

## Ecological site F090BY017WI Clayey Upland

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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 heterogeneous 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 6-24 inches 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 6-47 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 streams.

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: Rosemont Baldwin Plains and Moraines (222Md)

Small sections occur in Rib Mountain Rolling Ridges (212Qd), Lincoln Formation Till Plain - Mixed Hardwoods (212Qb), Lincoln Formation Till Plain - Hemlock Hardwoods (212Qc), St. Croix Moraine (212Qa), Mille Lacs Uplands (212Kb), Bayfield Sand Plains (212Ka)

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

## Ecological site concept

The Clayey Upland ecological site is an uncommon site but may be found in the southwest portion of MLRAs 90A and 90B, located on lake plains, hills, and ridges primarily in St. Croix and Pierce counties. These sites are characterized by moderately deep to very deep, moderately well to well drained soils that formed primarily in clayey lacustrine and clayey residuum. Precipitation and runoff from adjacent uplands are the primary sources of water. Soils range from very strongly acid to moderately alkaline.

Clayey Upland is distinguished from other ecological sites based on the clayey deposits and drainage. Other moderately well and well drained sites have sandy or loamy deposits. The clayey materials often have higher pH and available water capacity than coarser materials. The moderately well and well drained soils differentiates this site from other clayey sites.

## Associated sites

F090BY007WI	<p><b>Wet Clayey Lowland</b> Wet Clayey Lowland form in deep, loamy to clayey deposits derived from a mixture of alluvium, residuum, till, or lacustrine sources. These sites have a seasonally high water table at the surface, and some are subject to occasional ponding. Sustained saturation is enough for hydric conditions to occur. They are much wetter and occur lower on the drainage sequence than Clayey Upland.</p>
F090BY012WI	<p><b>Moist Clayey Lowland</b> Moist Clayey Lowland consist of deep clayey lacustrine deposits. The finer textures perch the water table. These soils remain moist - but not saturated - throughout much of the growing season. They are wetter and occur lower on the drainage sequence than Clayey Upland.</p>

## Similar sites

F090BY016WI	<p><b>Loamy Upland</b> Loamy Upland 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 occur in similar landscape positions with the same drainage class as Clayey Upland but with coarser particle sizes.</p>
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Table 1. Dominant plant species

Tree	(1) <i>Acer saccharum</i> (2) <i>Fraxinus pennsylvanica</i>
Shrub	(1) <i>Ribes oxycanthoides</i>
Herbaceous	(1) <i>Circaea lutetiana</i> (2) <i>Sanicula odorata</i>

## Physiographic features

These sites formed on lake plains, hills, and ridges. Slopes range from 0 to 35 percent. Sites are on summit, shoulder, and backslope positions.

These sites are not subject to ponding or flooding. Sites have a seasonally high water table at a depth of 6 to 34 inches. Water table can drop below 80 inches during dry conditions. Surface runoff is negligible to very high. The wide range in slope causes the range in surface runoff.

**Table 2. Representative physiographic features**

Hillslope profile	(1) Summit (2) Shoulder (3) Backslope
Slope shape across	(1) Concave
Slope shape up-down	(1) Linear
Landforms	(1) Lake plain (2) Hill (3) Ridge
Runoff class	Negligible to very high
Flooding frequency	None
Ponding frequency	None
Elevation	656–902 ft
Slope	0–35%
Water table depth	6–34 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.

The average annual precipitation for this ecological site is 30 inches. The average annual snowfall is 44 inches. The annual average maximum and minimum temperatures are 53°F and 34°F, respectively.

