USDA Natural Resources Conservation Service

Ecological site F090BY018WI
Dry Sandy Bedrock 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: Rosemont Baldwin Plains and Moraines (222Md)

Wisconsin DNR Ecological Landscapes: Western Prairie

Ecological site concept

The Dry Sandy Bedrock Upland ecological site is an uncommon site in MLRAs 90A and 90B but may be found in southwest portion, located on hills, till plains, and stream terraces. It’s found primarily in St. Croix and Pierce counties where bedrock is relatively shallow. These sites are characterized by moderately deep, somewhat excessively to excessively drained soils that formed in sandy alluvium, sandy till, and sandy residuum. Precipitation and runoff from adjacent uplands are the primary water sources. Soils range from extremely acid to moderately acid.

Dry Sandy Bedrock Upland is distinguished from other ecological sites based on somewhat excessive to excessive drainage and a moderately deep profile. Other somewhat excessively and excessively drained sands have soils that are greater than 80 inches in depth. The underlying bedrock perches the water table and can cause limitations to growth, acting as a root restricting layer. These sites are more vulnerable to tree tips. Other somewhat excessively and excessively drained sites have loamy deposits. Sands have lower pH and available water capacity than loamy sites, which can limit vegetative growth. The somewhat excessively and excessively drained soils differentiates this site from other sandy sites.

Associated sites

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. They are somewhat wetter and occur lower on the drainage sequence than Dry Sandy Bedrock Upland.
F090BY019WI	**Dry Sandy Upland** Dry Sandy Upland sites consist of primarily sandy deposits of various origin. Loamy deposits are also present in many soils. They may have a seasonally high water table within two meters of the surface, though they do not remain saturated for sustained periods. They may be found adjacent to Dry Sandy Bedrock Upland.

Similar sites

F090BY020WI	**Dry Loamy Bedrock Upland** Dry Loamy Bedrock Upland consist of silty loess, sometimes underlain by loamy till. Basalt or quartzite bedrock typically occurs within one meter of the surface. These soils show no evidence of a seasonally high water table. They occur in similar landscape positions and share both drainage class and bedrock contact with Dry Sandy Bedrock Upland but have finer particle sizes.
F090BY019WI	**Dry Sandy Upland** Dry Sandy Upland consist of primarily sandy deposits of various origin. Loamy deposits are also present in many soils. They may have a seasonally high water table within two meters of the surface, though they do not remain saturated for sustained periods. They occur in similar landscape positions and share both drainage class and particle size with Dry Sandy Bedrock Upland but lack bedrock contact within two meters of the surface.

Table 1. Dominant plant species

Tree	(1) *Pinus strobus* (2) *Quercus rubra*
Shrub	(1) *Rubus*
Herbaceous	(1) *Circaea ×intermedia* (2) *Parthenocissus quinquefolia*

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) Till plain (2) Stream terrace (3) Hill
Runoff class	Very low to high
Flooding frequency	None
Ponding frequency	None
Elevation	230–275 m
Slope	0–50%
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 45 inches. The annual average maximum and minimum temperatures are 53°F and 34°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	91-114 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

