

Ecological site F095XA001WI Mucky Swamp

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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): 095X–Eastern Wisconsin, Northern Illinois, and Upper Michigan Drift Plain

This MLRA is characterized by nearly level to rolling till plains, outwash plains, drumlin fields, and glacial lake plains. It is used to produce cash crops, feed grain, and livestock. It includes the shorelines of Lake Winnebago and Lake Michigan. This area is in Wisconsin (85 percent), Illinois (10 percent), and Michigan (5 percent). It makes up about 17,255 square miles (44,690 square kilometers). This area is in the Central Lowland province of the Interior Plains. Most of the area is in the Eastern Lake section. A narrow strip along the southwestern edge of the area is in the Wisconsin Driftless section. The southwestern quarter is in the Till Plains section. The nearly level to rolling till plains, glacial lake plains, and outwash plains are mixed with drumlin fields, ground moraines, end moraines, flood plains, lake terraces, beaches, dunes, swamps, and marshes. Most of the southern part of this area has belts of morainic hills and ridges and nearly level outwash terraces. Drumlins are prominent features in the central part of the area. Glaciokarst topography occurs in the east-central parts of the area influenced by underlying Niagara Dolomite. Lakes and streams are numerous, and streams generally form a dendritic drainage pattern. Elevation ranges from 530 to 1,580 feet (160 to 480 meters). Local relief is mainly 25 feet (8 meters), but the moraines, drumlins, and bedrock escarpments rise 80 to 330 feet (25 to 100 meters) above the adjacent valleys.

The annual precipitation ranges from 28 to 37 inches (700 to 950 millimeters) with a mean of 33 inches (840 millimeters). The annual temperature ranges from 41 to 48 degrees F (5.1 to 9.2 degrees C) with a mean of 46 degrees F (7.7 degrees C). The freeze-free period ranges from 115 to 185 days with a mean of 155 days. It decreases in length from south to north and from the shore of Lake Michigan inland. Lake Michigan helps to moderate the climate of the area.

This MLRA is mostly covered with glacial drift of Wisconsin age. Some of the higher areas are moraines that appear as arc-shaped ridges representing the retreat of the ice from south to north. Most of the bedrock in the area consists of Silurian, Ordovician, and Cambrian sandstone, limestone, and dolomite. Some igneous and metamorphic rocks underlie the northwestern edge of the area. Devonian limestone and shale occur at the far eastern edge in the Milwaukee area.

The dominant soil orders in this MLRA are Alfisols, Entisols, Histosols, Mollisols, and Spodosols. The soils in the area dominantly have a mesic or frigid temperature regime, an aquic or udic moisture regime, and mixed mineralogy. They are very deep, excessively drained to very poorly drained, and sandy to clayey. Areas of Spodosols and soils with a frigid soil temperature regime occur in the northern part of the MLRA.

The northern part of this MLRA supports natural stands of mixed northern hardwoods and pine. Sugar maple, oak, white ash, elm, yellow birch, white pine, red pine, and American beech are the principal species. Low-lying areas support both mixed hardwoods and conifers. Elm, soft maple, black ash, and northern white cedar are the major species. Brush and sedge meadows also occur in the low-lying areas.

The southern part of this MLRA supports hardwoods and prairie vegetation. Uplands support natural stands of oak, sugar maple, and hickory, and natural prairie vegetation is characterized by little bluestem and big bluestem. Many of the prairies have scattered oak and hickory trees. Low-lying areas support sedge and grass meadows and mixed

stands of hardwoods and conifers. Elm, ash, eastern cottonwood, soft maple, and white cedar are the major species in the low-lying areas. (USDA-NRCS, 2022)

LRU notes

The Northeastern Wisconsin Drift Plain LRU (Land Resource Unit - 95XA) corresponds closely to the Northern and Central Lake Michigan Coastal Ecological Landscapes. Some of the following brief overview is borrowed from the Wisconsin Department of Natural Resources Ecological Landscape publication (2015).