**Table 3. Representative climatic features**

Frost-free period (characteristic range)	91-113 days
Freeze-free period (characteristic range)	118-138 days
Precipitation total (characteristic range)	29-33 in
Frost-free period (actual range)	46-116 days
Freeze-free period (actual range)	90-146 days
Precipitation total (actual range)	28-35 in
Frost-free period (average)	93 days
Freeze-free period (average)	125 days
Precipitation total (average)	31 in

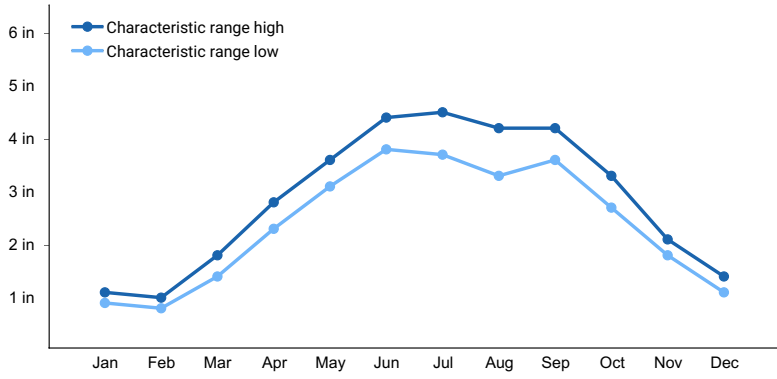


Figure 1. Monthly precipitation range

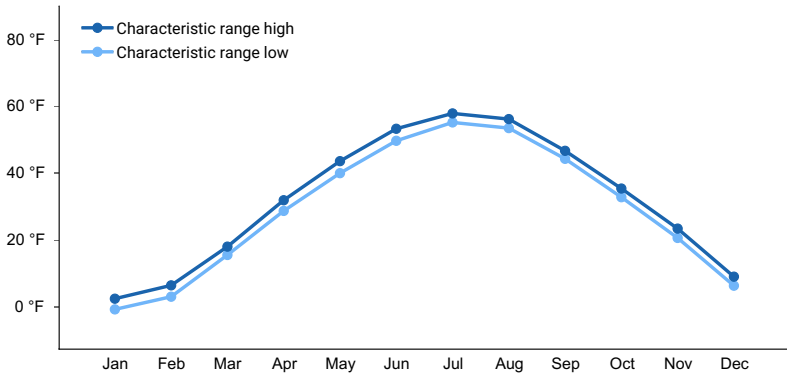


Figure 2. Monthly minimum temperature range

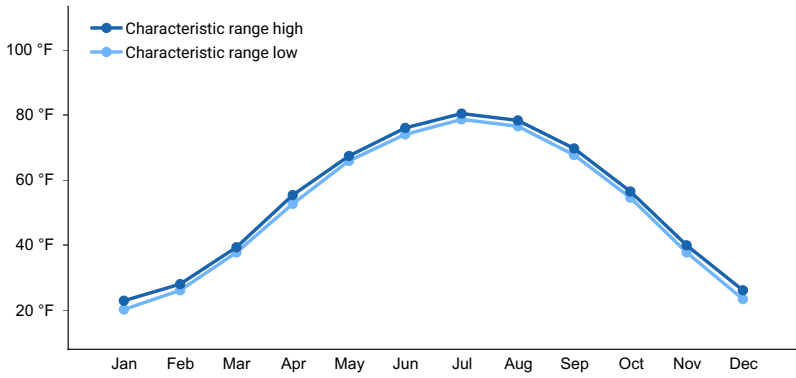


Figure 3. Monthly maximum temperature range

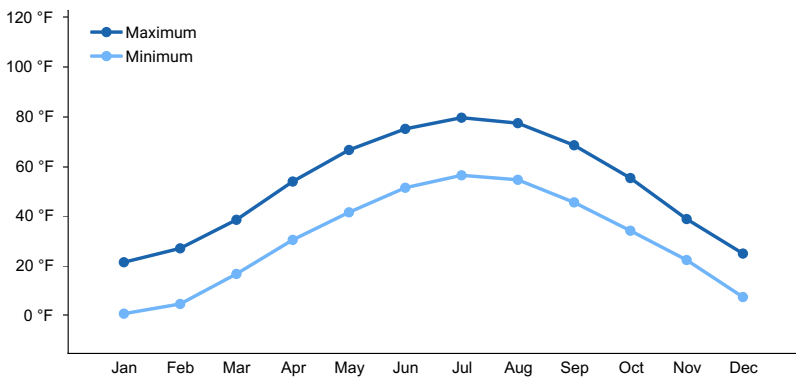
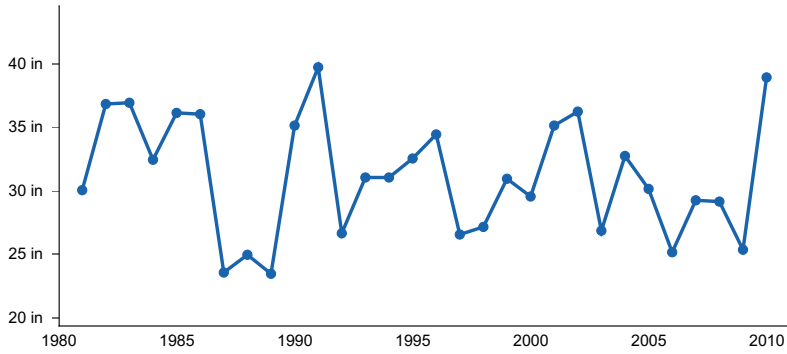
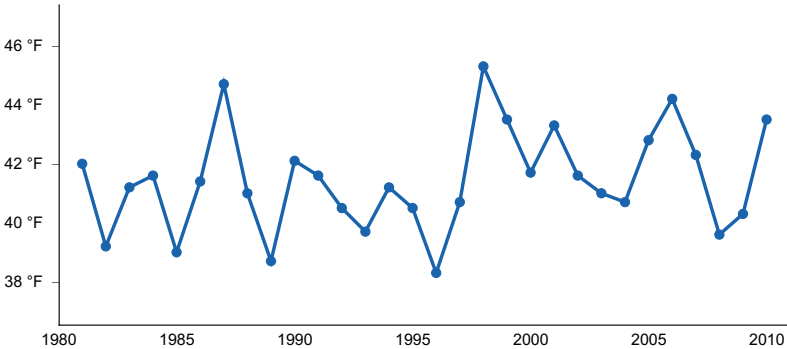


Figure 4. Monthly average minimum and maximum temperature



**Figure 5. Annual precipitation pattern**



**Figure 6. Annual average temperature pattern**

### Climate stations used

- (1) HOLCOMBE [USC00473698], Holcombe, WI
- (2) ROSHOLT 9 NNE [USC00477349], Wittenberg, WI