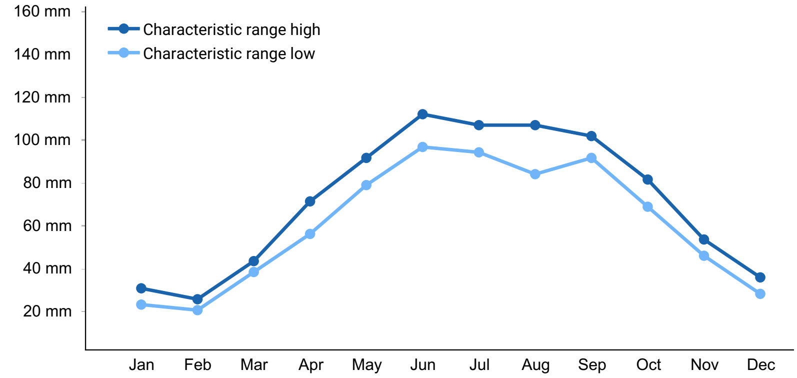


Figure 1. Monthly precipitation range

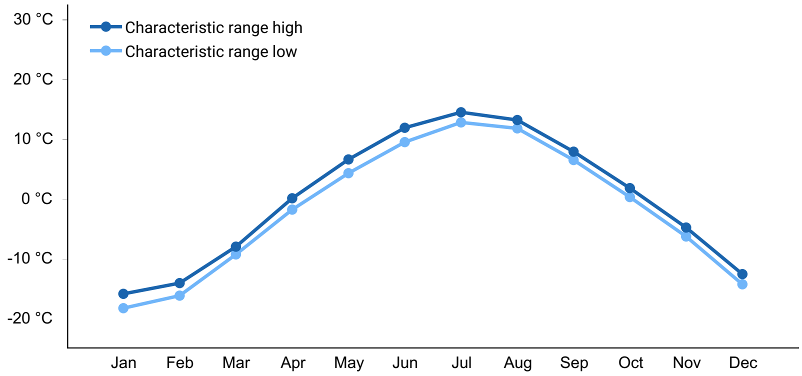


Figure 2. Monthly minimum temperature range

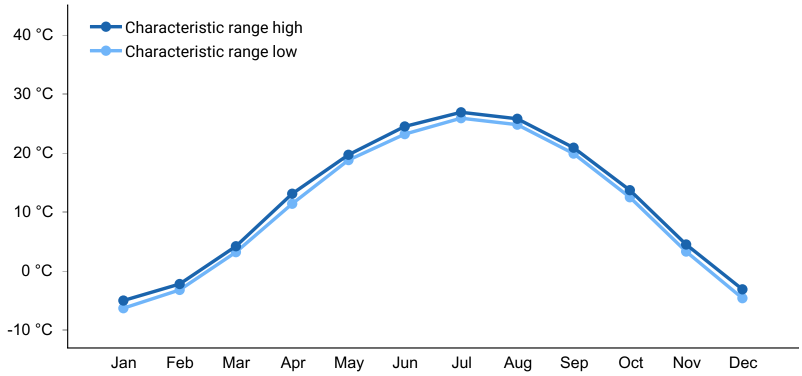


Figure 3. Monthly maximum temperature range

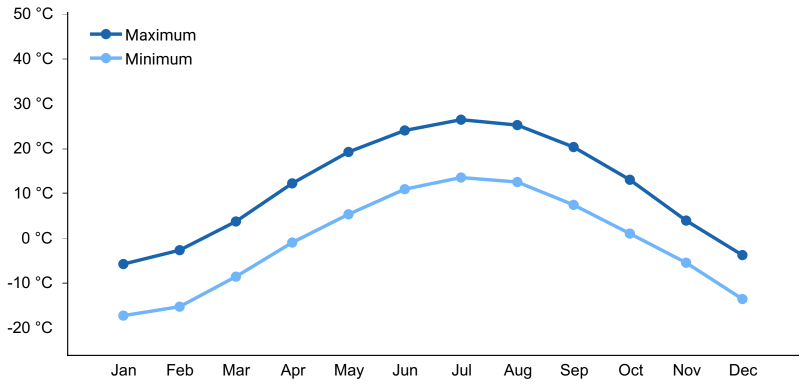


Figure 4. Monthly average minimum and maximum temperature

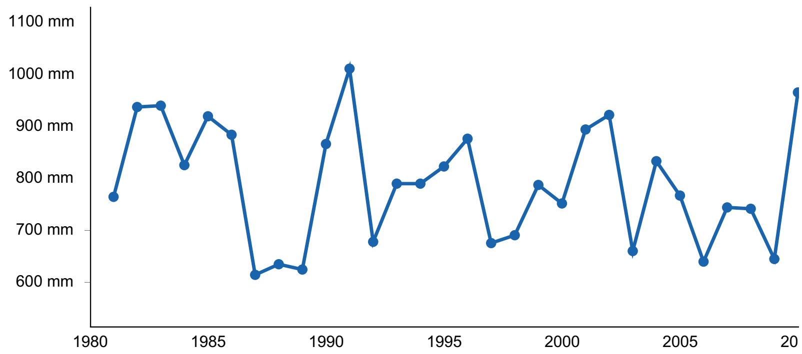


Figure 5. Annual precipitation pattern

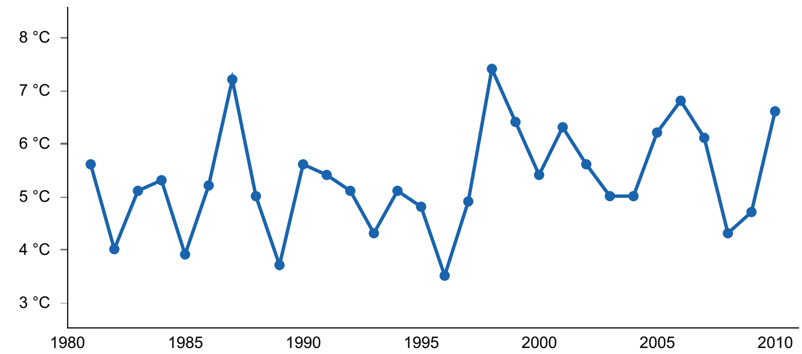


Figure 6. Annual average temperature pattern

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. Subsurface flow may occur where water perches on bedrock.

Wetland description

Permeability of these sites is slow to rapid.
Hydrologic Group: A, B
Hydrogeomorphic Wetland Classification: None
Cowardin Wetland Classification: None

Soil features

These sites are represented by the Boone and Ishpeming soil series, classified as Typic Quartzipsamments and Entic Haplorthods, respectively.

These soils formed in sandy residuum and sandy alluvium. Soils are moderately deep with bedrock occurring between 23 and 35 inches. Soils are somewhat excessively or excessively drained. They do not meet hydric soil requirements.