The Northeastern Wisconsin Drift Plain LRU is located along Wisconsin's northeastern and central coast of Lake Michigan and the Door Peninsula. This glacial landscape is comprised of approximately 3.6 million acres (5,715 square miles). It is dominated by till plains and glacial lake deposits. The Green Bay and Lake Michigan Lobes are responsible for the formation of the landscape. The Green Bay Lobe covered most of the LRU, excluding the eastern edge where the Lake Michigan Lobe advanced. The glaciers were separated by the Niagara Escarpment, a 650-mile-long dolomite ridge that begins in Wisconsin near the Illinois border, extends into Michigan's Upper Peninsula and down through Canada's Bruce Peninsula into Rochester, New York. Within LRU 95XA, the escarpment runs from Lake Winnebago northeast through the Door Peninsula. Much of the topography of this LRU is bedrock-controlled. Bedrock is generally deeper than 150cm except in the Door Peninsula, where bedrock is much shallower. Wetlands are common throughout this MLRA where drainage is impeded by fine-textured materials and shallow bedrock.

The northern portion of this LRU is dominated by an undulating till plain, gently sloping to the east, formed entirely by the Green Bay Lobe. This glacial lobe centered over the present-day city of Green Bay and flowed out in a fan shape, moving both south-south west and south-southeast over the Door Peninsula. The lobe deposited loamy and coarse-loamy till mixed with dolomite fragments plucked from the bedrock. In some areas, the till has been reworked by Glacial Lake Oshkosh or overlain by its lacustrine deposits. Numerous drumlins formed, orientated to the south-southwest in the direction of glacial flow. Some eskers are present. Much of this area has dolomite and limestone within 50 ft of the surface. Proglacial streams formed small areas of pitted and unpitted outwash plains, terraces, and fans.

The Door Peninsula was formed primarily by the early advances of the Green Bay Lobe. The till found here is comprised of relatively old, calcareous loamy materials mixed with dolomite and limestone fragments plucked by the glacial lobe from the shallow bedrock. The till is thinly draped over the Niagara Escarpment that lies 1 to 3 meters below the surface. A drumlin field is oriented south-southeast, the direction of the ice flow over the peninsula. The eastern shore of the peninsula is composed of lake sediments that were reworked and deposited by Lake Michigan Lobe. The northern tip of the peninsula has glaciolacustrine beach terrace and ridge deposits and eolian sand dunes, which are remnants of the intra- and postglacial lakes Nipissing and Algonquin.

The central portion of this LRU is dominated by lacustrine deposits from Glacial Lake Oshkosh. In its largest stage, Glacial Lake Oshkosh covered 1.4 million acres. The lake formed from meltwater as the Green Bay Lobe receded between ice sheet advances. The glacial lobe stalled between present day Lake Winnebago and the city of Green Bay, blocking the drainage of meltwater north to the Lake Michigan Basin. Glacial Lake Oshkosh continued to rise until it found other drainage pathways, eventually draining into the Wisconsin River Valley. Glacial Lake Oshkosh reworked the till deposits of the Green Bay Lobe. Silty and clayey lacustrine deposits formed in the deepest area of the lakes, whereas sandy beach ridges, terraces, and dunes formed along the ancient shore.

The area east of Glacial Lake Oshkosh and south along the shore of Lake Michigan are dominated by a thin till sheet over the Niagara Escarpment that was deposited by the Green Bay and Lake Michigan Lobes. The Green Bay Lobe deposited calcareous clay and silty till reworked from lake sediments. The Lake Michigan Lobe deposited silt loam, loam, and compacted sandy clay loam till. Remnants of the intra- and postglacial lakes Nipissing and Algonquin are also found along Lake Michigan shore. Proglacial streams formed small areas of pitted and unpitted outwash plains, terraces, and fans.

Historically, the vegetation in this LRU was dominated by northern and central hardwood forests and wetlands. The northern hardwoods were comprised of eastern hemlock (*Tsuga canadensis*) and American beech (*Fagus grandifolia*). The central hardwoods were dominated by sugar maple (*Acer saccharum*), American basswood (*Tilia Americana*), and American beech (*Fagus grandifolia*). Forested wetlands were a major part of the landscape, covering more than 25% in some areas.

