USDA Natural Resources
Conservation Service

Ecological site F090BY019WI
Dry Sandy Upland

Last updated: 11/16/2023
Accessed: 05/17/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 090B–Central Wisconsin Thin Loess Dissected Till Plain

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

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

North of the Perkinstown morainal system is a loess plain, with a loess mantle 6-24 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 steams.

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

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

Classification relationships

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

USFS Subregions: Glidden Loamy Drift Plain (212Xa), Hayward Stagnation Moraines (212Xf), St. Croix Moraine (212Qa), Lincoln Formation Till Plain - Mixed Hardwoods (212Qb), Green Bay Lobe Stagnation Moraine (212Ta), Brule and Paint Rivers Drumlinized Ground Moraine (212Xc), Rosemont Baldwin Plains and Moraines (222Md), Rib Mountain Rolling Ridges (212Qd)

Small sections occur in Central-Northwest Wisconsin Loess Plains (212Xd), Perkinstown End Moraine (212Xe), Mille Lacs Uplands (212Kb), Lincoln Formation Till Plain - Hemlock Hardwoods (212Qc), Bayfield Sand Plains (212Ka), Crystal Falls Till and Outwash (212Xq), Athelstane Sandy Outwash and Moraines (212Tc)

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

Ecological site concept

The Dry Sandy Upland ecological site is scattered throughout the MLRAs 90A and 90B, located on primarily on outwash plains but may also be found on lake plains, eskers, kames, drumlins, hills, and stream terraces. These sites are characterized by very deep, somewhat excessively to excessively drained soils that formed primarily in sandy deposits including alluvium, outwash, till and eolian. Precipitation and runoff from adjacent uplands are the primary sources of water. Soils range from extremely acid to neutral.

Dry Sandy Upland is distinguished from other ecological sites based on the deep sandy deposits and drainage. This site lacks the underlying bedrock found Dry Sandy Bedrock Upland.. Other somewhat excessively and excessively drained sites have loamy materials. Sandy materials often have lower pH and available water capacity, and often lack carbonates found in loamy materials. These conditions can limit vegetative growth. The somewhat excessive to excessive drainage differentiates this site from other sandy sites.

Associated sites

F090BY001WI	**Poor Fen** Poor Fen sites consist of deep herbaceous organic materials. Some sites have mineral soil contact. They are very poorly drained and remain saturated throughout the year. They are strongly to extremely acidic. These sites are permanently saturated wetlands. These sites are much wetter and occur lower on the drainage sequence than Dry Sandy Upland.
F090BY005WI	**Wet Sandy Lowland** Wet Sandy Lowland consist of deep sandy deposits derived from a mixture of outwash, alluvium, and lacustrine sources. They form in seasonally ponded depressions and are saturated long enough for hydric conditions to occur. Some sites are wetlands. These sites are much wetter and occur lower on the drainage sequence than Dry Sandy Upland.
F090BY009WI	**Moist Sandy Upland** Moist Sandy Lowland primarily consist of deep, sandy deposits from outwash, alluvium, lacustrine, and till. They sandy deposits may have a loamy mantle or be underlain by loamy deposits. The finer materials can cause episaturation and allow the site to remain moist for some of the growing season. These sites are wetter and occur lower on the drainage sequence than Dry Sandy Upland.
F090BY013WI	**Sandy Upland** Sandy Upland consist of deep sandy and loamy deposits of outwash, alluvium, till, and residuum. Soils are primarily sand and loamy sand and have a seasonally high water table within two meters, though they don't remain saturated for extended periods. These sites are somewhat wetter and occur lower on the drainage sequence than Dry Sandy Upland.

Similar sites

F090BY018WI	**Dry Sandy Bedrock Upland** Dry Sandy Bedrock Upland consist sandy alluvium or outwash, sometimes underlain by sandy residuum. Contact with igneous or sandstone bedrock typically occurs within one meter of the surface. These soils show no evidence of a seasonally high water table. They are found in similar landscape positions and share both drainage class and particle size with Dry Sandy Upland but have bedrock contact within two meters of the surface.
F090BY021WI	**Dry Loamy Upland** Dry Loamy Upland consist of deep sandy to loamy outwash, alluvium, or till. The water table is deeper than two meters year-round. They are found in similar landscape positions and share their drainage class with Dry Sandy Upland but have finer particle sizes.

