Ecological site F090BY002WI
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): 090B–Central Wisconsin Thin Loess Dissected Till Plain

The Wisconsin and Minnesota Thin Loess MLRA, Northern and Southern Parts (90A and 90B) correspond closely to the North Central Forest and the Forest Transition Ecological Landscapes, respectively. Some of the following brief overview is borrowed from the Wisconsin Department of Natural Resources ecological landscape publications (2015).

The Wisconsin and Minnesota Thin Loess MLRA, Northern and Southern Parts (90A and 90B) is an extensive glacial landscape that comprised of over 11.1 million acres (17,370 sq mi) throughout central and northern Wisconsin – about 27% of the total land area in the state. This glacial landscape is comprised of a heterogenous mix of loess-capped ground moraines, end moraines with eskers and ice-walled lake plains, and pitted, unpitted, and collapsed outwash plains sometimes interspersed with drumlins from the Illinoian and Pre-Illinoian glaciations. The entire area has been glaciated and nearly all of it is underlain by dense glacial till that impedes drainage. An extensive morainal system – the Perkinstown end moraine – spans most of the width of northern Wisconsin and divides the Northern and Southern Parts of this large landscape. This moraine, which has been sliced by outwash in many places, marks the southernmost extent of the Wisconsin glaciation (Wisconsin's most recent glacial advance).

North of the Perkinstown morainal system is a loess plain, with a loess mantle 6 to 24 inches (15-60 cm) thick. The northernmost edge of this landscape is an undulating till and outwash plain with materials deposited by the Chippewa Lobe. Drumlins are common in the northern and northeastern portions. The drumlins are oriented towards the southwest and formed during a glacial episode prior to the most recent glacial advance. Some are covered with glacial till. Pitted, unpitted, and collapsed outwash plains fill the spaces between drumlins. Detached from the major land mass to the northeast is the hummocky Hayward collapsed end moraines, where swamps, ice-walled lake plains, and eskers are common.

Most of the MLRA to the south of the Perkinstown morainal system is an extensive ground moraine with some proglacial stream features including pitted outwash plains, terraces, and fans. A layer of loess 6 to 47 inches thick covers much of the area. Like the Northern Part, all areas of the Southern Part of this MLRA were glaciated, although the southcentral portion is a relatively older till plain with materials from the Illinoian and pre-Illinoian glaciations, not the most recent Wisconsin glaciation. The landforms in the southcentral portion are highly variable. Much of the area topography is controlled by underlying bedrock. Sandstone outcrops and pediments can be found here. Some of the most southern portions of the MLRA are mixed glacial deposits and residuum.

The land surface of the southeastern portion was formed by many small glacial advances and retreats. Morainal ridges protrude through an erosional, pitted outwash-mantled surface. These parallel ridges run in a northeast to southwest orientation and are dissected by many steams.

The continental climate of this MLRA is typical of northcentral Wisconsin, with cold winters and warm summers. The southern boundary of this MLRA straddles Wisconsin's Tension Zone, a zone of transition between

Wisconsin's northern and southern ecological landscapes. Historically, the mesic forests were dominated by eastern hemlock (Tsuga canadensis), sugar maple (Acer saccharum), and yellow birch (Betula alleghaniensis).

Classification relationships

Major Land Resource Area (MLRA): Wisconsin and Minnesota Thin Loess and Till (Northern and Southern Parts - 90A and 90B)

USFS Subregions: Perkinstown End Moraine (212Xe), Mille Lacs Uplands (212Kb), Rib Mountain Rolling Ridges (212Qd), Glidden Loamy Drift Plain (212Xa), Hayward Stagnation Moraines (212Xf), Green Bay Lobe Stagnation Moraine (212Ta), Lincoln Formation Till Plain - Hemlock Hardwoods (212Qc), Lincoln Formation Till Plain - Mixed Hardwoods (212Qb), Central-Northwest Wisconsin Loess Plains (212Xd), Rosemont Baldwin Plains and Moraines (222Md)

Small sections occur in Central Wisconsin Moraines and Outwash (222Kb) and Bayfield Sand Plains (212Ka)

Wisconsin DNR Ecological Landscapes: Northwest Lowlands, North Central Forest, Forest Transition, Western Prairie, Northwest Sands

Ecological site concept

The Mucky swamp ecological site occurs throughout MLRA 90A and 90B in depressions and drainageways on moraines, outwash plains, and floodplains. These sites are characterized by very deep, very poorly drained soils that formed in thick organic deposits with underlying glacial 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. Soils range from slightly acid to neutral.