Classification relationships

Relationship to Established Framework and Classification Systems:

Habitat Types of N. & S. Wisconsin (Kotar, 2002, 1996): The sites of this ES keyed out to Fraxinus -Thuja - Abies/Athyrium [FnThAbAt] and Abies-Thuja-Acer/Acer [AbThArAsp]

WDNR Natural Communities (WDNR, 2015): This ES is most similar to the Great Lakes Ridge and Swale described by the WDNR.

Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Herbaceous Wetlands, Laurentian-Acadian Alkaline Conifer-Hardwood Swamp Forest, Laurentian-Acadian Alkaline Conifer-Hardwood Swamp Shrubland, Central Interior and Appalachian Swamp Forest, and Central Interior and Appalachian Swamp Shrubland

Hierarchical Framework Relationships:

Major Land Resource Area (MLRA): 095X–Eastern Wisconsin, Northern Illinois, and Upper Michigan Drift Plain

USFS Subregions: West Green Bay Till Plain (212Tb), Door Peninsula (212Tf), Outagamie Loamy Till and Silty Lake Plain (212Za), Green Bay Clayey and Silty Lake Plain (212Zb), Manitowoc Till Plain (212Zc), Lake Winnebago Clay Plain (222Kc)

DNR Ecological Landscapes: Northern Lake Michigan Coastal, Central Lake Michigan Coastal, Southeast Glacial Plains

Ecological site concept

The Mucky Swamps site is fourth-most extensive site within LRU 95XA with roughly 300,000 acres, or about 9% of total land area. It is found in depressions on lake plains, outwash plains, and moraines.

This site is characterized by very poorly drained, organic, mucky soils. Soils may be slightly acid to slightly alkaline. They may have periods of flooding or ponding seasonally. These are hydric soils and they are wetlands. Primary water sources are variously; precipitation, runoff, groundwater inflow, and stream inflow depending on an individual site's particular location.

Similar sites

F095XA002WI	<p>Wet Floodplain</p> <p>These sites occur exclusively on floodplains and form in very deep, loamy to clayey materials, primarily alluvial in origin. Most sites are subject to flooding events of varying frequency, duration, and intensity. They are poorly to moderately well drained. These sites are sometimes wetlands and may sometimes host ecological communities similar to those supported by Mucky Swamps.</p>
F095XA003WI	<p>Wet Sandy Lowland</p> <p>These sites consist of very deep, sandy materials, primarily glacial outwash. Some are underlain by finer-textured materials. They are very poorly to poorly drained. Like Mucky Swamps, they occupy landscape depressions and host vegetation tolerant of prolonged periods of wetness.</p>
F095XA004WI	<p>Wet Loamy or Clayey Lowland</p> <p>These sites consist of shallow to very deep, loamy to clayey deposits of various origin. They are sometimes underlain by sandy outwash. They are very poorly to poorly drained. Like Mucky Swamps, they occupy landscape depressions and host vegetation tolerant of prolonged periods of wetness.</p>

Table 1. Dominant plant species

Tree	(1) <i>Fraxinus nigra</i> (2) <i>Abies balsamea</i>
Shrub	(1) <i>Alnus incana</i> (2) <i>Cornus racemosa</i>

Herbaceous	(1) <i>Carex</i> (2) <i>Onoclea sensibilis</i>
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Physiographic features

This site occurs in relict lakebeds, floodplains, and depressions on lake plains, outwash plains, and moraines. In Marinette, Oconto, Shawano, and Door counties, it is found in depressions between drumlins. Landform shape is usually concave, and sites are in the toeslope position. Slopes range from 0 to 2 percent.

