Ecological site F090BY020WI
Dry Loamy Bedrock Upland

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General information

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

MLRA notes

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

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

The Wisconsin and Minnesota Thin Loess MLRA, Northern and Southern Parts (90A and 90B) is an extensive glacial landscape that comprised of over 11.1 million acres (17,370 sq mi) throughout central and northern Wisconsin – about 27% of the total land area in the state. This glacial landscape is comprised of a 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: Mille Lacs Uplands (212Kb), Perkinstown End Moraine (212Xe)

Wisconsin DNR Ecological Landscapes: Northwest Lowlands, North Central Forest

Ecological site concept

The Dry Loamy Bedrock Upland ecological site not particularly extensive but may be found in the northwest portion of MLRAs 90A and 90B on moraines and monadnocks. These sites are characterized by moderately deep, somewhat excessively to excessively drained soils that formed in loess and loamy till deposits over bedrock. Bedrock types include basalt and quartzite. Precipitation and runoff from adjacent uplands are the primary sources of water. Soils range from very strongly acid to strongly acid.

Dry Loamy Bedrock Upland is distinguished from other sites based on drainage and a moderately deep profile. The underlying bedrock can perch water and cause limitations to growth as a root restricting layer. These sites may be more vulnerable to tree tips. The loamy materials differentiate this site from other somewhat excessively and excessively drained sites that have sandy deposits. Loamy materials often have higher pH and available water capacity than sand. The somewhat excessive to excessive drainage differentiates this site from other loamy sites.

Associated sites

F090BY014WI	**Loamy Bedrock Upland** Loamy Bedrock Upland consist of loamy till, alluvium, or eolian deposits underlain by sandy to loamy residuum. Some sites may also contain sandy outwash or clayey pedisediment. Bedrock contact occurs within two meters of the surface. They have a seasonally high water table within one meter of the surface, though they don't remain saturated for extended periods of time. They are somewhat wetter and occur lower on the drainage sequence than Dry Loamy Bedrock Upland.

Similar sites

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 both drainage class and particle size with Dry Loamy Bedrock Upland but lack bedrock contact within two meters of the surface.
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 bedrock contact and drainage class and with Dry Loamy Bedrock Upland but have coarser particle sizes.

Table 1. Dominant plant species

Tree	(1) *Acer saccharum* (2) *Quercus rubra*
Shrub	(1) *Ostrya virginiana*
Herbaceous	(1) *Eurybia macrophylla* (2) *Desmodium glutinosum*

Physiographic features

These sites formed on hills, till plains, and stream terraces. Slopes range from 0 to 50 percent. Sites are on summit, shoulder, and backslope positions.

These sites are not subject to ponding or flooding. They show no evidence of a seasonally high water table within 80 inches. Surface runoff is very low to high.

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) Moraine (2) Monadnock
Runoff class	Low to very high
Flooding frequency	None
Ponding frequency	None
Elevation	215–275 m
Slope	1–40%
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 50 inches. The annual average maximum and minimum temperatures are 52°F and 30°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	91-113 days
Freeze-free period (characteristic range)	122-138 days
Precipitation total (characteristic range)	737-813 mm
Frost-free period (actual range)	45-116 days
Freeze-free period (actual range)	89-146 days
Precipitation total (actual range)	711-889 mm
Frost-free period (average)	93 days
Freeze-free period (average)	127 days
Precipitation total (average)	787 mm