Mucky swamp sites have a relatively high pH compared to Poor fen ecological sites. These sites have more interaction with groundwater containing dissolved carbonates, and many sites have carbonates throughout the profile or in the underlying mineral material. The carbonates raise the pH and improve growing conditions (nutrient availability) over Poor fen sites.

Associated sites

F090BY006WI	**Wet Loamy Lowland** Wet Loamy Lowland sites consist primarily of deep loamy deposits derived from a mixture of outwash, alluvium, loess, and lacustrine sources. Some sites may have bedrock contact within two meters of the surface. These sites are seasonally ponded depressions that remain saturated for sustained periods, allowing hydric conditions to occur. They are slightly drier and occur higher on the drainage sequence than Mucky swamps sites.
F090BY011WI	**Moist Loamy Lowland** Moist Loamy Lowland sites consist of deep sandy and loamy deposits derived from a mixture of alluvium, residuum, till, or lacustrine sources. The finer textures allow the soil to stay moist - but not saturated - for sustained periods during the growing season. They are drier and occur higher on the drainage sequence than Mucky swamps sites.
F090BY016WI	**Loamy Upland** Loamy Upland sites consist of deep loamy till, alluvium, residuum, lacustrine, or eolian deposits. Sandy deposits of these parent materials, plus outwash, may also be present. The depth to the seasonally high water table ranges from as high as the surface to as low as almost two meters below the surface. A few sites are on floodplains and upland drainageways, where very brief flooding is rare but possible. They are much drier and occur higher on the drainage sequence than Mucky swamps sites.
F090BY021WI	**Dry Loamy Upland** Dry Loamy Upland sites consist of deep sandy to loamy outwash, alluvium, or till. The water table is deeper than two meters year-round. They are much drier and occur higher on the drainage sequence than Mucky swamps sites.

Similar sites

F090BY001WI	**Poor Fen** Like Mucky swamp sites, Poor fen sites consist of herbaceous organic materials, sometimes with mineral soil contact. They are also very poorly drained, permanently saturated wetlands. Poor fen sites are more acidic because they receive less stream and groundwater. Additionally, the parent materials of adjacent sites are less calcareous than those adjacent to Mucky swamp sites. These differences are reflected in the vegetative communities, with Mucky swamp having improved growing conditions over Poor fen.
F090BY003WI	**Sandy Floodplain** Sandy Floodplain sites are found exclusively on floodplains in sandy and sometimes silty alluvium. These sites are somewhat poorly to poorly drained and are subject to flooding. Some sites may be saturated for long enough for hydric conditions to occur. The vegetative communities they support may sometimes be found on Mucky swamp sites.
F090BY004WI	**Loamy Floodplain** Loamy Floodplain are found exclusively on floodplains in loamy alluvium, sometimes underlain by sandy alluvium. Soils are very poorly to moderately well drained and are subject to flooding. Some sites may be saturated for long enough for hydric conditions to occur. They support similar vegetative communities as Mucky swamp sites.
F090BY006WI	**Wet Loamy Lowland** Wet Loamy Lowland consist primarily of deep loamy deposits derived from a mixture of outwash, alluvium, loess, and lacustrine sources. Some sites may have bedrock contact within two meters of the surface. These sites are seasonally ponded depressions that remain saturated for sustained periods, allowing hydric conditions to occur. They support similar vegetative communities as Mucky swamp sites.

Table 1. Dominant plant species

Tree	(1) *Fraxinus nigra* (2) *Acer rubrum*
Shrub	Not specified
Herbaceous	(1) *Impatiens*

Physiographic features

This site occurs in depressions and drainageways on moraines, outwash plains, lake plains, and sometimes floodplains. Slopes range from 0 to 2 percent.

These sites are subject to occasional to frequent ponding throughout much of the year. The ponding duration ranges from brief (2 to 7 days) and long (7 to 30 days), with depth up to 6 inches (15 cm) above the soil surface. Some sites may be subject to frequent flooding with a long duration. The soil has an apparent seasonally high water table (endosaturation) at a depth of 0 inches (0 cm) but the water table may drop below 80+ inches (200+ cm) during drought conditions. Runoff is negligible.