Table 1. Dominant plant species

Tree	(1) *Pinus strobus* (2) *Quercus rubra*
Shrub	(1) *Corylus cornuta* (2) *Prunus serotina*
Herbaceous	(1) *Eurybia macrophylla* (2) *Pteridium*

Physiographic features

These sites formed on outwash plains, lake plains, eskers, kames, drumlins, hills, and stream terraces. Slopes range from 0 to 55 percent. Sites are positioned on summit, shoulder backslope positions.

These sites are not subject to ponding or flooding. Sites have a seasonally high water table at depths of 40 to 80 inches. The water table can drop below 80 inches during dry conditions. Surface runoff ranges from negligible to high. The range in surface runoff is caused by the wide range in slope percent across the sites.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Shoulder (3) Backslope
Slope shape across	(1) Convex
Slope shape up-down	(1) Linear
Landforms	(1) Outwash plain (2) Lake plain (3) Esker (4) Kame (5) Drumlin (6) Hill (7) Stream (8) Terrace
Runoff class	Negligible to high
Flooding frequency	None
Ponding frequency	None
Elevation	170–305 m
Slope	0–55%
Water table depth	102–203 cm
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 32 inches. The average annual snowfall is 53 inches. The annual average maximum and minimum temperatures are 53°F and 32°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	91-114 days
Freeze-free period (characteristic range)	120-139 days
Precipitation total (characteristic range)	737-838 mm
Frost-free period (actual range)	44-117 days
Freeze-free period (actual range)	88-147 days
Precipitation total (actual range)	711-889 mm
Frost-free period (average)	93 days
Freeze-free period (average)	126 days
Precipitation total (average)	787 mm

