

## Ecological site F093BY008MI Fragic Loamy Uplands

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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): 093B–Superior Stony and Rocky Loamy Plains and Hills

The Wisconsin portion of this MLRA is a mixture of high-relief moraines and flat till plains with interspersed glacial meltwater deposits. It is bordered on the north by glaciolacustrine deposits of Glacial Lake Duluth and on the south by extensive pitted and unpitted outwash plains. The approximate land area is just under 600,000 acres (935 sq miles).

The Penokee-Gogebic Iron Range runs through the middle of the Wisconsin portion of this MLRA and into Michigan. The range is a hilly, bedrock-controlled moraine. The bedrock outcropping is composed of igneous and metamorphic materials and was created by inland folding and faulting of the ancient Superior continent when it collided with the Marshfield continent about 1.8 billion years ago (Dott & Attig, 2004). Volcanic and intrusive bedrock occurs in some places. This bedrock is overlain by a thin layer of glacial till deposited by the Chippewa Lobe.

To the north of the range is a former spillway for Glacial Lake Ontonagon. The flowing meltwater cut deep channels into the morainal systems. Glaciofluvial landforms here include old beaches and dunes. South of the range, along the southern edge of this MLRA, are rolling collapsed end moraines, pushed to their extent by the Chippewa and Ontonagon Lobes. The landscape is dotted with abundant kettle lakes and swamps, especially in the eastern portion. Ice-walled lake plains and eskers are also found along these collapsed moraines.

The climate is influenced by Lake Superior in areas near the lake, resulting in cooler summers, warmer winters, and greater precipitation – especially snowfall – compared to more inland locations. Historically, mixtures of eastern hemlock (*Tsuga canadensis*), sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), eastern white pine (*Pinus strobus*), and red pine (*Pinus resinosa*) covered the area. In wetter pockets (such as the swamps that dot the moraines to the south) white cedar (*Thuja occidentalis*), black spruce (*Picea mariana*), and tamarack (*Larix laricina*) were common (Finley, R., 1976).

### Classification relationships

Relationship to Established Frameworks and Classification Systems:

Habitat Types of N. Wisconsin (Kotar, 2002): Two sites key out to *Acer saccharum* – *Tsuga canadensis*/ *Dryopteris spinulosa* (ATD), two sites key to *Acer saccharum* – *Tsuga canadensis*/ *Maianthemum canadense* (ATM), and two sites key to *Acer saccharum* / *Vaccinium angustifolium* – *Viburnum acerifolium* (AVVb).

Biophysical Setting (Landfire, 2014): This ES is mapped as Laurentian-Acadian Northern Pine(-Oak) Forest, Laurentian-Acadian Northern Hardwoods Forest – Hemlock, and Laurentian-Acadian Northern Hardwoods Forest; though, it is likely best represented by the latter.

WDNR Natural Communities (WDNR (2015): This ES is most similar to the Northern Mesic Forest.

Hierarchical Framework Relationships:

Major Land Resource Area (MLRA): Superior Stoney and Rocky Loamy Plains and Hills, Eastern Part (93B)

USFS Subregions: Winegar Moraines (212Jc)

Small sections occur in the Gogebic-Penokee Iron Range (212Jb) subregion

Wisconsin DNR Ecological Landscapes: North Central Forest

## Ecological site concept

The Fragic Loamy Uplands ecological site is a dominant site in MLRA 93B, located on moraines, hills, and till plains. These sites are characterized by moderately deep to very deep, moderately well to well drained soils that formed in sandy and loam till, eolian, and glaciofluvial deposits, and residuum. Soils have a fragipan (a dense, reversibly-cemented layer) or fragic properties that perch water and restrict rooting depth. Precipitation and runoff from adjacent uplands are the primary sources of water. Soils range from ultra acid to moderately acid.

Fragic Loamy Uplands differ from all other sites by the presence of a fragipan or fragic properties, which limit rooting depth and may cause windthrow. Other upland sites have sandy materials. Loamy materials have a higher pH and available water capacity than sandy materials, which may promote more vegetative growth.

