

## Ecological site F094BY011MI Dry 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): 094B—Michigan Eastern Upper Peninsula Sandy Glacial Deposits

The Michigan Eastern Upper Peninsula MLRA (94B) corresponds closely with the Northwestern Sands Ecological Landscape. Some of the following brief overview is borrowed from the Wisconsin Department of Natural Resources ecological landscape publication (2015).

The Michigan Eastern Upper Peninsula MLRA is in northeast Wisconsin on the border of the Upper Peninsula of Michigan, with a very small portion on the Lake Michigan coast disjoined from the rest of the MLRA. The Wisconsin portion of the MLRA is a bit shy of 1.1 million acres (1,668 square miles). This region, which was covered entirely by the Green Bay Lobe in Wisconsin's most recent glaciation, has a unique glacial landscape defined by intermingled loamy moraines and sandy heads-of-outwash. Extensive pitted outwash plains dominate the region, with significant glaciolacustrine sediments in the southeast portion of this region.

A prominent landform in this MLRA is the hummocky ridges of intermingled loamy moraines and sandy heads-of-outwash that protrude from extensive pitted outwash plains. These north-south trending, loamy morainal ridges were deposited as the Green Bay Lobe was stagnant—the rate of melting was relatively equal to the rate of advancement. This stagnation allowed the deposition of a ridge of sandy loam materials. Supraglacial till was deposited unevenly, and buried ice blocks melted and collapsed the surface to form hummocky topography on the moraines. The heads-of-outwash formed while the ice was melting and thinning rapidly. Large amounts of sand and gravel outwash materials, and some till and loamy debris-flow sediment, were deposited on top of the thin edge of ice. They, too, have hummocky topography resulting from the collapse of buried ice. The topographically similar appearances of the moraines and heads-of-outwash make them difficult to distinguish superficially, but they are formed in different-textured materials and the vegetation divergence is often evident. These moraines and heads-of-outwash mark the western extent of the Green Bay Lobe and are sometimes referred to as the Athelstane Moraines.

As the Green Bay Lobe receded, meltwaters carried sand and gravel outwash sediments to lower-lying areas. The outwash buried broken ice that melted, collapsed the surface, and created extensive pitted outwash plains that occur between the high elevation moraines and heads-of-outwash. More than 50% of this land region is covered in outwash sediments, and most of the outwash is pitted or collapsed.

The southeast portions of this MLRA are dominated by glacial lake sediments. Glacial Lake Oshkosh covered a portion of this MLRA when it was at its largest extent (1.4 million acres). The lake deposited silts and clays along the southeast portion of the inland section of this MLRA. Beach terraces, ridges, and dunes were also formed by the lake. In the Lake Michigan coastal section of this MLRA, Glacial Lake Nipissing deposited a level lake plain full of sandy lacustrine material that overlies dolomite and limestone bedrock. Glacial Lake Nipissing was a postglacial lake that occurred in the Lake Michigan Basin as the Lake Michigan Lobe was receding. Wetlands are abundant in this area of the MLRA. In the north section, Glacial Lake Dunbar formed when ice dams impounded glacial meltwater between the Athelstane Moraine and the Inner Athelstane Moraine. This glacial lake deposited small areas of level sandy lacustrine materials.

The northeast section of this MLRA is a till plain that formed in later advances of the Green Bay Lobe. Some pitted outwash is present, but the till plain is much more exposed here than elsewhere in the MLRA. The till deposited throughout 94B is primarily sandy, dolomitic till. The dolomite was scraped off the Niagara Escarpment as the Green Bay Lobe moved across it. In some areas, the carbonates are deeply leached.