Table 2. Representative physiographic features

Landforms	(1) Depression (2) Drainageway (3) Outwash plain (4) Lake plain (5) Flood plain (6) Moraine
Runoff class	Negligible
Flooding duration	Long (7 to 30 days)
Flooding frequency	None to frequent
Ponding duration	Long (7 to 30 days)
Ponding frequency	Occasional to frequent
Elevation	492–1,099 ft
Slope	0–2%

Ponding depth	0–6 in
Water table depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

The climate of the expansive Wisconsin and Minnesota Thin Loess and Till Plain is highly variable. The eco-climatic zone (the “Tension Zone”) that runs southeast-northwest across the state splits the MLRA. In general, the MLRA has cold winters and warm summers with an adequate amount of precipitation. Near Lake Superior, precipitation and temperature tend to increase. The far western section of the MLRA, known as the western prairie ecological landscape by the Wisconsin DNR, has warmer temperatures compared to the rest of the MLRA because it falls below the eco-climatic zone. The soil moisture regime of MLRA is udic (humid climate). The soil temperature regime is frigid and cryic.

Table 3. Representative climatic features

Frost-free period (characteristic range)	78-114 days
Freeze-free period (characteristic range)	117-137 days
Precipitation total (characteristic range)	30-33 in
Frost-free period (actual range)	45-116 days
Freeze-free period (actual range)	89-146 days
Precipitation total (actual range)	28-35 in
Frost-free period (average)	91 days
Freeze-free period (average)	124 days
Precipitation total (average)	31 in