## Associated sites

F093BY004MI	<p><b>Wet Lowlands</b></p> <p>Wet Lowlands occur on depressions and drainageways and form in loamy till or loamy alluvium underlain by dense sandy till or sandy and gravelly outwash. These sites are poorly drained and occur lower on the drainage sequence than Fragic Loamy Uplands.</p>
F093BY005MI	<p><b>Moist Lowlands</b></p> <p>Moist Lowlands occur on footslope positions across the landscape. They are not subject to flooding nor ponding. Soils form in till, lacustrine deposits, or outwash deposits and may be loamy to sandy. These sites are somewhat poorly drained and occur slightly lower on the drainage sequence than Fragic Loamy Uplands.</p>

## Similar sites

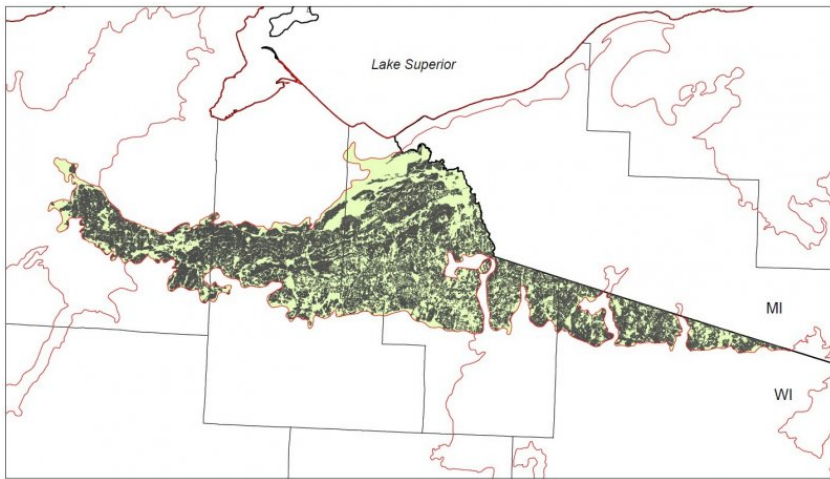
F093BY009MI	<p><b>Alfic Loamy Uplands</b></p> <p>Alfic Loamy Uplands occur on upland sites in loamy glaciofluvial deposits where an argillic horizon is either forming or present. Like Fragic Loamy Uplands, they are moderately well to well drained. They lack a Fragic layer that restricts rooting depth and perches the water table. Generally, Alfic Loamy Uplands support species with a slightly higher nutrient status than Fragic Loamy Uplands.</p>
F093BY010MI	<p><b>Loamy Uplands</b></p> <p>Loamy Uplands occur on upland sites in loamy till, sometimes with a mantle of loess. These soils lack significant clay accumulation or a Fragic layer. Like Fragic Loamy Uplands, they are moderately well to well drained. Generally, Loamy Uplands support species with a slightly higher nutrient status than Fragic Loamy Uplands.</p>

Table 1. Dominant plant species

Tree	(1) <i>Acer saccharum</i> (2) <i>Betula alleghaniensis</i>
Shrub	(1) <i>Acer saccharum</i>
Herbaceous	(1) <i>Maianthemum canadense</i> (2) <i>Aralia nudicaulis</i>

## Physiographic features

These sites are found on moraines and till plains in backslope, shoulder, and summit positions. Slope ranges from 1 to 45 percent. These sites are subject to neither ponding nor flooding. Because of their fragic properties, most sites have a perched seasonally high water table (episaturation) within 12 inches. Surface runoff is low to very high.



**Figure 1. Distribution of Fragic Loamy Uplands in the Superior Stoney and Rocky Loamy Plains and Hills, Eastern Part (93B).**

**Table 2. Representative physiographic features**

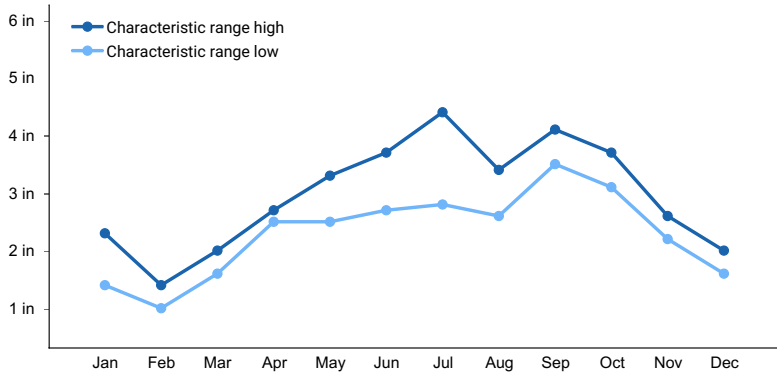
Landforms	(1) End moraine (2) Ground moraine (3) Hill (4) Till plain
Runoff class	Low to very high
Flooding frequency	None
Ponding frequency	None
Elevation	656–985 ft
Slope	1–75%
Water table depth	12–78 in
Aspect	W, NW, N, NE, E, SE, S, SW