Historically, this MLRA was dominated by a mixture of northern hardwood forests, Jack pine-scrub oak barrens, and forested coniferous wetlands at 30%, 29%, and 20%, respectively. White pine (*Pinus strobus*) and red pine (*Pinus resinosa*) were dominant tree species and covered an estimated 15% of the area. Northern hardwood forests were dominated by eastern white pine, eastern hemlock (*Tsuga canadensis*), and American beech (*Fagus grandifolia*). The Jack pine-scrub oak barrens were dominant in the sandy portions of this MLRA. Forested coniferous wetlands were occupied by northern white-cedar (*Thuja occidentalis*), black spruce (*Picea mariana*), and tamarack (*Larix laricina*).

## Classification relationships

Relationship to Established Framework and Classification Systems:

Habitat Types of N. Wisconsin (Kotar, 2002): Pinus-Acer/Vaccinium-Aralia, Viburnum variant (PARVAa-Vb), Pinus-Acer/Vaccinium-Opocynum (PARVAo), Acer/Vaccinium-Viburnum (AVVb)

Biophysical Settings (Landfire, 2014): Laurentian Jack Pine-Red Pine Forest, Laurentian-Acadian Northern Pine-(Oak) Forest, Laurentian-Acadian Northern Pine Forest, Laurentian-Acadian Northern Oak Forest, Laurentian-Acadian Pine-Hemlock Forest, Laurentian-Acadian Northern Hardwoods Forest

WDNR Natural Communities (WDNR, 2015): Northern Dry Forest

Hierarchical Framework Relationships:

Major Land Resource Area (MLRA): Michigan Eastern Upper Peninsula MLRA (94B)

USFS Subregions: Athelstane Sandy Outwash and Moraines (212Tc), Green Bay Sandy Lake Plain (212Te)

Wisconsin DNR Ecological Landscapes: Northeast Sands, Northern Lake Michigan Coastal

## Ecological site concept

The Dry Upland ecological site accounts for approximately 231,000 acres in MLRA 94B, or about 22% of total land area. It is the most extensive site in MLRA 94B. It is found in sandy deposits on a variety of landforms throughout the MLRA.

This site is characterized by sandy, excessively drained soils. Precipitation, runoff from adjacent uplands, and groundwater discharge are the primary sources of water. Soils are extremely acid to moderately alkaline.

## Associated sites

F094BY004MI	<b>Wet Sandy Lowland</b> Wet Sandy Lowland occupy landscape depressions in sandy landscapes, often sandy pitted outwash plains. They are poorly drained. They occupy the lower, wetter positions along the same drainage sequence as Dry Upland.
F094BY006MI	<b>Moist Sandy Lowland</b> Moist Sandy Lowland are found in lower landscape positions on outwash plains. They are somewhat poorly drained. They occupy the lower, wetter positions along the same drainage sequence as Dry Upland.
F094BY008MI	<b>Sandy Upland</b> Sandy Upland are found in upland landscape positions on outwash plains, stream terraces, sandy lake plains, and moraines. They are moderately well to somewhat excessively drained. They occupy the lower positions along the same drainage sequence as Dry Upland.

## Similar sites

F094BY008MI	<p><b>Sandy Upland</b></p> <p>Like Dry Upland, Sandy Upland are found in upland landscape positions on outwash plains, stream terraces, sandy lake plains, and moraines. They are moderately well to somewhat excessively drained. They are very similar to Dry Upland except have lower drainage capabilities.</p>
F094BY009MI	<p><b>Loamy Upland</b></p> <p>Loamy Upland are found in upland landscape positions on moraines, lake plains, and outwash plains. They are moderately well to somewhat excessively drained. They have lower drainage capabilities and finer soil textures than Dry Upland.</p>

**Table 1. Dominant plant species**

Tree	(1) <i>Pinus strobus</i> (2) <i>Quercus rubra</i>
Shrub	(1) <i>Prunus serotina</i>
Herbaceous	(1) <i>Pteridium aquilinum</i>

## Physiographic features

This site is found on outwash plains, stream terraces, moraines, lake plains, kames, and eskers throughout the MLRA. Slopes range from 0 to 35 percent.