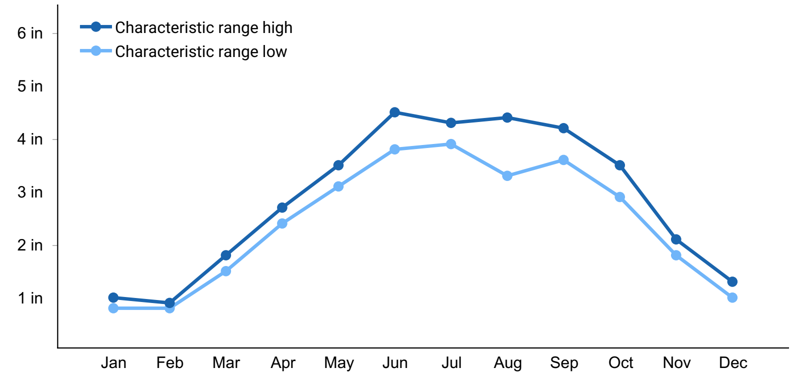


Figure 1. Monthly precipitation range

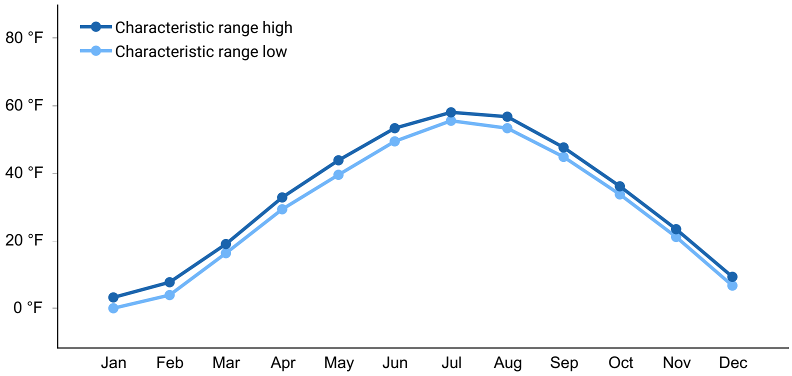


Figure 2. Monthly minimum temperature range

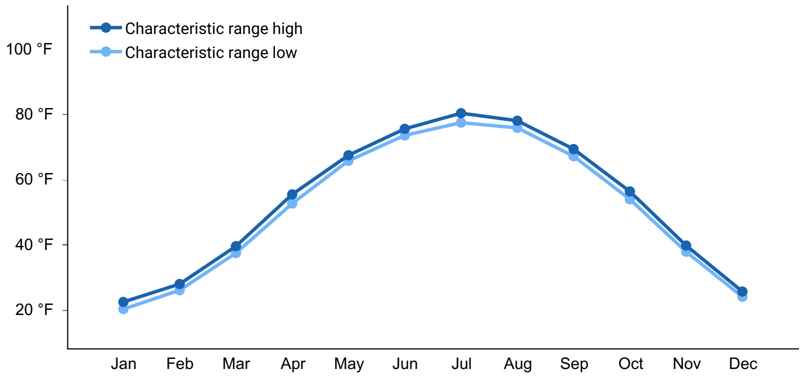


Figure 3. Monthly maximum temperature range

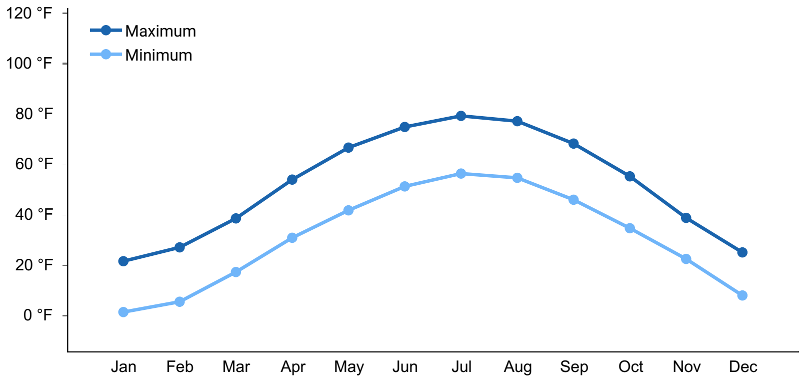


Figure 4. Monthly average minimum and maximum temperature

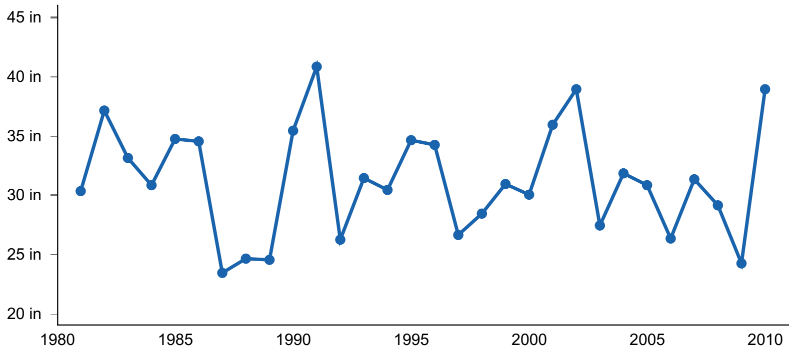


Figure 5. Annual precipitation pattern

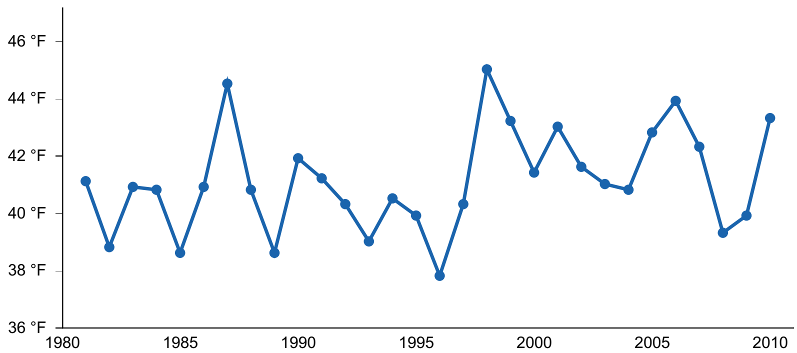


Figure 6. Annual average temperature pattern

Climate stations used

- (1) WINTER [USC00479304], Ojibwa, WI
- (2) COUDERAY 7 W [USC00471847], Stone Lake, WI
- (3) LUCK [USC00474894], Luck, WI

- (4) AMERY [USC00470175], Amery, WI
- (5) HOLCOMBE [USC00473698], Holcombe, WI
- (6) JUMP RIVER 3E [USC00474080], Sheldon, WI
- (7) PARK FALLS DNR HQ [USC00476398], Park Falls, WI
- (8) GOODMAN SANITARY DIST [USC00473174], Goodman, WI
- (9) STAMBAUGH 2SSE [USC00207812], Iron River, MI
- (10) MOOSE LAKE 1 SSE [USC00215598], Moose Lake, MN
- (11) AITKIN 2E [USC00210059], Aitkin, MN
- (12) ISLE 12N [USC00214103], Isle, MN

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 lost from the site primarily through stream outflow, subsurface outflow, evapotranspiration, and ground water recharge.

