |
| F094BY007MI | **Moist Loamy Lowland**<br>Moist Loamy Lowland sites are found in lower landscape positions on moraines, lake plains, or outwash plains. They are somewhat poorly drained. They are found in higher positions along the same drainage sequence as Mucky Swamp sites. |

| | |
|---|---|
| F094BY008MI | **Sandy Upland**<br>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 found in higher positions along the same drainage sequence as Mucky Swamp sites and are often found directly adjacent to Mucky Swamps. |
| F094BY009MI | **Loamy Upland**<br>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 found in higher positions along the same drainage sequence as Mucky Swamp sites and are often found directly adjacent to Mucky Swamp sites. |

## Similar sites

| | |
|---|---|
| F094BY001MI | **Poor Fen**<br>Like Mucky Swamp sites, Poor Fen sites 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 more acidic than Mucky Swamp sites (dysic rather than euic). They have a lower nutrient status than Mucky Swamp sites. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Abies balsamea*<br>(2) *Thuja occidentalis* |
| Shrub | (1) *Alnus incana*<br>(2) *Ilex verticillata* |
| Herbaceous | (1) *Carex*<br>(2) *Sphagnum* |

## Physiographic features

This site is found on landscape depressions on moraines and outwash plains throughout the MLRA. Slopes range from 0 to 1 percent.

Some sites are subject to rare flooding or occasional to frequent ponding. Ponding duration may be long (7 to 30 days) to very long (greater than 30 days). The soil has 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) Concave |
| Landforms | (1) Depression<br>(2) Drainageway |
| Runoff class | Negligible |
| Flooding duration | Long (7 to 30 days) |
| Flooding frequency | None to rare |
| Ponding duration | Long (7 to 30 days) to very long (more than 30 days) |
| Ponding frequency | None to frequent |
| Elevation | 685–863 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 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) | 102-110 days |
| Freeze-free period (characteristic range) | 126-140 days |
| Precipitation total (characteristic range) | 30-32 in |
| Frost-free period (actual range) | 99-111 days |
| Freeze-free period (actual range) | 122-143 days |
| Precipitation total (actual range) | 30-32 in |
| Frost-free period (average) | 107 days |
| Freeze-free period (average) | 130 days |
| Precipitation total (average) | 31 in |