This site is subject to neither flooding nor ponding. Soils lack evidence of a seasonally-high water table within 80 inches of the surface. Runoff potential is generally negligible to low but may be medium where slopes are steeper.

**Table 2. Representative physiographic features**

Hillslope profile	(1) Summit (2) Shoulder (3) Backslope
Slope shape across	(1) Linear
Slope shape up-down	(1) Convex
Landforms	(1) Outwash plain (2) Stream terrace (3) Moraine (4) Lake plain (5) Kame (6) Esker
Runoff class	Negligible to medium
Flooding frequency	None
Ponding frequency	None
Elevation	555–945 ft
Slope	0–35%
Water table depth	80 in
Aspect	Aspect is not a significant factor

## Climatic features

The continental climate of the Michigan Eastern Upper Peninsula MLRA is typical of northern Wisconsin: cooler summers, colder winters, and shorter growing seasons.

**Table 3. Representative climatic features**

Frost-free period (characteristic range)	98-113 days
Freeze-free period (characteristic range)	120-148 days
Precipitation total (characteristic range)	30-32 in
Frost-free period (actual range)	97-116 days
Freeze-free period (actual range)	119-153 days
Precipitation total (actual range)	25-34 in
Frost-free period (average)	102 days
Freeze-free period (average)	126 days
Precipitation total (average)	30 in