- (3) STAMBAUGH 2SSE [USC00207812], Iron River, MI
- (4) BIG FALLS HYDRO [USC00470773], Glen Flora, WI
- (5) COUDERAY 7 W [USC00471847], Stone Lake, WI
- (6) ISLE 12N [USC00214103], Isle, MN
- (7) MOOSE LAKE 1 SSE [USC00215598], Moose Lake, MN
- (8) MILACA [USC00215392], Milaca, MN
- (9) WINTER [USC00479304], Ojibwa, WI
- (10) LAKEWOOD 3 NE [USC00474523], Lakewood, WI
- (11) MINONG 5 WSW [USC00475525], Minong, WI
- (12) AMERY [USC00470175], Amery, WI
- (13) BRUNO 7ENE [USC00211074], Bruno, MN

### Influencing water features

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

### Wetland description

Permeability of these sites is impermeable to slow.

Hydrologic Group: C, D, A/D, C/D

Hydrogeomorphic Wetland Classification: None

Cowardin Wetland Classification: None

### Soil features

These sites are represented by the Campia Variant, Derinda, Eaupleine Variant, Hiles Variant, and Taylor soil

series. Campia Variant and Hiles Variant are classified as a Typic Glossudalfs; Derinda is an Oxyaquic Hapludalf; Eupleine Variant is a Haplic Glossudalf; Taylor is an Aquertic Hapludalf.