### Climatic features

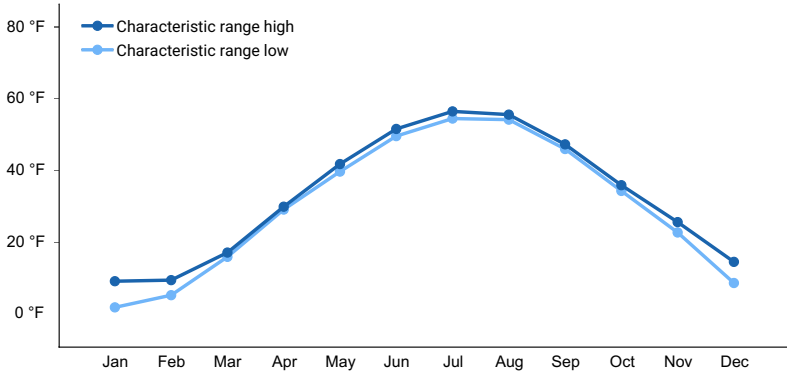
The continental climate of the Superior Stoney and Rocky Loamy Plains and Hills, Eastern Part MLRA is characterized by long, cold winters and short, warm summers where precipitation exceeds evapotranspiration. Neither average annual precipitation nor average annual minimum and maximum temperatures vary greatly within this MLRA, though the climate of the northern tip is somewhat affected by Lake Superior and receives higher annual precipitation in the form of lake effect snow.

**Table 3. Representative climatic features**

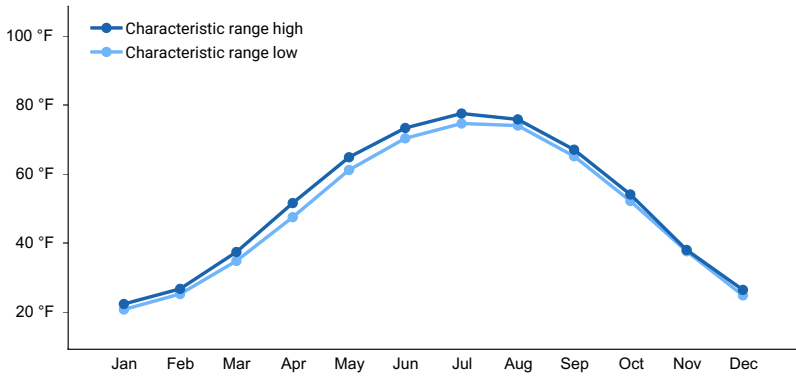
Frost-free period (characteristic range)	92-118 days
Freeze-free period (characteristic range)	124-146 days
Precipitation total (characteristic range)	29-34 in
Frost-free period (actual range)	84-121 days
Freeze-free period (actual range)	120-156 days
Precipitation total (actual range)	28-36 in
Frost-free period (average)	104 days
Freeze-free period (average)	136 days
Precipitation total (average)	32 in



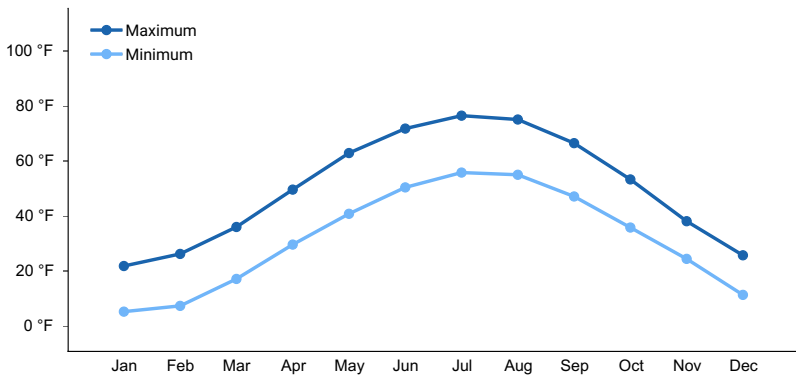
**Figure 2. Monthly precipitation range**