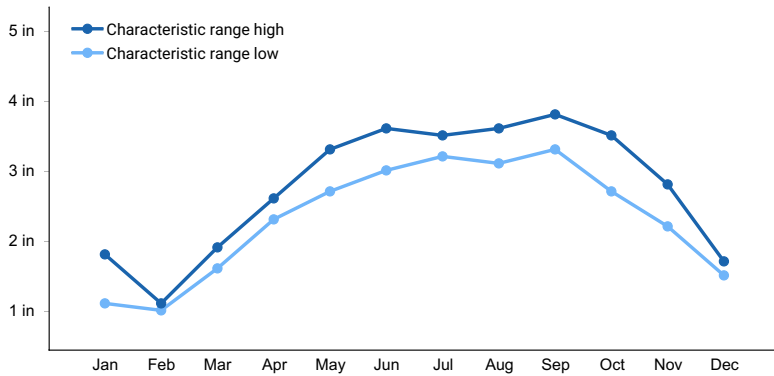


Figure 1. Monthly precipitation range

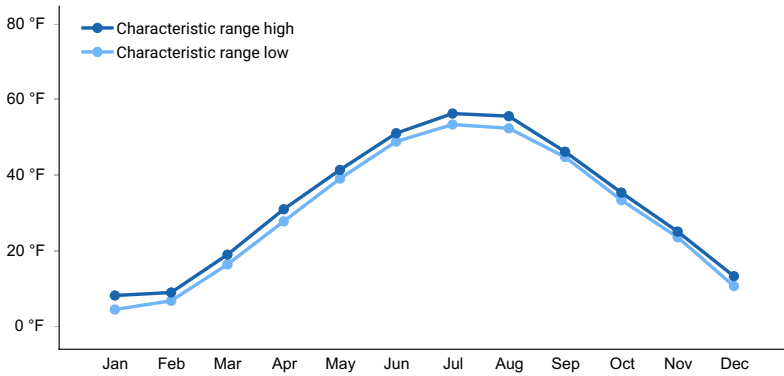


Figure 2. Monthly minimum temperature range

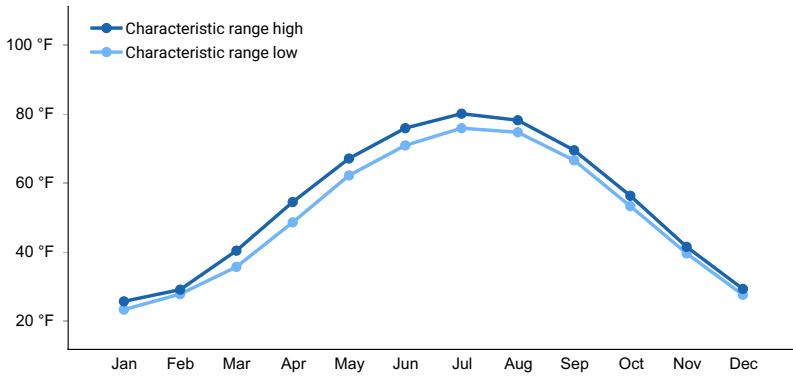
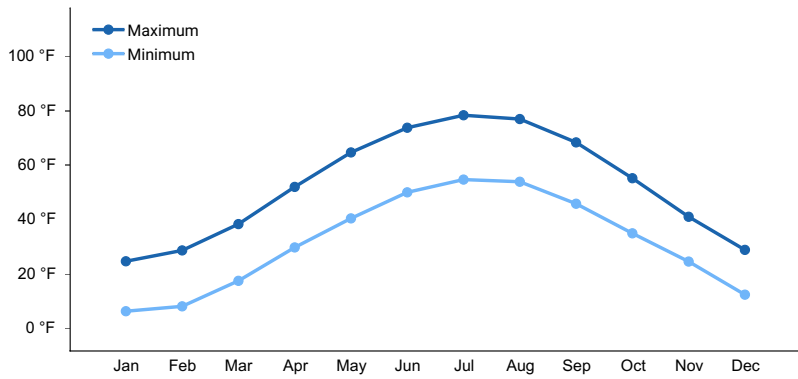
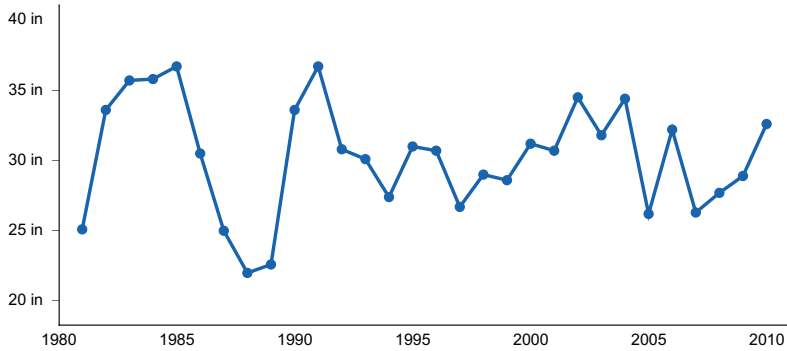


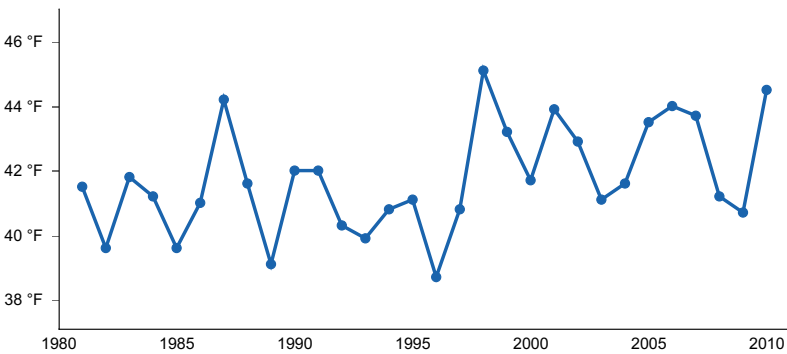
Figure 3. Monthly maximum temperature range



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



**Figure 5. Annual precipitation pattern**



**Figure 6. Annual average temperature pattern**

### Climate stations used

- (1) CRIVITZ HIGH FALLS [USC00471897], Crivitz, WI
- (2) PESHTIGO [USC00476510], Peshtigo, WI
- (3) SURING [USC00478376], Suring, WI
- (4) CHATHAM 1 SE [USW00054810], Chatham, MI
- (5) MANISTIQUE WWTP [USC00205073], Manistique, MI
- (6) IRON MTN FORD AP [USW00094893], Iron Mountain, MI

### 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 moderate to rapid.  
Hydrologic Group: A

Hydrogeomorphic Wetland Classification: None  
Cowardin Wetland Classification: None

## Soil features

The soils of this site are represented by the Alpena, Grayling, Mahtomedi, Menahga, Rubicon, Sayner, Shawano, and Vilas soil series. Udipsamments make up 90% of the acreage of this site. Haplorthods make up 9%. A small amount of Hapludolls also belong to this site and may be found in a few loamy-mantled sites in the eastern half of MLRA 94B.