These soils formed in various parent materials including loess, loamy or clayey residuum, sandy or clayey lacustrine, and sandy outwash. Bedrock can be found as high as 30 inches. Sites are moderately well or well drained. They do not meet hydric soil requirements.

The surface of these soils is loamy sand, loam, silt loam, or fine sandy loam. Subsurface textures are silt loam, clay loam, silty clay loam, loam, silty clay, clay, sandy loam, fine sandy loam, and sand. Soil pH ranges from very strongly acid to moderately alkaline with values of 4.6 to 7.9. Carbonates may be present up to 18 percent beginning at 25 inches.

**Table 4. Representative soil features**

Parent material	(1) Eolian deposits (2) Lacustrine deposits (3) Till (4) Outwash (5) Sandstone and shale (6) Metamorphic rock
Surface texture	(1) Loamy sand (2) Sandy loam (3) Loam (4) Silt loam
Drainage class	Moderately well drained to well drained
Permeability class	Very slow to slow
Soil depth	30–80 in
Surface fragment cover ≤3"	0–6%
Surface fragment cover >3"	0–7%
Available water capacity (0-60in)	1.89–3.14 in
Calcium carbonate equivalent (0-40in)	0–18%
Soil reaction (1:1 water) (0-40in)	4.6–7.9
Subsurface fragment volume ≤3" (Depth not specified)	0–5%
Subsurface fragment volume >3" (Depth not specified)	0–18%

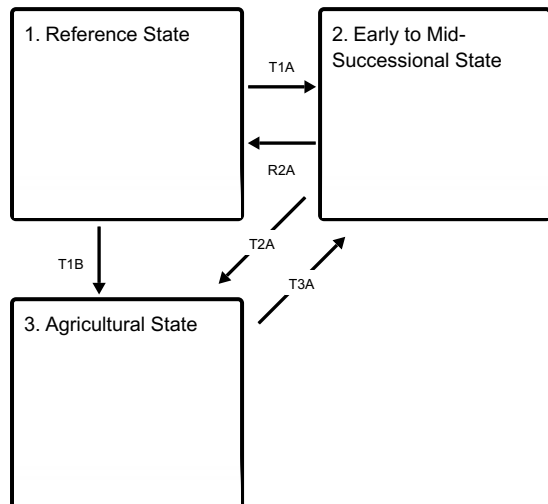
## Ecological dynamics

Historically, this site was dominated by mesic hardwoods in a landscape adapted to fire disturbance that allowed for a strong presence of oaks. 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 these species adapted to fire 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 to establish under a canopy, and in time, may become a component of the canopy. Mesic hardwoods are sensitive to fire, but in its absence, they have the ability to dominate sites based on their shade tolerance and prolific seed production.

Today, these forests most commonly include stands of sugar maple, red maple, and other mesic hardwoods. Some sites have a strong presence of red oak, and white pine is successfully reinvading the landscape in some areas. These sites have the conditions to support shade tolerant mesic hardwoods, but historically had significant wind throw and fire disturbance that allowed for a strong presence of oak species and white pine. As long as fire is continually suppressed, maples and other mesic hardwoods will continue to dominate the canopy.

## State and transition model

### Ecosystem states



**T1A** - Major stand replacing disturbance e.g. blow-down and fire, or clear-cutting, followed by fire.

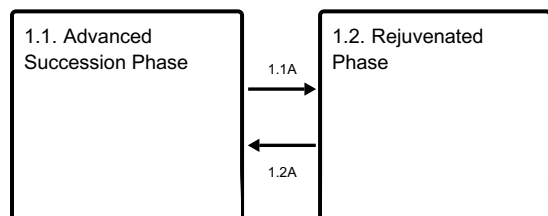
**T1B** - Elimination of forest cover, application of agricultural practices.