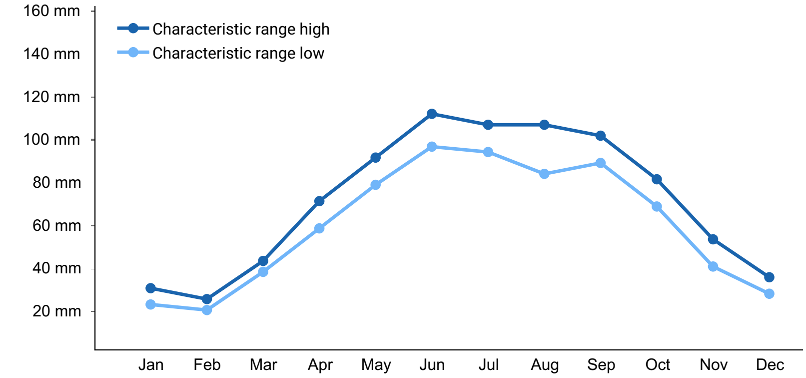


Figure 1. Monthly precipitation range

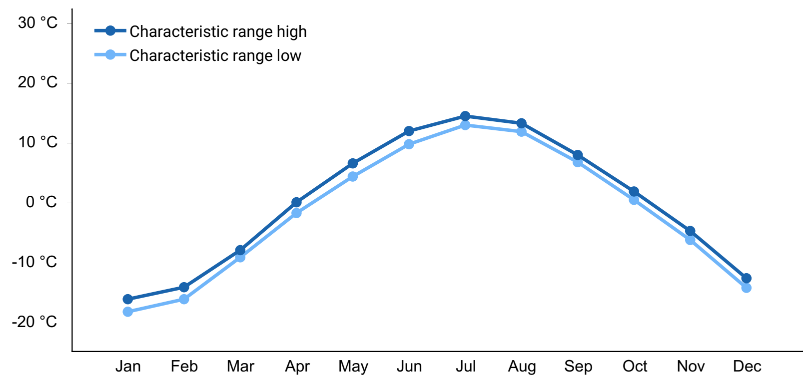


Figure 2. Monthly minimum temperature range

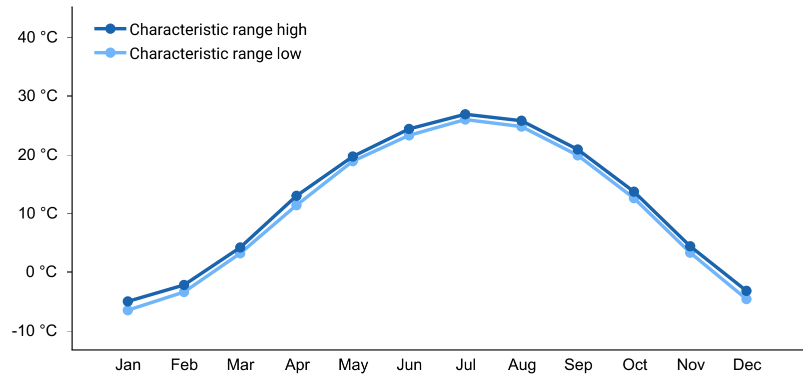


Figure 3. Monthly maximum temperature range

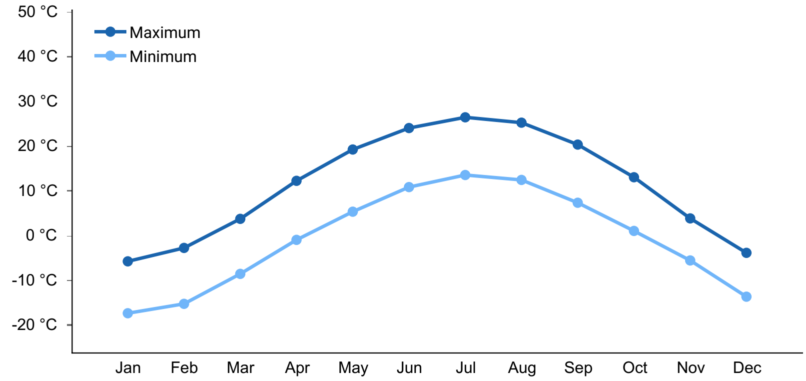


Figure 4. Monthly average minimum and maximum temperature

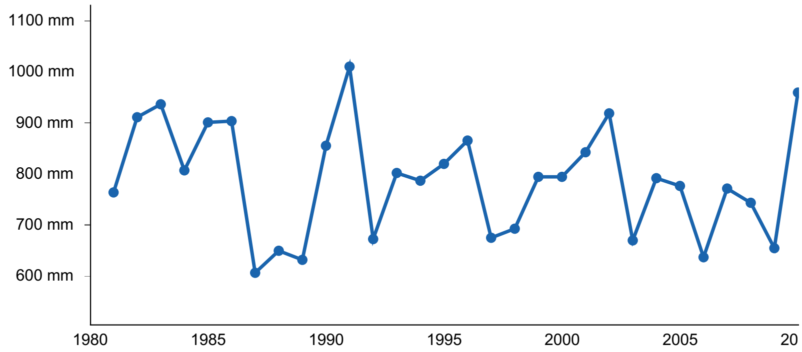


Figure 5. Annual precipitation pattern

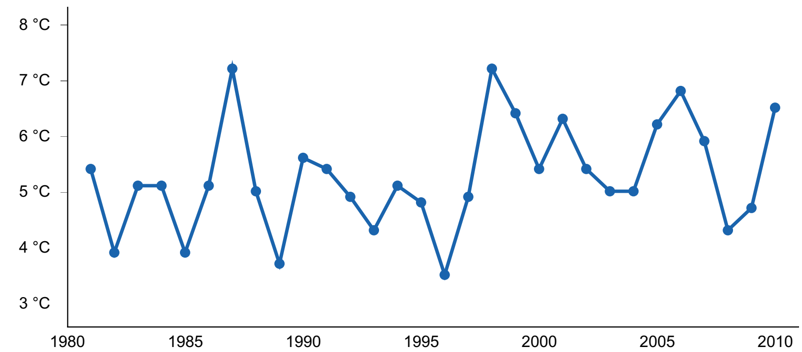


Figure 6. Annual average temperature pattern

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
- (12) AITKIN 2E [USC00210059], Aitkin, 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. Subsurface flow may occur where water perches on bedrock.

Wetland description

Permeability of these sites is impermeable to moderately slow.
Hydrologic Group: C, D
Hydrogeomorphic Wetland Classification: None
Cowardin Wetland Classification: None

Soil features

These sites are represented by the Haustrup and Ribhill soil series classified as a Humic Lithic Dystrudepts and Haplic Glossudalfs, respectively.

These soils formed in loess and till over basalt or quartzite bedrock. Soil depth ranges from shallow to deep. Bedrock occurs between 16 and 38 inches. Soils are somewhat excessively or excessively drained. Sites do not meet hydric soil requirements.

Surface textures of these sites are silt loam and moderately decomposed plant material. Subsurface texture is silt loam. Some horizons have cobbly or very cobbly modifiers. Soil pH ranges from very strongly acid to strongly acid with values of 4.4 to 5.3. Carbonates are absent within 80 inches.

Table 4. Representative soil features

Parent material	(1) Eolian deposits (2) Till (3) Metamorphic rock
Surface texture	(1) Silt loam
Drainage class	Somewhat excessively drained to excessively drained
Permeability class	Very slow to moderately slow
Soil depth	41–97 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–2%
Available water capacity (0-154.9cm)	3.71–5.05 cm
Calcium carbonate equivalent (0-100.1cm)	0%
Soil reaction (1:1 water) (0-100.1cm)	4.4–5.3
Subsurface fragment volume <=3" (Depth not specified)	5–9%
Subsurface fragment volume >3" (Depth not specified)	0–26%