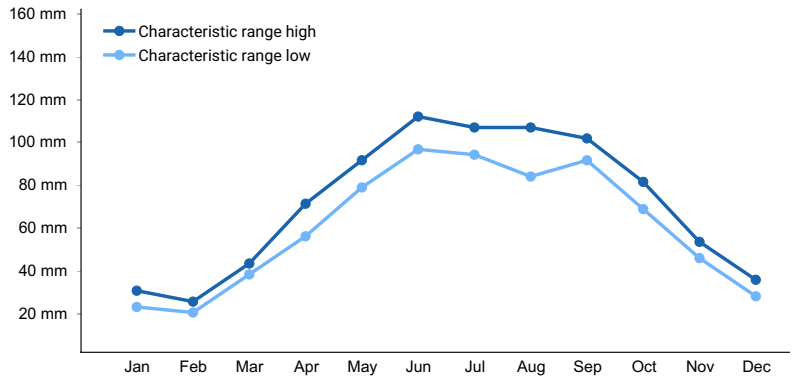


Figure 1. Monthly precipitation range

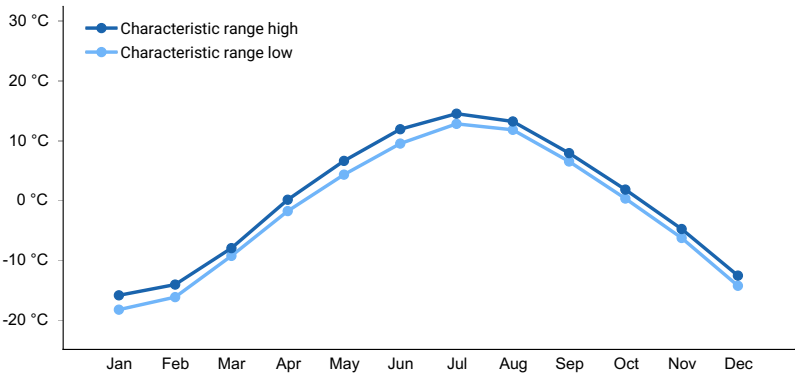


Figure 2. Monthly minimum temperature range

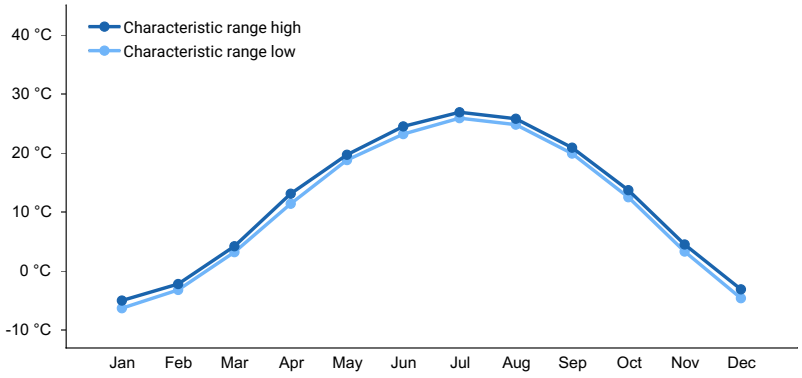


Figure 3. Monthly maximum temperature range

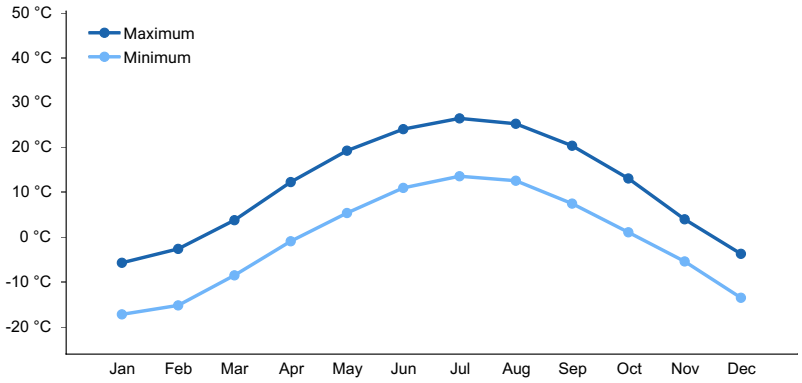


Figure 4. Monthly average minimum and maximum temperature

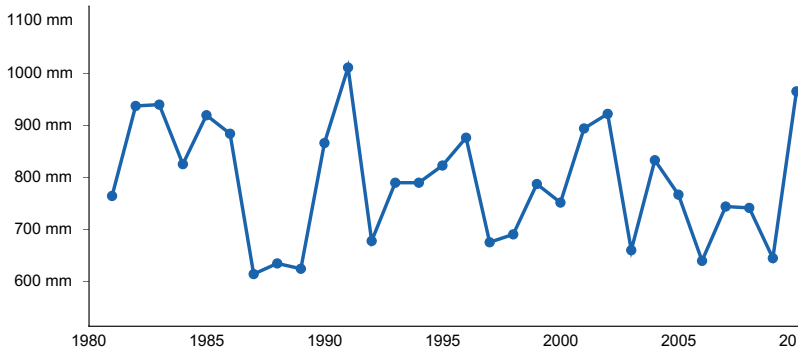


Figure 5. Annual precipitation pattern

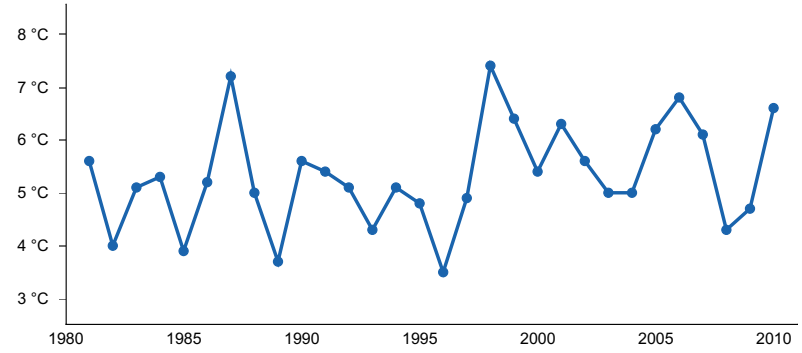


Figure 6. Annual average temperature pattern

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) MILACA [USC00215392], Milaca, MN
- (8) LAKEWOOD 3 NE [USC00474523], Lakewood, WI
- (9) MINONG 5 WSW [USC00475525], Minong, WI
- (10) AMERY [USC00470175], Amery, WI
- (11) 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 slow to rapid.
Hydrologic Group: A, B, A/D
Hydrogeomorphic Wetland Classification: None
Cowardin Wetland Classification: None