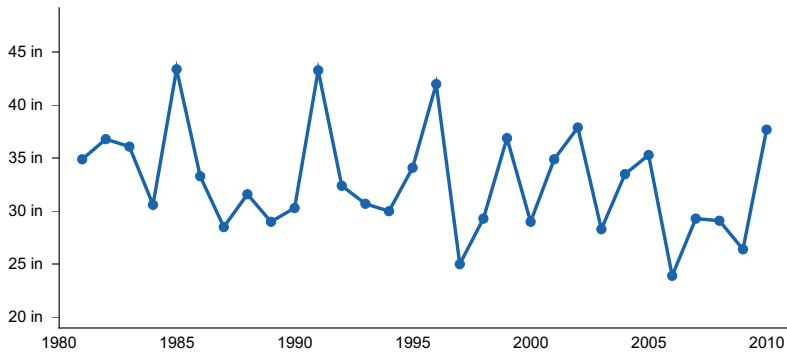
**Figure 3. Monthly minimum temperature range**



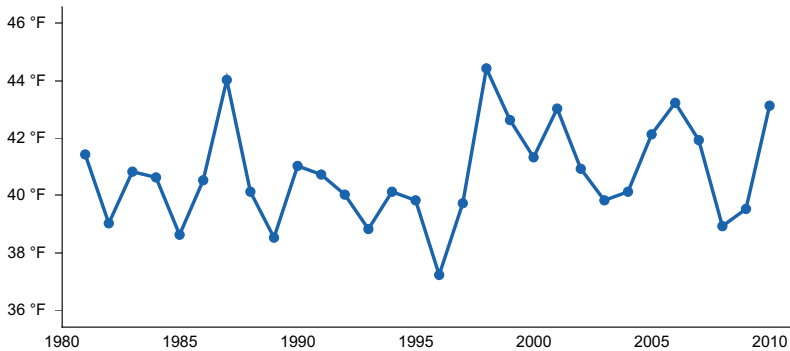
**Figure 4. Monthly maximum temperature range**



**Figure 5. Monthly average minimum and maximum temperature**



**Figure 6. Annual precipitation pattern**



**Figure 7. Annual average temperature pattern**

### Climate stations used

- (1) MARQUETTE [USW00014838], Marquette, MI
- (2) HANCOCK HOUGHTON CO AP [USW00014858], Calumet, MI
- (3) MELLEEN 4 NE [USC00475286], Mellen, WI
- (4) HURLEY [USC00473800], Ironwood, WI
- (5) DRUMMOND [USC00472240], Drummond, WI
- (6) WATTON [USC00208706], Watton, MI

### Influencing water features

Water is received through precipitation and runoff from adjacent uplands. Water is lost from the site primarily through runoff, evapotranspiration, and groundwater recharge. Subsurface outflow may occur based on water perching on the fragipan.

Permeability of the soils is impermeable to very slow. The hydrologic soil group of these sites is C, D, or C/D.

### Wetland description

Hydrologic Group: C, D, C/D

Hydrogeomorphic Wetland Classification: None

Cowardin Wetland Classification: None

### Soil features

These sites are represented primarily by the Gogebic series, classified as an Alfic Oxyaquic Fragiorthod. Also representing these sites are the Schweitzer, Wakefield, and Michigamme series, classified as Alfic Fragiorthods, Alfic Oxyaquic Fragiorthods, and Fragic Haplorthods, respectively.

In these soils, a fragipan is either present or developing. This root-restrictive layer is usually found within 14 inches, and thickness ranges from 3 to 20 inches. These soils formed in loamy till, usually overlain by modified loamy or silty eolian deposits. Sometimes, the loamy till is underlain by sandy till or, rarely, igneous or metamorphic bedrock.

These soils are often impermeable. When not impermeable, permeability is very slow. They are usually very deep and are moderately well to well drained. They do not meet hydric soil requirements.

Surface textures are fine sandy loam to silt loam and may contain up to 5 percent cobbles. Subsurface textures range from sand to silt loam. Subsurface fragments are nearly always present. Gravels constitute 6 to 22 percent of volume, while cobbles constitute 1 to 30 percent of volume. Soil pH ranges from ultra acid to moderately acid with values of 3.1 to 5.9. Carbonates are absent in these soils.