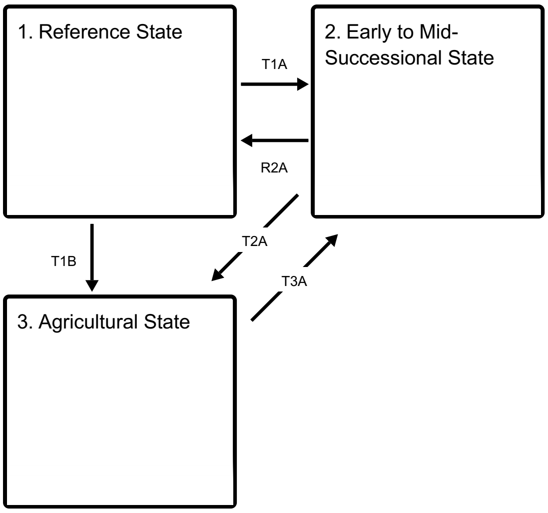
Ecological dynamics

Historically, this site was dominated by mesic hardwoods in a landscape adapted to fire disturbance that allowed for a strong presence of oaks. In pre-European settlement time wildfire was the main controlling factor of forest community dynamics. Following a severe, stand-replacing fire, any of the species present on the landscape could become established, depending on seed source availability and specific conditions of post-fire seedbed. The newly established young stands of any species were easily eliminated by recurring fires, but differences in fire-resisting properties among the species began to play a role in any species' survival success. Many pine and oak species were dominant in the region because of their fire-resistant properties and successful regeneration post-fire. With clear cutting and continued fire suppression, many of these species adapted to fire and intolerant of shade are replaced by other species. Species such as white pine and red oak are still common on the landscape based on their tolerance to some shade; these species to establish under a canopy, and in time, may become a component of the canopy. Mesic hardwoods are sensitive to fire, but in its absence, the have the ability to dominate sites based on their shade tolerance and prolific seed production.

Today, these forests most commonly include stands of sugar maple, and other mesic hardwoods. Some sites have a strong presence of red oak. These sites have the conditions to support shade tolerant mesic hardwoods, but these sites have dry soil moisture regime. Red oak can compete with the mesic hardwoods based on its ability to grow in drier soils. Historically, these sites had significant wind throw and fire disturbance that allowed for a strong presence of oak species. As long as fire is continually suppressed, maples and other mesic hardwoods will continue to dominate the canopy with oak as an associate.

State and transition model

Ecosystem states



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

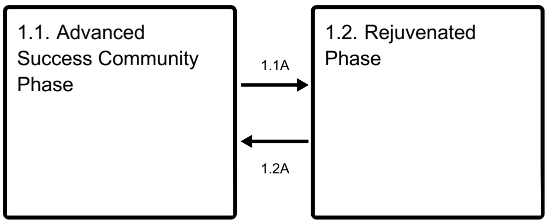
T1B - Removal of forest vegetation and tilling.

R2A - Time and natural succession.

T2A - Cessation of agricultural practices, natural, or artificial afforestation.

T3A - Clear cutting and tillage to establish agriculture.

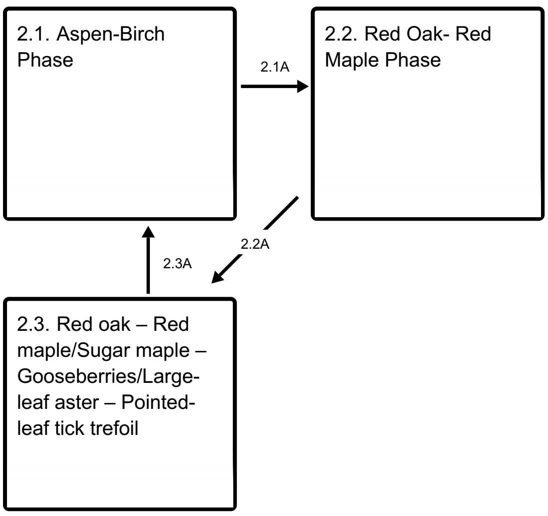
State 1 submodel, plant communities



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

1.2A - Time and natural succession.

State 2 submodel, plant communities



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

2.2A - Time and natural succession.

2.3A - Major stand replacing disturbance e.g. blow-down and fire, or clear-cutting, followed by fire.

State 3 submodel, plant communities

3.1. Agricultural Phase

State 1
Reference State

Reference state is a forest community dominated by sugar maple (*Acer saccharum*). Depending on history of disturbance, two community phases can be distinguished largely by differences in dominance of tree species and community age structure.

Community 1.1
Advanced Success Community Phase

In the absence of any major disturbance, specifically fire, this community is dominated by sugar maple. Common associates include other mesic hardwoods like white ash (*Fraxinus americana*), basswood (Tilia Americana), and on some sites may include red oak (*Quercus rubra*). Red oak requires some disturbance to create gaps for regeneration; with the absence of disturbance, they are less common in the canopy. The shrub layer is often dominated by ironwood (*Ostrya virginiana*) and maple saplings. The ground layer is dominated by pointed-leaf tick trefoil (*Desmodium glutinosum*), large-leaf aster (*Eurybia macrophylla*), and sedges (Carex, spp.).