This site forms in very deep, sandy outwash deposits, sometimes overlain by thin mantle of loamy outwash. These soils generally lack bedrock contact within two meters of the surface. They are excessively drained and do not meet hydric soil requirements.

The surfaces of these sites are usually composed of sand or loamy sand, though sandy loam may sometimes be found. Subsurface textures are sand or loamy sand. Small fragments (gravel) may occupy up to 28 volume of the substratum. Larger fragments (cobbles, mostly) may occupy up to 5 percent volume. Soils are extremely acid to moderately alkaline. Accumulations of secondary carbonates are rare but may be found as high as 8 inches (20 cm) from the surface and may occupy up to 18 percent volume.



Figure 7. Menahga Soil Series sample taken in Marinette County, WI on 06/18/2020. Courtesy of UWSP.

Table 4. Representative soil features

Parent material	(1) Drift (2) Outwash
Surface texture	(1) Loam (2) Sandy loam (3) Loamy sand
Drainage class	Excessively drained
Permeability class	Moderate to rapid
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-60in)	2.3-5.6 in
Calcium carbonate equivalent (0-40in)	0-18%
Soil reaction (1:1 water) (0-40in)	4.2-8.2

Subsurface fragment volume <=3" (0-40in)	1-28%
Subsurface fragment volume >3" (0-40in)	0-5%

## Ecological dynamics

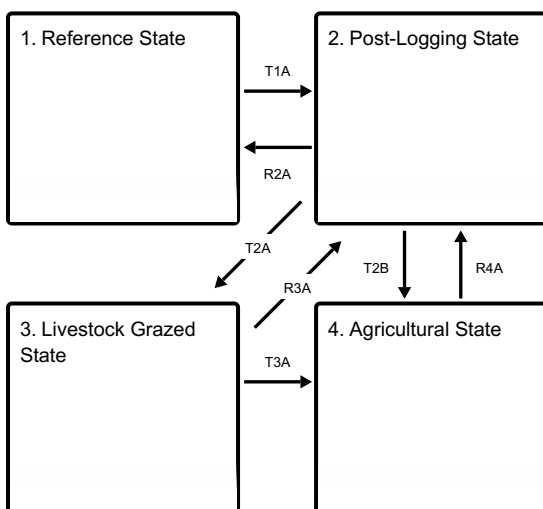
The Dry Upland Ecological Site is characterized by sandy textured and excessively drained soils. The rainfall and runoff from adjacent uplands and groundwater discharge are the primary sources of water for plant growth. The soils within this site are extremely acid to moderately alkaline.

Fires were a natural disturbance on this site that were a main factor in 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. White pine is best adapted for long-term success on this Ecological Site. Although vulnerable to damage or elimination by fire in early life it eventually develops thick fire-resistant bark which helps to extend its longevity, in some cases for up to four centuries or more. These survival properties assure the species' relatively continuous seed source in the region as a whole. White pine is also moderately shade-tolerant in early life which means that it can become established in some pioneer communities, such as aspen – white birch stands, or in poorly stocked oak and red maple dominated communities. Red pine had in the past been a common associate of white pine stands. It shares some of the fire-resisting properties of white pine, but it lacks shade-tolerance and does not become established in the understory. For this reason, it has not maintained its presence in current stands and its seed source has been greatly reduced throughout its natural range following the onset of fire suppression.