Many sites are subject to ponding and flooding throughout the year. Inundation by water may last between two days to over a month. The soils have an apparent seasonally high water table (endosaturation) within 8 inches. The water table may be much deeper during drought conditions. Runoff is negligible.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope
Slope shape across	(1) Concave
Slope shape up-down	(1) Linear
Landforms	(1) Lakebed (relict) (2) Flood plain (3) Outwash plain (4) Moraine
Runoff class	Negligible
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	None to frequent
Ponding duration	Brief (2 to 7 days) to very long (more than 30 days)
Ponding frequency	None to frequent
Elevation	558–1,050 ft
Slope	0–2%
Ponding depth	0–24 in
Water table depth	0–8 in
Aspect	Aspect is not a significant factor

Climatic features

The continental climate of the Northeastern Wisconsin Drift Plain is typical of central Wisconsin – cold winters and warm summers. The climate is moderated by the thermal mass of Lake Michigan, especially in coastal areas. Fall and early winter temperatures are slightly warmer and spring and early summer temperatures are slightly cooler along the Lake Michigan coastline. Lake effect snow occurs along the coastline.

The average annual precipitation for this site is 32 inches. The average annual maximum and minimum temperatures are 54oF and 34oF, respectively. This site receives greater annual snow than the MLRA average, 46 inches compared to 44 inches. 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)	101-124 days
Freeze-free period (characteristic range)	129-155 days
Precipitation total (characteristic range)	30-32 in
Frost-free period (actual range)	92-125 days

Freeze-free period (actual range)	125-158 days
Precipitation total (actual range)	30-33 in
Frost-free period (average)	112 days
Freeze-free period (average)	142 days
Precipitation total (average)	31 in