Surface Texture: Fine sandy loam, very fine sandy loam, loam, silt loam

Surface Texture Modifiers: Cobbly

Subsurface Texture: Sand, loamy sand, sandy loam, fine sandy loam, very fine sandy loam, loam, silt loam

Subsurface Texture Modifiers: Gravelly, cobbly, very cobbly

**Table 4. Representative soil features**

Parent material	(1) Eolian deposits (2) Residuum (3) Glaciofluvial deposits (4) Till
Surface texture	(1) Cobbly fine sandy loam (2) Very fine sandy loam (3) Loam (4) Silt loam
Drainage class	Moderately well drained to well drained
Permeability class	Very slow
Soil depth	31–78 in
Surface fragment cover ≤3"	0%
Surface fragment cover >3"	0–5%
Available water capacity (Depth not specified)	4.4–13.9 in
Calcium carbonate equivalent (Depth not specified)	0%
Soil reaction (1:1 water) (Depth not specified)	3.1–5.9
Subsurface fragment volume ≤3" (Depth not specified)	6–22%
Subsurface fragment volume >3" (Depth not specified)	1–30%

## Ecological dynamics

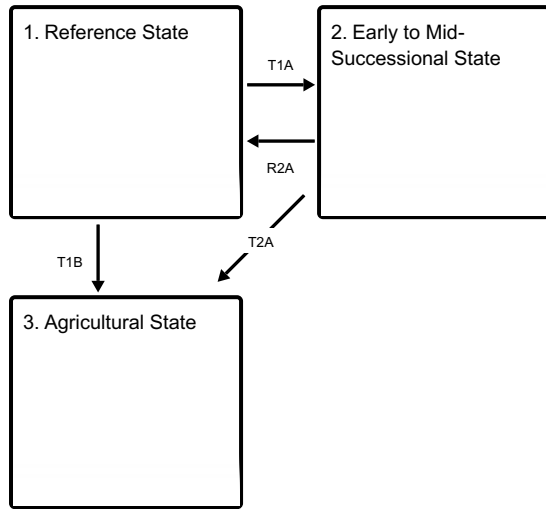
Historically, mature forests on this ecological site were dominated by shade tolerant sugar maple and hemlock, often with an admixture of yellow birch (Wilde, 1933, Finley, 1976). This association was self-maintained with new cohorts of advance regeneration gaining canopy status through gaps formed by small-scale disturbances and natural mortality in the dominant canopy. Scattered large individuals of less shade tolerant white pine also were common component of mesic hardwood forests. These presumably became established following relatively rare disturbances that included fire (Schulte and Mladenoff, 2005).

Current stands on this Ecological Site represent the entire array of potential successional stages from pure aspen, or aspen-white birch, stands to sugar maple dominated mixed northern hardwoods stands. Succession to sugar maple dominance is evident everywhere that seed sources are present. However, hemlock regeneration is scarce. In old forests, hemlock finds optimal conditions for germination and seedling establishment on rotten logs, stumps and mounds that normally have warmer surfaces and better moisture retention than the forest floor (USDA, 1990). Most present forest communities lack these conditions.

While this ES may be similar to others (Loamy Uplands and Alfic Loamy Uplands) in its state and transition model, it should be noted that due to the fragipan or fragic properties of the subsoil there are likely to be more frequent blow downs and stunted trees on these sites due in both cases to root restrictions. In essence this ES will have lower productivity and frequently younger potentially stunted trees.

## State and transition model

### Ecosystem states



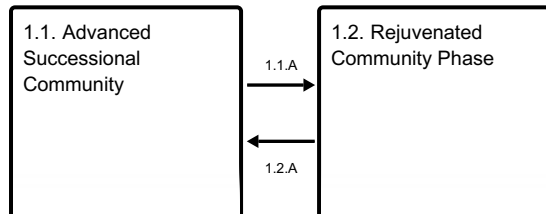
**T1A** - Major stand replacing disturbance e.g. blow-down and fire, or clear-cutting, followed by fire