Red maple has not been identified by Finley (1976) as an important component of historic pine or oak forests, but it is a prominent member in current stands. Absence of fire since the original logging era is probably the main reason. Red maple is extremely sensitive to fire, but is a prolific and early seed producer. Stems of 2-4 inches in diameter can produce large amounts of seed (USDA For. Serv. 1990). It is sufficiently shade-tolerant to become established in the understories of most communities on sandy soils. On this Ecological Site it behaves similarly to white pine, but because of its much smaller size at maturity, it does not compete with white pine in the upper canopy.

## State and transition model

### Ecosystem states



**T1A** - Clear cutting or stand-replacing fire.

**R2A** - Disturbance-free period 70+ years.

**T2A** - Grazing by livestock.

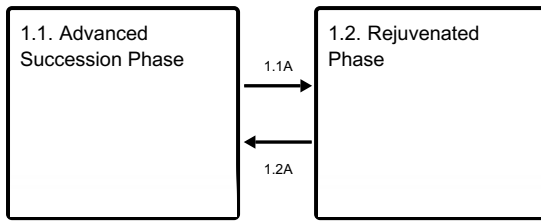
**T2B** - Removal of forest vegetation and tilling.

**R3A** - Removal of livestock grazing.

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

**R4A** - Cessation of agricultural practices, natural or artificial afforestation.

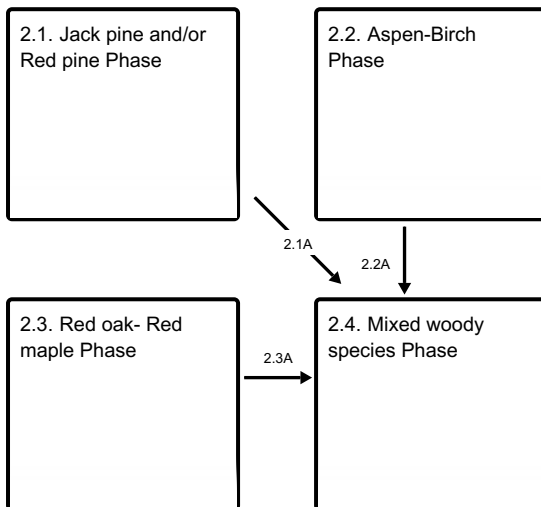
### State 1 submodel, plant communities



**1.1A** - Light to moderate intensity fires, blow-downs, snow-ice breakage.

**1.2A** - Disturbance-free period 30+ years

### State 2 submodel, plant communities

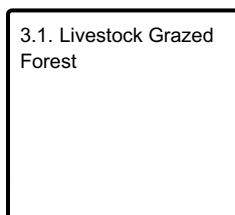


**2.1A** - Immigration and establishment of white pine and red maple.

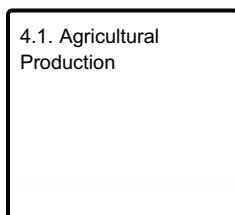
**2.2A** - Immigration and establishment of white pine and red maple.

**2.3A** - Immigration and establishment of white pine and red maple.

### State 3 submodel, plant communities



### State 4 submodel, plant communities



## State 1 Reference State

In absence of stand-leveling disturbances the Reference State Community oscillates between two easily definable community phases, a mature, or late successional, community phase and a rejuvenated community phase.



## Community 1.1 Advanced Succession Phase

A mature forest community contains a super-canopy, or a scattering, of large white pine trees. Historically these trees would have been anywhere from 80 to more than 300 years old (Sterns, 1950). Common associates have been red pine (*P. resinosa*), red oak (*Q. rubra*) and white oak (*Q. alba*). However, only white pine and white oak are moderately shade-tolerant and able to reproduce in small canopy openings and remain as permanent members of mature community in absence of moderate to severe disturbance. Red maple (*Acer rubrum*) had not been an important species in pre-settlement forests, but is today the most successful reproducing tree species in forest communities on this Ecological Site.