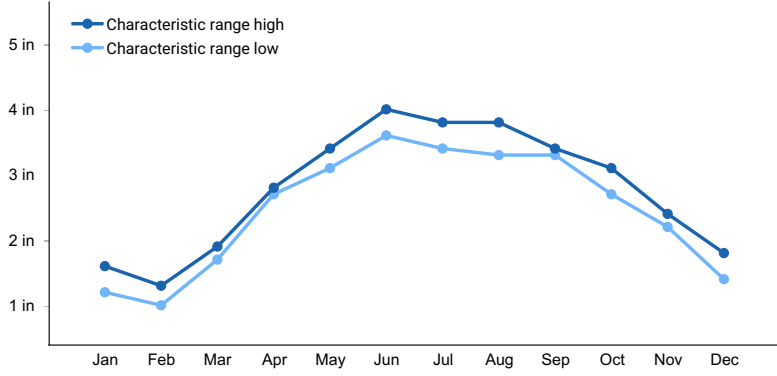


Figure 1. Monthly precipitation range

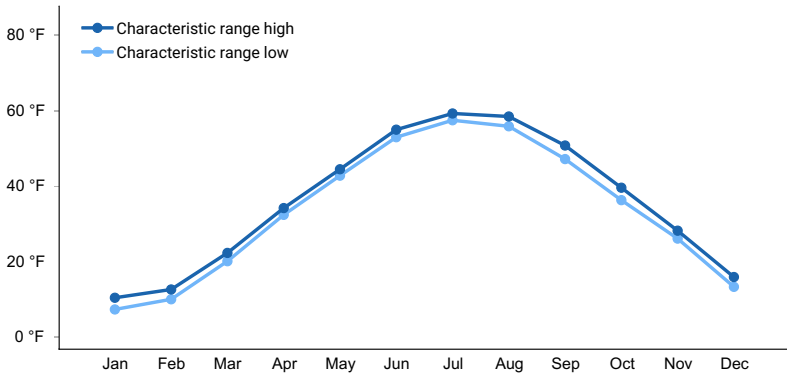


Figure 2. Monthly minimum temperature range

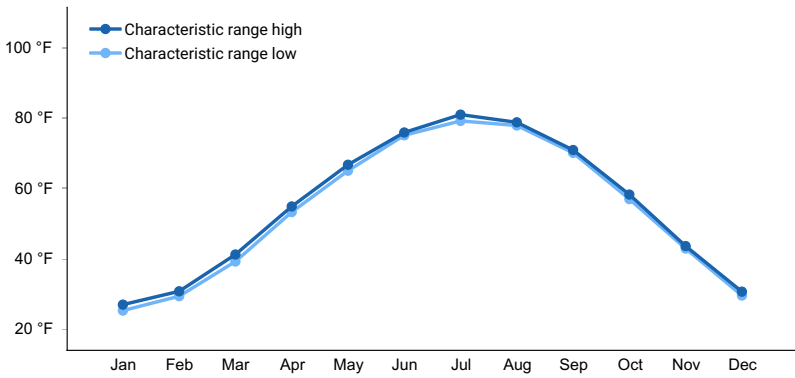


Figure 3. Monthly maximum temperature range

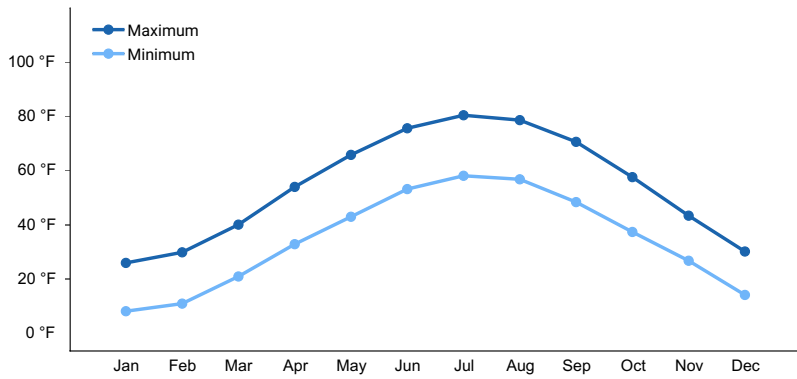


Figure 4. Monthly average minimum and maximum temperature

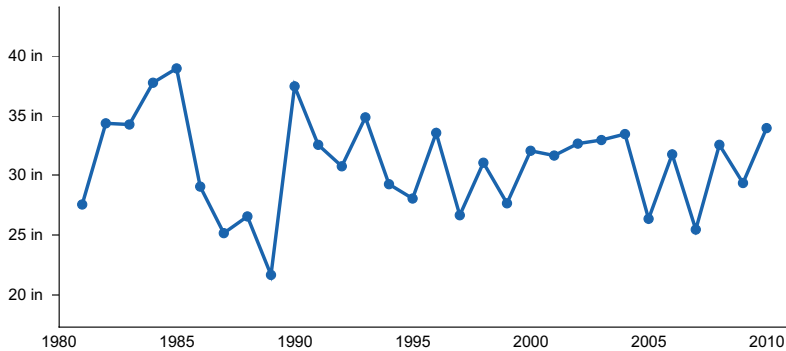


Figure 5. Annual precipitation pattern

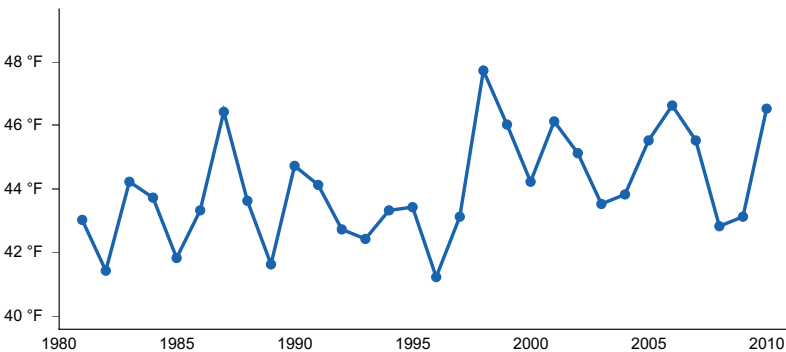


Figure 6. Annual average temperature pattern

Climate stations used

- (1) STEPHENSON 5WSW [USC00207867], Stephenson, MI
- (2) OCONTO 4 W [USC00476208], Oconto, WI
- (3) DENMARK WWTP [USC00472055], Denmark, WI
- (4) BRILLION [USC00471064], Brillion, WI
- (5) STURGEON BAY EXP FARM [USC00478267], Sturgeon Bay, WI
- (6) HINGHAM [USC00473661], Sheboygan Falls, WI

Influencing water features

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

Wetland description

Under the Cowardin System of Wetland Classification, or National Wetlands Inventory (NWI), the wetlands can be

classified as:

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

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

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

Permeability of the soil is impermeable to moderately slow. The hydrologic soil groups of this site are A/D, B/D, and C/D.