**T1B** - Clearing of site; agricultural production

**R2A** - Time and natural succession

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

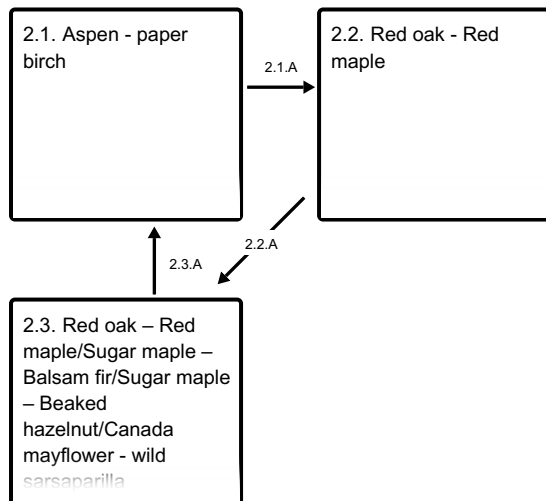
### State 1 submodel, plant communities



**1.1.A** - 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 maple.

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

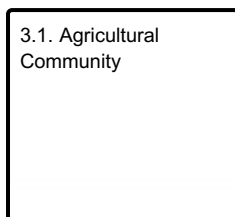
### State 2 submodel, plant communities



2.1.A - Red oak and red maple regenerate under aspen-paper birch canopy

2.2.A - Time and natural succession

### State 3 submodel, plant communities



## State 1 Reference State

The reference plant community is categorized as mesic forest community dominated by mixed deciduous species, primarily sugar maple (*Acer saccharum*), and sporadic occurrence of several conifer species. Although forest communities can vary greatly in terms of species composition and stand structure, depending on type, degree and frequency of disturbance, two common phases predominate: Advanced succession community and Rejuvenated community.

### Dominant plant species

- sugar maple (*Acer saccharum*), tree
- yellow birch (*Betula alleghaniensis*), tree
- eastern hemlock (*Tsuga canadensis*), tree
- sugar maple (*Acer saccharum*), shrub
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- wild sarsaparilla (*Aralia nudicaulis*), other herbaceous

## Community 1.1 Advanced Successional Community

In the absence of major, stand-replacing disturbance this community is dominated by sugar maple, yellow birch (*Betula alleghaniensis*) and eastern hemlock (*Tsuga Canadensis*), often with scattered occurrence of old white pines. This was the most common condition in pre-European settlement forests. The tree sapling and shrub layer in this community is not well developed due to dense shade created by multi-story tree canopy. Most common, but low coverage shrub species are American hophornbeam (*Ostrya virginiana*), hornbeam (*Carpinus caroliniana*), and hazelnuts (*Corylus*, spp.). The herb layer is relatively species rich, but moderate in abundance. The dominant herbs typically include Canada mayflower (*Maianthemum canadense*) and wild sarsaparilla (*Aralia nudicaulis*). Other common herb species include woodferns (*Dryopteris*, spp.), American starflower (*Trientalis borealis*), Hairy Solomon's seal (*Polygonatum pubescens*), and false Solomon's seal (*Maianthemum racemosum*). It is important to note that in most current mature stands, hemlock is significantly under-represented compared to historic conditions. Apparently, this lack of hemlocks is due to seed source elimination during the early logging era and herbivory by currently high white tail deer populations.

### Dominant plant species

- sugar maple (*Acer saccharum*), tree
- yellow birch (*Betula alleghaniensis*), tree
- eastern hemlock (*Tsuga canadensis*), tree
- sugar maple (*Acer saccharum*), shrub
- hophornbeam (*Ostrya virginiana*), shrub
- American hornbeam (*Carpinus caroliniana*), shrub
- hazelnut (*Corylus*), shrub
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- wild sarsaparilla (*Aralia nudicaulis*), other herbaceous



## **Community 1.2**

### **Rejuvenated Community Phase**

Disturbances described in Pathway 1.1A lead to increased species and structural diversity of the forest community. Depending on seed source, red oak, red maple and—in many cases—white pine regenerate in the canopy openings and in time join sugar maple and hemlock in the dominant canopy. White pine easily exceeds the height of the deciduous canopy and often remains on the site, as scattered individuals, for up to four centuries. This exceptional longevity virtually assures perpetual white pine seed source on the site. The relative density of the shrub and herb layers also increases during this stage. Species composition remains relatively unchanged, but abundance changes can be significant. Particularly beaked hazelnut can form dense thickets and big leaf aster often forms continuous carpets. Many other herb species that were present with very low abundance in the advanced-succession community typically form much larger population clusters.