### Dominant plant species

- eastern white pine (*Pinus strobus*), tree
- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree
- beaked hazelnut (*Corylus cornuta*), shrub
- black cherry (*Prunus serotina*), shrub
- blueberry (*Vaccinium*), shrub
- brackenfern (*Pteridium*), other herbaceous

## Community 1.2 Rejuvenated Phase



Figure 8. Photo courtesy of UWSP taken on 06/18/2020 in Marinette County, WI.

The canopy of the rejuvenated community is still dominated by original species, but the understory now also includes a well established younger cohort and perhaps a few additional seedlings and saplings of less shade tolerant species.

## **Dominant plant species**

- eastern white pine (*Pinus strobus*), tree
- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree
- beaked hazelnut (*Corylus cornuta*), shrub
- black cherry (*Prunus serotina*), shrub
- blueberry (*Vaccinium*), shrub
- brackenfern (*Pteridium*), 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 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. 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**

### **Post-Logging State**

Post-logging state may consist of considerable diversity of pioneer and mid-successional community phases. Here we are describing four, most commonly found under current conditions.

## **Community 2.1**

### **Jack pine and/or Red pine Phase**

Jack pine and red pine have historically been almost entirely dependent on fire for regeneration. Jack pine is a predominantly a northern species and in southern part of Wisconsin seldom approaches its growth potential. Everywhere it occurs it is a pronounced pioneer, highly light demanding and resistant to drought and frost. It has low requirements for soil organic matter and nutrients. It is a prolific producer of seed and it often colonizes burnt over areas. Forest fires speed natural regeneration by opening the cones. However, today, jack pine is regenerated mostly by planting. Without disturbance jack pine does not regenerate and is readily succeeded by various species, even those of only moderate shade tolerance, such as white pine and red oak. Historically, red pine has often occurred in mixtures with jack pine. In terms of light, soil moisture and nutrient requirements it is intermediate between jack and white pines. In contrast to jack pine, natural red pine regeneration is often found in moderately dense pure or mixed pine stands, although not to the same extent as is white pine. Under current ecological and economic conditions red pine is regenerated almost entirely by planting.

## **Dominant plant species**

- jack pine (*Pinus banksiana*), tree
- red pine (*Pinus resinosa*), tree

## **Community 2.2**

### **Aspen-Birch Phase**

Although a ubiquitous species, quaking aspen (*Populus tremuloides*) is far more characteristic of northern rather than southern forest regions. Its most notable ecological characteristic is the ability to rapidly invade cut-over and burned-over areas. However, its perpetuation depends entirely on recurrence of disturbance. Because of its extreme intolerance to shade, it is readily replaced by many tree species in the absence of disturbance. Once in place, aspen reproduces entirely by sprouting from extensive, superficial root systems (root suckering). Most aspen

stands on this Ecological Site resulted from sprouting following clear cutting of mixed stands of pine and/or oak, in which some aspen trees were still present. Paper birch (*Betula papyrifera*) is often a member of aspen stands. It shares aspen's intolerance of shade and also produces small, winged seeds that readily disperse by wind. It does not sucker from root sprouts, but it readily sprouts from stumps upon clear cutting. It also has greater ability than does aspen of reproducing from seed under favorable seedbed conditions and in presence of large canopy openings. However in absence of disturbance it also succeeds to other species.

#### **Dominant plant species**

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

### **Community 2.3**

#### **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 2.4**

#### **Mixed woody species Phase**



Figure 9. Photo courtesy of UWSP taken on 06/30/2020 in Marinette County, WI.

This community phase is considered a mid-successional community between the pioneering communities 2.1, 2.2, 2.3 and the Reference State. The community is characterized by canopy dominance of any of the early - succession species (i.e.: oaks, aspen - birch, jack pine) and strong presence in the understory of white pine and/or red maple seedlings and saplings.