Soil features

The soils of this site are represented by the Adrian, Carbondale, Cathro, Chippeny, Houghton, Lobo, Markey, Muskego, Ogden, Palms, Rondeau, Seelyeville, Suamico, and Willette series. Adrian, Cathro, Markey, Ogden, Palms, Suamico, and Willette are classified as Terric Haplosaprists, Seelyeville and Houghton are Typic Haplosaprists, Chippeny is a Lithic Haplosaprist, Carbondale is a Hemic Haplosaprist, Lobo is a Hemic Sphagnofibrist, and Rondeau and Muskego are Limnic Haplosaprists.

These soils formed in organic materials, primarily of herbaceous origin. About 30% of the acreage of this site has mineral contact within 60 inches, generally starting between 16 and 31 inches. A few sites with bedrock contact within 80 inches can be found in the Door Peninsula where the dolomitic bedrock is shallow. Soils are very poorly drained and remain saturated throughout the year. They meet hydric soil requirements.

The surfaces of these soils are composed of herbaceous organic materials. If present, mineral subsurface horizons may be composed of sandy outwash, sandy to clayey glaciofluvial deposits or clayey lacustrine deposits (including marl). Most soils are slightly acid to slightly alkaline, though a few sites in Outagamie County are ultra acid. Surface fragments are generally absent in these soils. Subsurface fragments are often found in the mineral substratum. Fragments smaller than 3 inches in diameter may occupy up to 19 percent volume. Larger fragments may occupy up to 9 percent volume. Some of these fragments may be pieces of limestone and dolomite plucked from the bedrock by glacial ice and mixed in with the mineral glacial deposits. Secondary carbonates are often present and may be found as high as 64 cm. Most soils with carbonates have a CaCO₃ equivalency somewhere between 10 and 15 percent. A few sites in eastern Ozaukee county may have a CaCO₃ equivalency up to 70 percent.



Figure 7. Markey Soil Series sampled on 06/07/2020 in Marinette County, WI.

Table 4. Representative soil features

Parent material	(1) Glaciofluvial deposits (2) Outwash (3) Lacustrine deposits (4) Residuum
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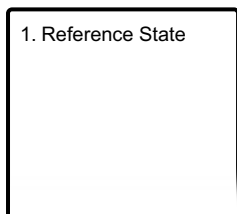
Surface texture	(1) Mucky peat (2) Muck (3) Sand (4) Loam (5) Silty clay loam (6) Silty clay
Drainage class	Very poorly drained
Permeability class	Moderately slow
Soil depth	38–79 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-59.1in)	2.54–13.2 in
Soil reaction (1:1 water) (0-39.4in)	3.4–7.9
Subsurface fragment volume <=3" (0-39.4in)	0–19%
Subsurface fragment volume >3" (0-39.4in)	0–9%

Ecological dynamics

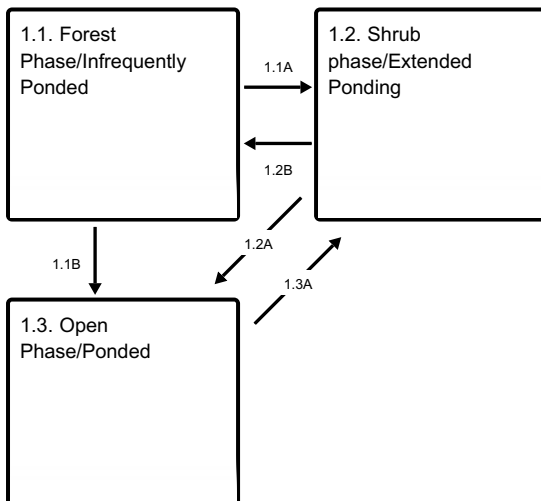
Because this Ecological Site is subject to seasonal, yearly and long-term variation in hydrological conditions, it is not possible to speak of any directional, community-driven plant succession, as is typical of more environmentally-stable upland plant communities. Instead, individual hydrologic events 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. Frequency and duration of flooding/ponding is the main driver as to which of these community phases will be achieved and maintained.