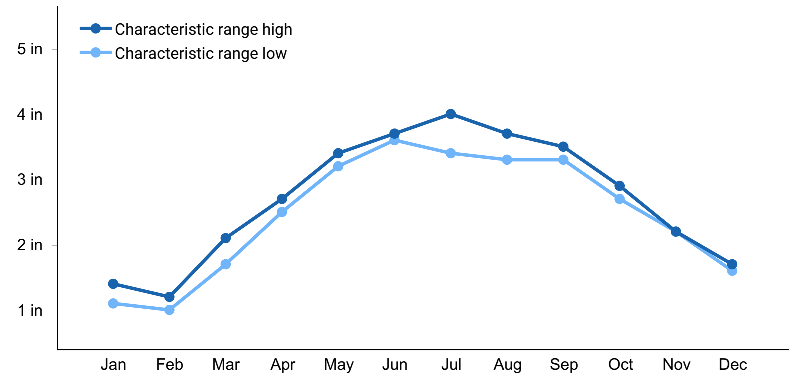



**Figure 1. Monthly precipitation range**

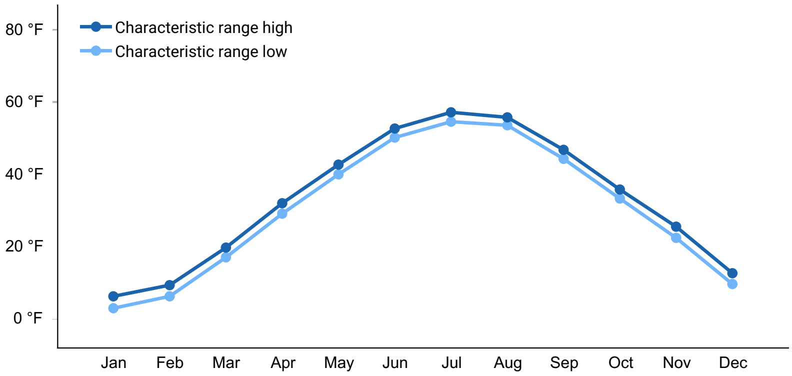



**Figure 2. Monthly minimum temperature range**

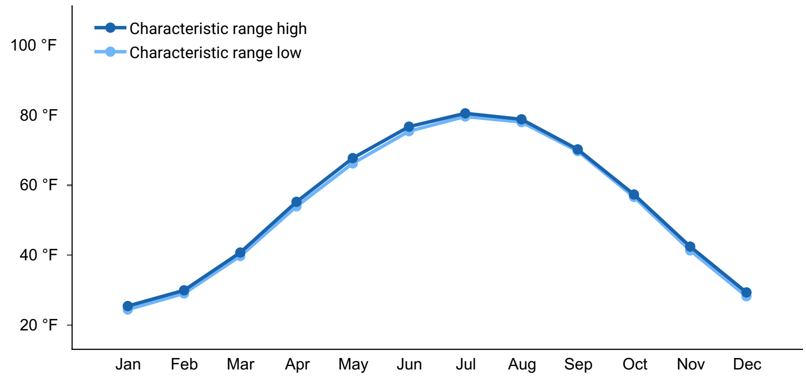



**Figure 3. Monthly maximum temperature range**

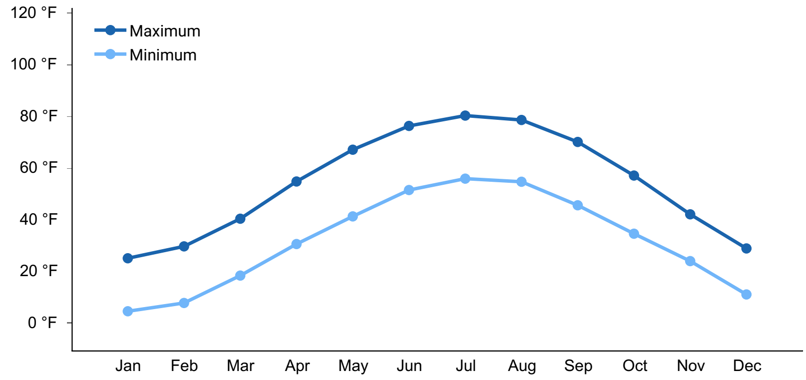



**Figure 4. Monthly average minimum and maximum temperature**

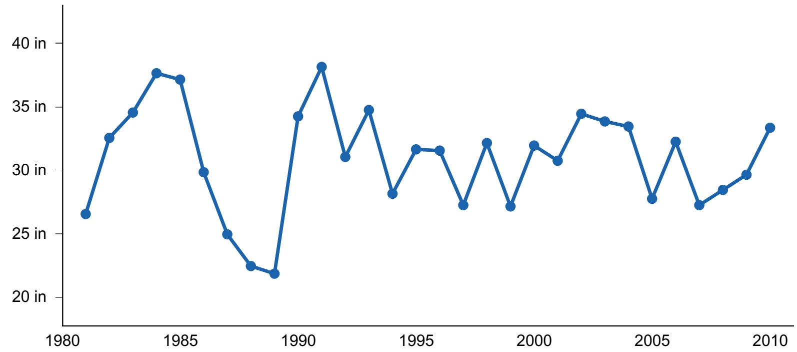



**Figure 5. Annual precipitation pattern**

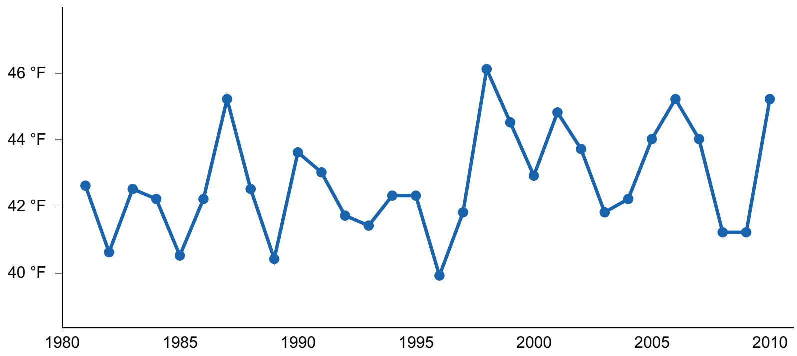



**Figure 6. Annual average temperature pattern**

## Climate stations used

- (1) SURING [USC00478376], Suring, WI
- (2) CRIVITZ HIGH FALLS [USC00471897], Crivitz, WI
- (3) OCONTO 4 W [USC00476208], Oconto, 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.