#### **Dominant plant species**

- eastern white pine (*Pinus strobus*), tree
- quaking aspen (*Populus tremuloides*), tree
- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree

### **Pathway 2.1A**

#### **Community 2.1 to 2.4**

Immigration and establishment of relatively shade tolerant white pine and red maple into shade – intolerant communities of aspen – birch, oaks or jack pine.

### **Pathway 2.2A** **Community 2.2 to 2.4**

Immigration and establishment of relatively shade tolerant white pine and red maple into shade – intolerant communities of aspen – birch, oaks or jack pine.

### **Pathway 2.3A** **Community 2.3 to 2.4**

Immigration and establishment of relatively shade tolerant white pine and red maple into shade – intolerant communities of aspen – birch, oaks or jack pine.

## **State 3** **Livestock Grazed State**

Livestock grazed forests are more often referred to as woodlands rather than forests because this long-term land use significantly changes some soil characteristics and nature of vegetative community. Species composition is altered by selective browsing and grazing as well as by distribution of seeds and other propagules by grazing animals. In addition, soil compaction differentially affects germination and establishment of plant species, including trees.

### **Community 3.1** **Livestock Grazed Forest**

This community phase is characterized as an open woodland where grazing has diminished the number and coverage of trees and grasses and forbs now compose the majority of the understory. Persistence in this phase may eventually lead to pasture type conditions as trees mature and die without regeneration.

## **State 4** **Agricultural State**

Indefinite period of applying agricultural practices, such as tilling and irrigation.

### **Community 4.1** **Agricultural Production**

This community phase is characterized by row crop production using tillage and potentially irrigation. In some instances there may be hay production or permanent pasture as well.

## **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.

## **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 relatively shade tolerant white pine and sub-canopy of red maple, returning the community to Reference State.

## **Transition T2A**

## **State 2 to 3**

Introduction of grazing by livestock. Livestock remove and trample most of the regenerating trees, shrubs, and understory plants leading to the establishment of grasses and forbs.

## **Transition T2B**

### **State 2 to 4**

Removal of forest vegetation for agricultural crop production. Includes plowing, tilling, and irrigation.

## **Restoration pathway R3A**

### **State 3 to 2**

Removal of livestock grazing. As long as grazing was not present for too great a length of time the understory plants may recover and return to the site. Grasses are likely to persist and out compete the native understory plants until the canopy is closed.

## **Transition T3A**

### **State 3 to 4**

Removal of forest vegetation for agricultural crop production. Includes plowing, tilling, and irrigation.

## **Restoration pathway R4A**

### **State 4 to 2**

Cessation of agricultural practices, natural or artificial afforestation. Process of afforestation is likely to take over 100 years to reach the reference state.

## **Additional community tables**

### **Inventory data references**

Plot and other supporting inventory data for site identification and community phases is located on a NRCS North Central Region shared and one drive folder. University Wisconsin-Stevens Point described soils, took photographs, and inventoried vegetation data at community phases within the reference state. The data sources include WI ESD Plot Data Collection Form - Tier 2, Releve Method, NASIS pedon description, NRCS SOI 036, photographs, and Kotar Habitat Types.

Habitat Types of N. Wisconsin (Kotar, 2002): Pinus-Acer/Vaccinium-Aralia, Viburnum variant (PArVAa-Vb), Pinus-Acer/Vaccinium-Apocynum (PArVAo), Acer/Vaccinium-Viburnum (AVVb)

Biophysical Settings (Landfire, 2014): Laurentian Jack Pine-Red Pine Forest, Laurentian-Acadian Northern Pine-(Oak) Forest, Laurentian-Acadian Northern Pine Forest, Laurentian-Acadian Northern Oak Forest, Laurentian-Acadian Pine-Hemlock Forest, Laurentian-Acadian Northern Hardwoods Forest

WDNR Natural Communities (WDNR, 2015): Northern Dry Forest

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## Approval

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## Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	04/26/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

### 1. Number and extent of rills:

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### 2. Presence of water flow patterns:

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### 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):

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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:
- 

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