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- northern red oak (*Quercus rubra*), tree
- white ash (*Fraxinus americana*), tree
- hornbeam (*Carpinus*), shrub
- bigleaf aster (*Eurybia macrophylla*), other herbaceous
- pointedleaf ticktrefoil (*Desmodium glutinosum*), other herbaceous

Community 1.2
Rejuvenated Phase

This community is often dominated by sugar maple and red oak. The shrub and ground layers are similar to the advanced succession phase, but may include the establishment of new seedlings.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- northern red oak (*Quercus rubra*), tree
- hophornbeam (*Ostrya*), shrub
- black cherry (*Prunus serotina*), shrub
- Missouri gooseberry (*Ribes missouriense*), shrub
- bigleaf aster (*Eurybia macrophylla*), other herbaceous
- pointedleaf ticktrefoil (*Desmodium glutinosum*), 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. Lacking a major disturbance, the canopy will likely be replaced with sugar maple, but red oak can compete to maintain its place in the canopy. Small scale disturbances may still occur periodically, but once second or third canopies are established there is minimal new regeneration taking place and the forest gradually returns to mature state.

State 2
Early to Mid-Successional State

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

Community 2.1
Aspen-Birch Phase

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

Dominant plant species

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

Community 2.2
Red Oak- Red Maple Phase

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

Dominant plant species

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

Community 2.3
Red oak – Red maple/Sugar maple – Gooseberries/Large-leaf aster – Pointed-leaf tick trefoil

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, white ash.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), tree
- Missouri gooseberry (*Ribes missouriense*), shrub
- bigleaf aster (*Eurybia macrophylla*), other herbaceous
- pointedleaf ticktrefoil (*Desmodium glutinosum*), other herbaceous

Pathway 2.1A
Community 2.1 to 2.2

Time and the immigration, establishment, and growth of red oak and red maple seedlings. These moderately shade tolerant species seed in beneath the aspen and birch and eventually outcompete these intolerant species.

Pathway 2.2A
Community 2.2 to 2.3

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

Pathway 2.3A
Community 2.3 to 2.1

Clear cutting or stand-replacing fire that allows for the reinvasion of the aspen—birch community.

State 3
Agricultural State

Indefinite period of applying agricultural practices. Primary crops include row crops, hay, and pasture.

Community 3.1
Agricultural Phase

The agricultural phase consists of planted row crops, hay, or pasture.

Transition T1A
State 1 to 2

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

Transition T1B
State 1 to 3

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

Restoration pathway R2A
State 2 to 1

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

Transition T2A
State 2 to 3

Abandonment of agricultural practices and allowing natural vegetation to colonize the site or apply artificial afforestation. Whether re-vegetation or planting is allowed it is likely to require over 100 years to return to the reference state via the early to mid-successional state.

Transition T3A
State 3 to 2

Removal of forest vegetation and tilling to establish agricultural crops.

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. & S. Wisconsin (Kotar, 2002 & 1996): The sites of this ES keyed out to four habitat types: *Acer saccharum*/Hydrophyllum; Acer-Tilia/Caulophyllum-Laportea variant (ATiCa-La); *Acer saccharum*-Tsuga/Maianthemum (ATM); Pinus-Acer rubrum/Vaccinium-Aralia (PArVAa)
Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Northern Hardwoods Forest and Boreal White Spruce-Fir Forest
WDNR Natural Communities (WDNR, 2015):

Other references

Cleland, D.T.; Avers, P.E.; McNab, W.H.; Jensen, M.E.; Bailey, R.G., King, T.; Russell, W.E. 1997. National Hierarchical Framework of Ecological Units. Published in, Boyce, M. S.; Haney, A., ed. 1997. Ecosystem Management Applications for Sustainable Forest and Wildlife Resources. Yale University Press, New Haven, CT. pp. 181-200.

County Soil Surveys from St. Croix, Polk, Barron, Rusk, Chippewa, Clark, Marathon, Taylor, Price, Sawyer, Burnett, Washburn, Douglas, Bayfield, Ashland, Lincoln, Oneida, Langlade, Shawano, Menominee, Forest, Florence, Marinette, and Pierce Counties.

Curtis, J.T. 1959. Vegetation of Wisconsin: an ordination of plant communities. University of Wisconsin Press, Madison. 657 pp.