The hydrology of Mucky Swamp 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. Mucky Swamp sites have a higher pH and improved growing conditions over the other herbaceous organic ecological site within this MLRA, Poor Fen.

## 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, 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 slow.
Hydrologic Group: A/D, B/D
Hydrogeomorphic Wetland Classification: Depressional, forested/organic; Depressional, scrub-shrub/organic
Cowardin Wetland Classification: PFO1B, PFO4B, PSS4B, PEM1B

## Soil features

The soils of this site are represented by the Lupton soil series, a Typic Haplosaprist.
These soils formed in herbaceous organic material. Some sites have mineral subsoil derived from outwash or till. These sites are very poorly drained and remain saturated throughout the year. They meet hydric soil requirements.

The surface of these soils is composed of highly decomposed organic matter (sapric materials). Subsurface horizons are often composed of highly decomposed organic matter but may also be sandy to loamy mineral deposits. Soil pH is slightly alkaline. Small fragments (gravel) may occupy up to 10% volume of the substratum. Secondary carbonates are absent within two meters of the soil surface.


**Figure 7. Lupton Soil Series sample taken in Florence County, WI on 06/25/2020. Courtesy of UWSP.**

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Organic material<br>(2) Outwash<br>(3) Till |
| Surface texture | (1) Mucky sand<br>(2) Mucky sandy loam<br>(3) Mucky loam |
| Drainage class | Very poorly drained |
| Permeability class | Slow |
| Soil depth | 80 in |
| Surface fragment cover <=3" | 0% |
| Surface fragment cover >3" | 0% |
| Available water capacity (0-60in) | 6.5–23.6 in |
| Calcium carbonate equivalent (0-40in) | 0% |
| Soil reaction (1:1 water) (0-40in) | 4.5–7.8 |
| Subsurface fragment volume <=3" (0-1in) | 0–10% |
| Subsurface fragment volume >3" (Depth not specified) | 0% |

## Ecological dynamics

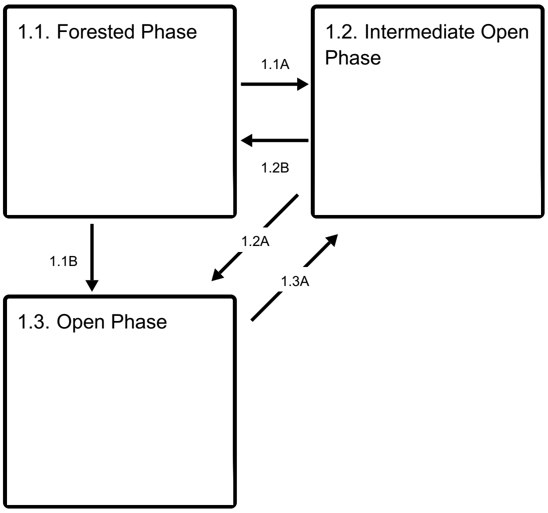
Vegetative communities on this ecological site are driven primarily by the hydrology of the site. . These sites are part of the acid peatlands of northern Wisconsin. Communities range from open bogs to black spruce swamps. These sites developed in wet depressions that allowed organic matter to build over time. These communities are distinct from other wetland communities by the dominance and total carpeting of Sphagnum moss and its effects on the hydrology, pH, and nutrient availability of the site. As Sphagnum moss dominates these sites, it develops thick layers that raise the surface and effectively isolates vegetation from groundwater interaction. Precipitation and runoff become the primary sources of water, which cause sites to become very acidic and poor in nutrients. These sites remain saturated throughout the year based on the moss’ ability to retain water. Vegetation on these sites is limited by species that can tolerate saturation, high acidity, and low nutrient availability. Alteration to the hydrology can cause severe changes. Drainage on or near the site that lowers the water table can allow for invasion of woody shrubs.

## State and transition model

**Ecosystem states**

1. Reference State

**State 1 submodel, plant communities**




**1.1A** - Mortality of canopy species from blow-downs, ice storms, or an increase in ponding frequency and duration from lack of transpiration.

**1.1B** - Major disturbance causes ponding frequency and duration to increase dramatically.

**1.2B** - Major disturbance causes ponding frequency and duration to increase dramatically.

**1.2A** - Ponding frequency and duration increases.

**1.3A** - Decrease in ponding frequency and duration. Sphagnum moss continues to grow and build up thick layers, beginning to isolate surface from groundwater and create zone of aeration. Woody shrubs and saplings begin to colonize.