#### **Dominant plant species**

- sugar maple (*Acer saccharum*), tree
- northern red oak (*Quercus rubra*), tree
- balsam fir (*Abies balsamea*), tree
- hophornbeam (*Ostrya virginiana*), shrub
- American hornbeam (*Carpinus caroliniana*), shrub
- western brackenfern (*Pteridium aquilinum*), other herbaceous
- bigleaf aster (*Eurybia macrophylla*), other herbaceous

### **Pathway 1.1.A**

#### **Community 1.1 to 1.2**

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 maple.

### **Pathway 1.2.A**

#### **Community 1.2 to 1.1**

In the absence of canopy reducing disturbances natural succession leads to community dominance by the most shade-tolerant species resulting in return to community phase 1.1.

## **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 red oak -red maple -sugar maple, red oak - red maple, and aspen paper birch.

#### **Dominant plant species**

- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree
- quaking aspen (*Populus tremuloides*), tree
- paper birch (*Betula papyrifera* var. *papyrifera*), tree
- sugar maple (*Acer saccharum*), shrub
- beaked hazelnut (*Corylus cornuta*), shrub
- western brackenfern (*Pteridium aquilinum*), other herbaceous
- bigleaf aster (*Eurybia macrophylla*), other herbaceous

### **Community 2.1**

#### **Aspen - paper birch**

These two species have a very narrow window of environmental and ecological conditions for successful establishment. 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**

This community phase may occur via two different origins: 1. By sprouting from stumps or by local seed source, following stand-leveling disturbance, or 2. By invading and succeeding a pioneer aspen-birch community. For this reason, tree species composition and community structure in early stages of development vary considerably, from pure canopy dominance by red oak and red maple, singly, or in combination, to 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 – Balsam fir/Sugar maple – Beaked hazelnut/Canada mayflower - wild sarsaparilla**

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, eastern hemlock, or balsam fir and white spruce. Sporadic occurrence of individual white pine trees also is common. Eastern hemlock, although historically a prominent member of mature communities on this site, is today under-represented presumably due to lack of seed source and selective browsing by the white-tailed deer.

#### **Dominant plant species**

- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), tree
- white spruce (*Picea glauca*), tree
- beaked hazelnut (*Corylus cornuta*), shrub
- sugar maple (*Acer saccharum*), shrub
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- wild sarsaparilla (*Aralia nudicaulis*), other herbaceous

### **Pathway 2.1.A**

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

Natural succession leads to community dominance by the most shade-tolerant species.

### **Pathway 2.2.A**

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

Succession by shade-tolerant species, sugar maple, basswood and in some cases also balsam fir and white spruce.

## **Pathway 2.3.A**

### **Community 2.3 to 2.1**

#### **State 3**

##### **Agricultural State**

This community phase is composed of crops, hay, or pasture.

#### **Community 3.1**

##### **Agricultural Community**

This community phase is composed of crops, hay, or pasture.

#### **Transition T1A**

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

Major stand-replacing disturbance. In pre-European settlement time, the event was most often a severe blow down, sometimes followed by fires. Such blow downs have been estimated to occur in this part of Wisconsin every 300 to 400 years (Schulte and Mladenoff, 2005). In post settlement virtually every acre has been logged either by clear cutting or successive cuts targeting species marketable at that time. Post logging slash fires also have been a significant factor in most areas. These disturbances created the environment suitable for natural regeneration of many shade-intolerant species and for commercial planting.

#### **Transition T1B**

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

Elimination of forest cover, application of agricultural practices

#### **Restoration pathway R2A**

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

Allow natural vegetation to colonize the site or apply artificial afforestation. The time required for forest community to reach the reference state conditions may exceed 100 years.

#### **Transition T2A**

##### **State 2 to 3**

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

### **Additional community tables**

#### **Inventory data references**

Sites key primarily to mesic Kottar Habitat Types. STM designed based on ATM and ATD types. (Wisconsin Forest Habitat Type Classification System)

Gogebic is the only soil represented in the sites collected for this ESD.

#### **Other references**

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## **Approval**

Suzanne Mayne-Kinney, 9/27/2023

## **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	09/27/2023
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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