The hydrology of organic sites significantly impacts their ecological development. These sites have a strong connection with groundwater as a primary source of water. The groundwater contribution to these sites may interact with surrounding calcareous materials that deliver dissolved carbonates to these sites. In addition, carbonates are present in the loamy substratum of some of these sites. The strong interaction with groundwater and presence of carbonates prevent drops in pH on these sites.

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 very slow to moderate.
Hydrologic Group: A/D, B/D, C/D
Hydrogeomorphic Wetland Classification: Depressional, forested/organic; Depressional, scrub-shrub/organic
Cowardin Wetland Classification: PFO1B, PFO4B, PSS1B, PEM1B

Soil features

The soils of these sites are represented by Bowstring, Cathro, Dora, Lupton, Markey, Rifle, and Seelyeville soil series. Bowstring is classified as a Fluvaquentic Haplosaprist; Cathro, Dora, and Markey are classified as Terric Haplosaprists; Lupton and Seelyeville are Typic Haplosaprists; Rifle is a Typic Haplohemist.

These soils are formed in moderately deep to very deep, highly decomposed organic material primarily of herbaceous origin. Organic deposits are 15 to over 60 inches (40 to over 150 cm) deep. Some sites may be underlain by loamy drift, or sandy or loamy outwash. These sites are very poorly drained and remain saturated throughout the year. They meet hydric soil requirements.

The surface horizon of these soils muck, peat, or mucky peat. The subsurface horizons are highly decomposed muck—sapric materials. Where mineral contact occurs, textures may be loam, sandy loam, silty clay loam, silty clay, and sand. Soil pH is slightly acid to neutral with a range from 6.40 to 7.20. Sites are commonly absent of carbonates, but some may be present at depths of 28 inches (71 cm).

Table 4. Representative soil features

Parent material	(1) Woody organic material (2) Herbaceous organic material (3) Drift (4) Outwash
Surface texture	(1) Mucky, peaty
Drainage class	Very poorly drained
Permeability class	Very slow to moderate
Soil depth	80–100 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–3%
Available water capacity (0-61in)	4.71–11.98 in
Calcium carbonate equivalent (0-39.4in)	0–15%
Soil reaction (1:1 water) (0-39.4in)	6.4–7.2
Subsurface fragment volume <=3" (Depth not specified)	0–14%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

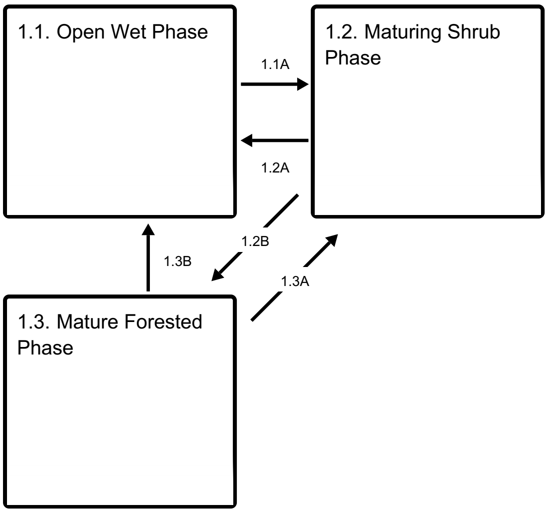
Sites in this ES may be driven to different phases by hydroperiod. Many of these locations are near floodplains or drainageways and are susceptible to some flooding or ponding. The results of this are that sites with high frequencies of flooding and longer durations of flooding lose their trees. Thus this ES represents a spectrum of flooding/ponding frequency and duration. The spectrum of vegetation varies from a black and/or green ash forest, to northern shrub (alder) thicket, to open northern wet meadow. These three states may all be considered stable as long as the hydroperiod remains consistent. Frequency and duration of flooding/ponding is the main driver as to which of these states will be achieved and maintained.