## State 1
## Reference State

**Figure 8. Photo courtesy of UWSP taken on 06/24/2020 in Oconto County, WI.**

The reference state includes three community phases that are part of the mosaic of norther acid peatlands. We chose three distinct community phases to represent the Reference state: a forested phase, shrub phase, and open bog phase. Other communities may exist within this ecological site if they lack similar hydrology. In addition, many sites may exhibit characteristics of multiple community phases. These community phases are not necessarily linear success but may develop in that fashion.

## Community 1.1
## Forested Phase

**Figure 9. Photo courtesy of UWSP taken on 06/26/2020 in Florence County, WI.**

This community phase consists of forest communities tolerant of seasonal, brief ponding. Vegetation must also be tolerant of acidic soils. The presence of moisture causes these communities to be slow-growing and canopy trees may be stunted. Such forests are characterized by presence, or dominance of balsam fir, red maple, and white cedar, with tamarack and white pine as a common associates. The shrub layer may be well developed in some communities and often tag alder and winterberry. Sedges and/or sphagnum are likely to dominant the forest floor.

**Resilience management.** The forested phase is driven by seasonal, brief ponding.

**Dominant plant species**

- balsam fir (*Abies balsamea*), tree
- red maple (*Acer rubrum*), tree
- white cedar (*Tabebuia heterophylla*), tree
- hazel alder (*Alnus serrulata*), shrub
- common winterberry (*Ilex verticillata*), shrub
- sedge (*Carex*), grass
- sphagnum (*Sphagnum*), other herbaceous

## Community 1.2
## Intermediate Open Phase

This community phase is dominated by Labrador tea and leatherleaf, two species tolerant of extended ponding. The understory is dominated by Sphagnum and sedges. Sphagnum moss is developing thick layers and isolating site from groundwater.

**Resilience management.** The intermediate open phase is driven by extended ponding.

**Dominant plant species**

- balsam fir (*Abies balsamea*), tree
- Labrador tea (*Ledum*), shrub
- leatherleaf (*Chamaedaphne*), shrub
- hazel alder (*Alnus serrulata*), shrub
- sedge (*Carex*), grass
- sphagnum (*Sphagnum*), other herbaceous

## Community 1.3
## Open Phase

**Figure 10. Photo courtesy of UWSP taken on 06/24/2020 in Oconto County, WI.**

This community is dominated by sedges and rushes with a few very tolerant associates and some sphagnum. These sites often have standing water throughout the growing season.

**Resilience management.** The open phase is driven by standing water.

### Dominant plant species

- sedge (*Carex*), grass
- rush (*Juncus*), grass
- sphagnum (*Sphagnum*), other herbaceous

## Pathway 1.1A
## Community 1.1 to 1.2

Mortality of canopy species from blow-downs, ice storms, or an increase in ponding frequency and duration. Lack of tree species may be increase ponding duration with the loss of transpiration. Increased connection to nutrient-rich groundwater.

## Pathway 1.1B
## Community 1.1 to 1.3

**Forested Phase**

**Open Phase**

Mortality of canopy species from major disturbance events or a dramatic increase in ponding frequency and duration. Lack of tree species will increase ponding duration with the loss of transpiration. Increased connection to nutrient-rich groundwater.

## Pathway 1.2B
## Community 1.2 to 1.1

Decrease in ponding frequency and duration. Sphagnum moss continues to grow and build up thicker layers, causing surface to be isolated from groundwater. Establishment of balsam fir and red maple.

## Pathway 1.2A
## Community 1.2 to 1.3

Increase in ponding frequency and duration. Mortality of some woody species intolerant to increased ponding.

Increased connection to nutrient-rich groundwater.

### Pathway 1.3A
### Community 1.3 to 1.2

Decrease in ponding frequency and duration. Sphagnum moss continues to grow and build up thick layers, beginning to isolate surface from groundwater.

## 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.
Habitat Types of N. Wisconsin (Kotar, 2017): Picea-Larix/Nemopanthus (PmLNe)
Biophysical Settings (Landfire, 2014): Laurentian-Acadian Alkaline Conifer-Hardwood Swamp, Laurentian-Acadian Wet Meadow
WDNR Natural Communities (WDNR, 2015): Northern Tamarack Swamp

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## Approval

Suzanne Mayne-Kinney, 11/16/2023

## Acknowledgments

NRCS contracted UWSP to write ecological sites. 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 | 04/26/2024 |
| 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:**