**R2A** - Time and natural succession.

**T2A** - Elimination of forest cover, application of agricultural practices.

**T3A** - Removal of forest vegetation and tilling.

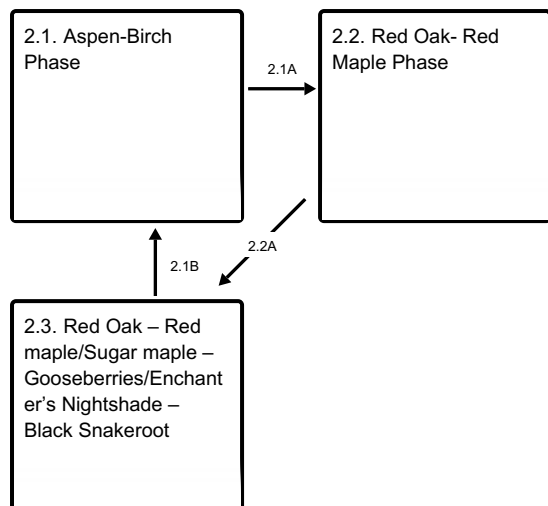
### State 1 submodel, plant communities



**1.1A** - Natural mortality in the oldest age classes, sporadic small-scale blow-downs and ice storms, create openings for entry of mid-tolerant species, such as red oak and red maple.

**1.2A** - Time and natural succession.

### State 2 submodel, plant communities

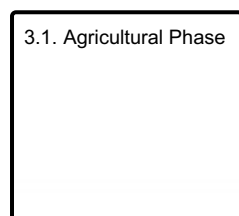


**2.1A** - Red oak and red maple regenerating under aspen -- paper birch canopy

**2.2A** - Time and natural succession.

**2.1B** - Clear cutting or stand-replacing fire.

### State 3 submodel, plant communities



## State 1 Reference State

Reference state is a forest community dominated by sugar maple (*Acer saccharum*) and red maple (*Acer rubrum*). 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 Phase

In the absence of any major disturbance, specifically fire, this community is dominated by sugar maple. Common associates include moderately shade tolerant white ash, basswood, and red oak. Some sites may be dominated by red oak but is unlikely without any disturbance. The shrub layer is often dominated by ironwood, witch hazel, and hazelnuts. The ground layer is dominated by hog peanut and baneberry, with goldenrod, Enchanter's nightshade, and wood ferns also common.

#### Dominant plant species

- sugar maple (*Acer saccharum*), tree
- white ash (*Fraxinus americana*), tree
- basswood (*Tilia*), tree
- American hornbeam (*Carpinus caroliniana*), shrub
- enchanter's nightshade (*Circaea xintermedia*), other herbaceous
- Canadian blacksnakeroot (*Sanicula canadensis*), other herbaceous

### Community 1.2 Rejuvenated Phase

This community is often dominated by sugar maple, red oak, and red maple. The shrub and ground layers are



similar to the advanced succession phase, but may include the establishment of new seedlings.

### **Dominant plant species**

- sugar maple (*Acer saccharum*), tree
- red maple (*Acer rubrum*), tree
- northern red oak (*Quercus rubra*), tree
- hazelnut (*Corylus*), shrub
- pricklyash (*Zanthoxylum*), shrub
- bigleaf aster (*Eurybia macrophylla*), other herbaceous
- Canada mayflower (*Maianthemum canadense*), other herbaceous

### **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 advance regeneration and stimulating new seedling establishment. Some additional less shade tolerant species such as red oak and white pine may be able to enter the community.

### **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. Lacking a major disturbance, the canopy will likely be replaced with red and sugar maple. 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**

### **Early to Mid-Successional State**

Following disturbances described in Transition T1A a wide range of forest community phases may come into temporary existence, the three most common ones are described here.

### **Community 2.1**

#### **Aspen-Birch Phase**

These two species have a very narrow window of environmental and ecological conditions for successful establishment. The main requirements are exposed mineral soil and elimination—most effectively by fire—of on-site seed sources of potential competing vegetation. In addition, adequate soil moisture must be available for initial seedling development. Once seedlings are firmly established, height growth of both species is relatively rapid and able to outgrow most competitive species. Paper birch seedlings and saplings tolerate partial shade and often become members of mixed species communities. This is not true for aspen which requires continuous full-sun exposure for survival. Aspen stands are initially very dense due to sprouting from extensive lateral roots, but rapid natural thinning ensues as stems compete for available light.