Soil features

These sites are represented by the Burkhardt, Cress, Cromwell, Drammen, Duelm Variant, Elderon, Emmert, Graycalm, Hubbard, Karlin, Lilah, Lindquist, Mahtomedi, Menahga, Moberg, Nymore, Omega, Pelissier, Pence, Plainfield, Rosholt, Sayner, Udorthents, and Vilas soil series. Burkhardt is classified as a Typic Hapludoll; Duelm variant is an Aquic Hapludoll; Karlin, Plissier, Rubicon, Sayner, and Vilas are classified as Entic Haplorthods; Hubbard is an Entic Hapludoll; Cress is a Humic Dystrudept; Lindquist is Lamellic Haplorthod; Drammen is a Lamellic Hapludalf; Graycalm is a Lamellic Udipsamment; Lilah is a Psammentic Hapludalf; Cromwell, Elderon, and Moberg are Typic Dystrudepts; Omega and Pence are Typic Haplorthods; Mahtomedi, Menahga, Nymore, Plainfield, and Rosholt are Typic Udipsamments; Emmert is a Typic Udorthent.

These soils formed in various parent materials including sandy or loamy alluvium; sandy, loamy, and gravelly outwash; sandy, loamy, gravelly, and cobbly drift; loamy till; and eolian sand. Soils are very deep, and somewhat excessively or excessively drained. They do not meet hydric soil requirements.

Surface texture is sandy loam, silt loam, loamy sand, sand, and slightly to highly decomposed plant material. Some surface horizons have a fine sand or gravelly modifier. Subsurface textures are sandy loam, silt loam, loamy sand, and sand. Some horizons have fine sand, gravelly, very gravelly, extremely gravelly, very cobbly, or extremely cobbly modifiers. Soil pH ranges from very strongly acid to slightly acid with values of 4.6 to 6.9. Carbonates may be present up to 8 percent beginning at 17 inches.

Table 4. Representative soil features

Parent material	(1) Alluvium (2) Eolian deposits (3) Till (4) Outwash
Surface texture	(1) Loamy sand (2) Sandy loam (3) Loam (4) Silt loam (5) Sand
Drainage class	Somewhat excessively drained to excessively drained
Permeability class	Slow to rapid
Soil depth	203–254 cm

Surface fragment cover <=3"	0–8%
Surface fragment cover >3"	0–5%
Available water capacity (0-152.4cm)	1.19–6.27 cm
Calcium carbonate equivalent (0-101.6cm)	0–8%
Soil reaction (1:1 water) (0-101.6cm)	4.6–6.9
Subsurface fragment volume <=3" (Depth not specified)	0–45%
Subsurface fragment volume >3" (Depth not specified)	0–30%

Ecological dynamics

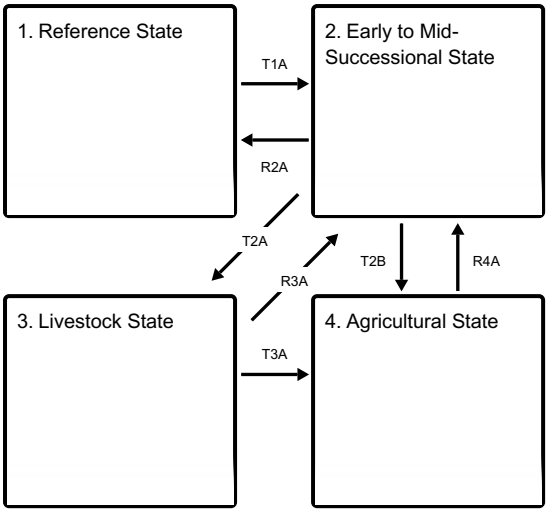
Perhaps the most important ecological characteristic of this Ecological Site, in terms of its influence on forest community dynamics, is its lack of capacity to support the high to moderate soil moisture and nutrient requiring species such as sugar maple, basswood and white ash, the shade-tolerant species, that typically dominate the more productive sites throughout Wisconsin.

In pre-European settlement time wild fire 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. 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 unset of fire suppression.

Red maple has not been identified by Finley (1976) as an important component of pre-settlement 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 - Major stand replacing disturbance such as blow-down or clear-cutting in conjunction with fire.

R2A - Disturbance-free period 70+ years.

T2A - Grazing by livestock.