Davis, R.B. 2016. Bogs and Fens, A Guide to the Peatland Plants of Northeastern United States and Adjacent Canada. University Press of New England, Hanover and London. 296 pp.

Finley, R. 1976. Original vegetation of Wisconsin. Map compiled from U.S. General Land Office notes. U.S. Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Hvizdak, David. Personal knowledge and field experience.

Jahnke, J. and Gienccke, A. 2002. MLRA 92 Clay Till Field Investigations. Summary of field day investigations by Region 10 Soil Data Quality Specialists.

Kotar, J. 1986. Soil – Habitat Type relationships in Michigan and Wisconsin. J. For. and Water Cons. 41(5): 348-350.

Kotar, J., J.A. Kovach and G. Brand. 1999. Analysis of the 1996 Wisconsin Forest Statistics by Habitat Type. U.S.D.A. For. Serv. N.C. Res. Stn. Gen. Tech. Rept. NC-207.

Kotar, J., J. A. Kovach, and T. L. Burger. 2002. A Guide to Forest Communities and Habitat Types of Northern Wisconsin. Second edition. University of Wisconsin-Madison, Department of Forest Ecology and Management, Madison.

Kotar, J., and T. L. Burger. 2017. Wetland Forest Habitat Type Classification System for Northern Wisconsin: A Guide for Land Managers and landowners. Wisconsin Department of Natural Resources, PUB-FR-627 2017, Madison.

Martin, L. 1965. The physical geography of Wisconsin. Third edition. The University of Wisconsin Press, Madison.

McNab, W.H. and P.W. Avers. 1994. Ecological Subregions of the United States: Section Descriptions. USDA For. Serv. Pun. WO-WSA-5, Washington, D.C.

NatureServe. 2018. International Ecological Classification Satandard: Terrestrial Ecological Classifications. NautreServe Centreal Databases. Arlington, VA. U.S.A. Data current as of 28 August 2018.

Radeloff, V.C., D.J. Mladenoff, H.S. He and M.S. Boyce. 1999. Forest landscape change in Northwestern Wisconsin Pine Barrens from pre-European settlement to the present. Can. J. For. Res. 29: 1649-1659.

Schulte, L.A., and D.J. Mladenoff. 2001. The original U.S. public land survey records: their use and limitations in reconstructing pre-European settlement vegetation. Journal of Forestry 99:5–10.

Schulte, L.A., and D.J. Mladenoff. 2005. Severe wind and fire regimes in northern forests: historical variability at the regional scale. Ecology 86(2):431–445.

Soil Survey Staff. Input based on personal experience. Tim Miland, Scott Eversoll, Ryan Bevernitz, and Jason Nemecek.

Stearns, F. W. 1949. Ninety years change in a northern hardwood forest in Wisconsin. Ecology, 30: 350-58.

United States Department of Agriculture, Forest Service. 1989. Proceedings – Land Classification Based on Vegetation: Applications for Management. Gen. Tech. Report INT-527.

United States Department of Agriculture, Forest Service. 1990. Silvics of North America, Vol. 1, Hardwoods. Agricultural Handbook 654, Washington, D.C.

United States Department of Agriculture, Forest Service. 1990. Silvics of North America, Vol. 2, Conifers. Agricultural Handbook 654, Washington, D.C.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource and Major Land Resource Areas of the United Sates, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

United States Department of Agriculture, Natural Resources Conservation Service. 2008. Hydrogeomorphic Wetland Classification System: An Overview and Modification to Better Meet the Needs of the Natural Resources Conservation Service. Technical Note No. 190-8-76. Washington D.C.

Wilde, S.A. 1933. The relation of soil and forest vegetation of the Lake States Region. Ecology 14: 94-105.

Wilde, S.A. 1976. Woodlands of Wisconsin. University of Wisconsin Cooperative Extension, Pub. G2780, 150 pp.

Wisconsin Department of Natural Resources. 2015. The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management. Wisconsin Department of Natural Resources, PUB-SS-1131 2015, Madison.

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Approval

Suzanne Mayne-Kinney, 11/16/2023

Acknowledgments

NRCS contracted UWSP to write ecological sites in MLRA 90B, completed in 2021.

Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	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):**

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:**

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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:**