### **Dominant plant species**

- quaking aspen (*Populus tremuloides*), tree
- paper birch (*Betula papyrifera*), tree

### **Community 2.2**

#### **Red Oak- Red Maple Phase**

This community phase occurs by invading and succeeding a pioneer aspen-birch community. Stand structure consists of dominant red oak and red maple in combination with a modest, or strong presence of mature, or decaying, aspen and/or paper birch. The shrub layer, dominated by beaked hazelnut (*Corylus cornuta*), typically reaches its best development in this community phase.

### **Dominant plant species**

- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree

### **Community 2.3**

#### **Red Oak – Red maple/Sugar maple – Gooseberries/Enchanter's Nightshade – Black Snakeroot**

This community phase represents distinct transition into mid-successional state, by strong presence in second canopy, or in reproductive layers, of shade-tolerant species, sugar maple, basswood, green ash. Sporadic occurrence of individual white pine trees also is common.

### **Dominant plant species**

- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), tree
- hazelnut (*Corylus*), shrub
- bigleaf aster (*Eurybia macrophylla*), other herbaceous
- Canada mayflower (*Maianthemum canadense*), other herbaceous

### **Pathway 2.1A**

#### **Community 2.1 to 2.2**

Time and the immigration, establishment, and growth of white and red pine seedlings. This pathway most likely includes small, but frequent fire disturbance that favors the shade intolerant, and fire adapted red pine, and moderately tolerant white pine.

### **Pathway 2.2A**

#### **Community 2.2 to 2.3**

Time and natural succession. Red oak and red maple have succeeded the aspen-birch community. Depending on seed source, sugar maple begins growth and establishment in the understory.

### **Pathway 2.1B**

#### **Community 2.3 to 2.1**

Clear cutting or major fire disturbance allows for the reinvasion of the shade intolerant aspen-birch community.

### **State 3**

#### **Agricultural State**

Indefinite period of applying agricultural practices.

### **Community 3.1**

#### **Agricultural Phase**

The agricultural phase constitutes tillage and the planting of row crops or hay or pasture.

### **Transition T1A**

#### **State 1 to 2**

Clear cutting with initial control of competing vegetation, or stand-replacing fire, prepare the site for occupancy by shade intolerant species. This may occur through natural regeneration or by planting.

### **Transition T1B**

#### **State 1 to 3**

Abandonment of agricultural practices and allowing natural vegetation to colonize the site or apply artificial afforestation.

## **Restoration pathway R2A**

### **State 2 to 1**

A period of some 70-100 years without major stand disturbance, especially fire, leads to decreased presence, through natural mortality, of early successional species and the dominance of moderately shade tolerant red maple and red oak and a sub-canopy of shade tolerant sugar maple, returning the community to Reference State.

## **Transition T2A**

### **State 2 to 3**

Removal of forest cover, tilling and application of other agricultural techniques to grow agricultural crops.

## **Transition T3A**

### **State 3 to 2**

Abandonment of agricultural practices and allowing natural vegetation to colonize the site or apply artificial afforestation.

## **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.

Habitat Types of N. & S. Wisconsin (Kotar, 2002 & 1996): The sites of this ES keyed out to two habitat types: *Acer saccharum*/Caulophyllum-Circaea (ACaCi); *Acer rubrum*/Circaea (ArCi)

Biophysical Settings (Landfire, 2014): This ES is largely mapped as North-Central Interior Maple-Basswood Forest, Eastern Cool Temperate Row Crop, Eastern Cool Temperate Pasture and Hayland, and Eastern Cool Temperate Close Grown Crop

WDNR Natural Communities (WDNR, 2015):

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### Approval

Suzanne Mayne-Kinney, 11/16/2023

### Acknowledgments

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:**

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

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

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

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

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

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

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

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

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

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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:**

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