State and transition model

Ecosystem states

1. Reference State

State 1 submodel, plant communities



1.1A - Flooding frequency and duration decreases

1.2A - Flooding frequency and duration increases

1.2B - Very infrequent flooding

1.3B - Flooding frequency and duration increases dramatically

1.3A - Flooding frequency and duration increases moderately

State 1
Reference State

Reference State is a continuum of hydroperiod influenced vegetation where flooding frequency and duration drive vegetation communities. There are three distinct phases, each being stable within a window of hydroperiod variation. Sites on or near floodplains are most likely to be in phases 1.1 and 1.2 while sites farther from streams are more likely to be in phase 1.3. The higher the frequency and more prolonged the wetness the more likely the site will be a northern wet meadow 1.1 (dominantly sedges with sporadic willows and steeplebush). As wetness frequency and duration decreases the site will become a northern shrub thicket 1.2 and speckled alder (and tag alder) will appear and begin to dominate the vegetation. If a site has very low frequency flooding/ponding that is of short duration a Black and/or Green ash forest will likely form 1.3. In some cases this forest will also include White cedar as an associate, but deer browsing has limited the regeneration of this species in this MLRA. Paper birch is another possible associate.

Community 1.1
Open Wet Phase

With frequent flooding and long durations of inundation this ES will exhibit as a northern wet meadow. The vegetation will be dominated by sedges and grasses with sporadic willows and steeplebush present. Willows can be quite extensive in these sites at times. As long as the hydroperiod is consistent this is a stable state.

Dominant plant species

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

Community 1.2
Maturing Shrub Phase

With moderate frequency of flooding with out very long durations of inundation a shrub thicket will form on these sites. The composition of the shrubs on these sites is often dominated by Tag and/or Speckled alder but willow may occur as well. As long as the hydroperiod is consistent this is a stable state.

Dominant plant species

- speckled alder (*Alnus incana ssp. rugosa*), shrub
- gray alder (*Alnus incana*), shrub

Community 1.3
Mature Forested Phase

In the absence of frequent long duration flooding a wet forest community composed of Black and/or Green ash will dominate these sites. Common associates may include Red maple, Paper birch and White cedar. Reproduction of Black and Green ash is often very successful in these stands. A shrub layer may be present in this community phase as well. The shrub layer is often composed of Tag alder. Understory plant communities may be composed of many different species including sedges, grasses, and ferns. As long as flooding frequency and duration remain low this is a stable state.

Dominant plant species

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

Pathway 1.1A
Community 1.1 to 1.2

This transition represents a decrease in hydroperiod where flooding frequency and duration decrease enough for Tag alder and Speckled alder to establish in what was previously open sedges with Steeplebush, and a few isolated Willows.

Pathway 1.2A
Community 1.2 to 1.1

This transition represents an increase in the hydroperiod where flooding frequency and duration increase enough for Sedges to out compete Tag alder and Speckled alder. This could be done as a restoration effort if hydroperiod is controllable or the stream channel is made narrower causing increased frequency of flooding.

Pathway 1.2B
Community 1.2 to 1.3

This transition represents a decrease in hydroperiod where flooding frequency and duration decrease enough for Black and/or Green ash to establish and out compete Tag alder and Speckled alder. This ecosystem is stable with very infrequent and/or short duration flooding. Understory species will shift to Impatiens spp., sedges, and sometimes skunk cabbage. Sites where there is little deer browse may include White cedar as an associate. Red maple and Paper birch are possible associates when seed source is present.

Pathway 1.3B
Community 1.3 to 1.1

This transition represents a dramatic increase in the hydroperiod where flooding frequency and duration increase enough for Sedges to out compete Black and Gree ash and Balsam. This could be done as a restoration effort if hydroperiod is controllable or the stream channel is made narrower causing increased frequency of flooding.

Pathway 1.3A
Community 1.3 to 1.2

This transition represents an increase in the hydroperiod where flooding frequency and duration increase enough for Tag alder and Speckled alder to outcompete Black and Green ash.

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.
Wetland Forest Habitat Type Classification System for Northern Wisconsin (Kotar and Burger, 2017): All four visited sites in this ES keyed out to two habitat types: [FnOn] and [FnArI-Ix] but some sites are not well represented by this Habitat Type as they are more open sedge-meadow than forested wetland.
Biophysical Settings (Landfire, 2014): This ES is largely mapped as Boreal White Spruce-Fir Forest, Laurentian-Acadian Alkaline Conifer-Hardwood Swamp Forest, and Laurentian-Acadian Pine-Hemlock Forest
WDNR Natural Communities (WDNR, 2015): Northern Hardwood Swamp

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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 90B, 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	04/20/2024
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):**

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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:

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

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

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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:**