State and transition model

Ecosystem states



State 1 submodel, plant communities



- 1.1A - Ponding frequency and duration increase.
- 1.1B - Ponding frequency and duration increase dramatically.
- 1.2B - Very infrequent ponding.
- 1.2A - Ponding frequency and duration increase moderately.
- 1.3A - Ponding frequency and duration decrease.

State 1 Reference State

Because of the dynamic nature of hydrological events affecting this Ecological Site, many different plant communities can be found at any given time. Three distinct community phases represent the Reference state: 1) a forested phase with seasonal, brief ponding, community phase, 2) shrub phase with extended ponding community phase, and 3) open phase ponded community phase.

Community 1.1 Forest Phase/Infrequently Ponded



Figure 8. Image courtesy of UWSP taken on 06/07/202 in Marinette County, WI.

This community phase consists of forest communities tolerant of seasonal, brief ponding. Such forests are characterized by strong presence, or dominance of black ash (*Fraxinus nigra*), with balsam fir (*Abies balsamea*) as a common associate and presence of White cedar (*Thuja occidentalis*) when seed source is present and deer browse is limited. The shrub layer may be well developed in some communities and often includes tag alder (*Alnus incana*) and Gray dogwood (*Cornus racemose*). Characteristic understory plants include sedges, grasses, and sensitive fern (*Onoclea sensibilis*).

Dominant plant species

- black ash (*Fraxinus nigra*), tree
- balsam fir (*Abies balsamea*), tree

- gray alder (*Alnus incana*), shrub
- gray dogwood (*Cornus racemosa*), shrub
- sedge (*Carex*), grass
- sensitive fern (*Onoclea sensibilis*), other herbaceous

Community 1.2

Shrub phase/Extended Ponding

This community phase is dominated by tag alder, gray dogwood, and steeplebush, and other species tolerant of extended ponding. The understory is dominated by sedges and grasses.

Dominant plant species

- gray alder (*Alnus incana*), tree
- gray dogwood (*Cornus racemosa*), tree
- steeplebush (*Spiraea tomentosa*), shrub
- sedge (*Carex*), grass

Community 1.3

Open Phase/Ponded



Figure 9. Image courtesy of UWSP taken on 06/28/2020 in Waupaca County, WI.

This community is dominated by sedges and grasses with a few very tolerant associates and sporadic steeplebush and willows. These sites often have standing water throughout the growing season.

Dominant plant species

- willow (*Salix*), tree
- steeplebush (*Spiraea tomentosa*), shrub
- sedge (*Carex*), grass

Pathway 1.1A

Community 1.1 to 1.2

Increase in ponding frequency and duration. Mortality of canopy species. Lack of tree species may be cause of ponding duration with the loss of transpiration.

Pathway 1.1B

Community 1.1 to 1.3



Forest Phase/Infrequently
Ponded

Open Phase/Ponded

Ponding frequency and duration increase dramatically.

Pathway 1.2B

Community 1.2 to 1.1

Decrease in ponding frequency and duration. Establishment of black ash and balsam fir.

Pathway 1.2A

Community 1.2 to 1.3

Ponding frequency and duration increase moderately.

Pathway 1.3A

Community 1.3 to 1.2

Decrease in ponding frequency and duration. Establishment of tag alder and other species tolerant of some extended ponding events.

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 Types.

Other references

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Approval

Suzanne Mayne-Kinney, 11/16/2023

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NRCS contracted UWSP to write ecological sites in MLRA 95X. 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	04/18/2024

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:**
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17. **Perennial plant reproductive capability:**
-