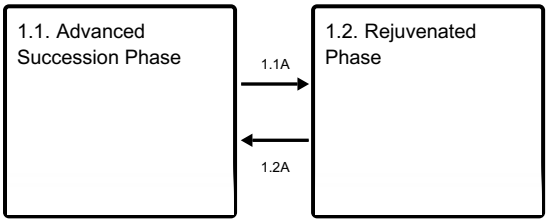
T2B - Removal of forest vegetation and tilling.

R3A - Removal of livestock grazing.

T3A - Removal of forest vegetation and tilling.

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

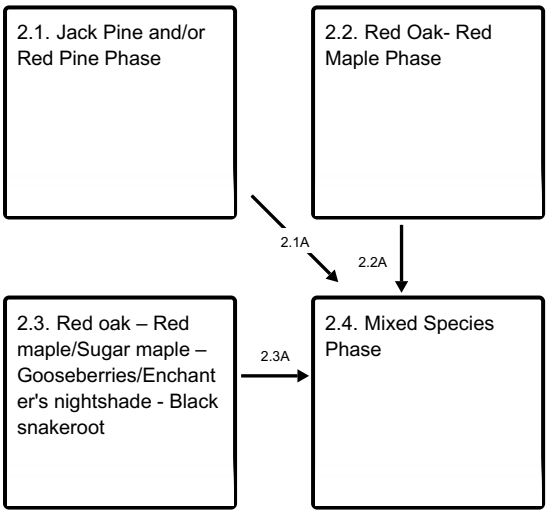
State 1 submodel, plant communities



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

3.1. Agricultural Phase

State 4 submodel, plant communities

4.1. Agricultural Production Phase

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. In pre-European settlement time such 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
- black cherry (*Prunus serotina*), shrub
- beaked hazelnut (*Corylus cornuta*), shrub
- bigleaf aster (*Eurybia macrophylla*), other herbaceous
- brackenfern (*Pteridium*), other herbaceous

Community 1.2
Rejuvenated Phase

This community is often dominated by White pine and red oak. While similar to the Advanced Succession Phase there are likely to be some openings in the canopy. The shrub and ground layers are similar to the advanced succession phase, but may include the establishment of new seedlings and the presence of box elder and red elderberry where there are small canopy openings.

Dominant plant species

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

- bigleaf aster (*Eurybia macrophylla*), other herbaceous
- 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
Early to Mid-Successional 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 pronounce 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
Red Oak- Red Maple 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

- 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 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
- sugar maple (*Acer saccharum*), tree
- Missouri gooseberry (*Ribes missouriense*), shrub
- enchanter's nightshade (*Circaea ×intermedia*), other herbaceous
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

Community 2.4
Mixed Species Phase

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 white pine and red maple.

Pathway 2.2A
Community 2.2 to 2.4

Immigration and establishment of white pine and red maple.

Pathway 2.3A
Community 2.3 to 2.4

Immigration and establishment of white pine and red maple.

State 3
Livestock 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
Agricultural Phase

Sites phase consists of various crops being grown. Agricultural pactices such as tillage are likely in use in this phase. Crops may include row crops, hay, and pasture.

State 4
Agricultural State

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

Community 4.1
Agricultural Production Phase

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): The sites of this ES keyed out to eight habitat types: Acer saccharum/Athyrium (AAt); Acer saccharum/Vaccinium-Desmodium (AVDe); Acer saccharum-Tsuga/Dryopteris (ATD); Acer saccharum-Tsuga/Maianthemum (ATM); Acer saccharum/Viburnum, Vaccinium variant (AVb-V); Pinus-*Acer rubrum*/Vaccinium-Aralia (PArVHa); Pinus-*Acer rubrum*/Vaccinium-Amphicarpa (PArVAm); Pinus-*Acer rubrum*/Vaccinium-Hamamelis (PArVHa)
Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Northern Hardwoods Forest, Laurentian-Acadian Northern Oak Forest, Boreal White Spruce-Fir Forest, Boreal White Spruce-Fir-Hardwood Forest, Boreal Hardwood Forest, Eastern Cool Temperate Row Crop, Managed Tree Plantation-Northern and Central Hardwood and Conifer Plantation Group, Eastern Cool Temperate Urban Shrubland, Developed-Low Intensity, and Developed-Medium Intensity
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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	05/17/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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

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

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

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

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

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

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

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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:**