Surface textures are primarily loamy fine sand moderately decomposed plant material. Subsurface textures include sandy loam, loamy sand, and sand. Some horizons have fine sands. Soil pH ranges from very strongly acid to strongly acid with values of 4.6 to 5.5. . Carbonates are absent within 80 inches.

Table 4. Representative soil features

Parent material	(1) Alluvium (2) Eolian deposits (3) Lacustrine deposits (4) Till (5) Outwash (6) Drift (7) Sandstone (8) Igneous and metamorphic rock
Surface texture	(1) Loamy sand (2) Sandy loam (3) Loam (4) Silt loam
Drainage class	Moderately well drained to well drained
Permeability class	Very slow to moderately rapid
Depth to restrictive layer	58–89 cm
Soil depth	201–249 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–5%
Available water capacity (0-154.9cm)	2.82–12.65 cm
Calcium carbonate equivalent (0-100.1cm)	0%
Soil reaction (1:1 water) (0-100.1cm)	4.6–5.5
Subsurface fragment volume <=3" (Depth not specified)	7–10%
Subsurface fragment volume >3" (Depth not specified)	0–3%

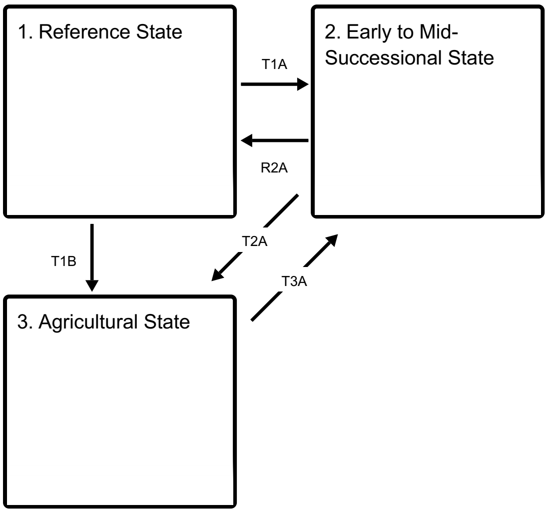
Ecological dynamics

A unique feature of dry, nutrient poor sites such as this ES is that they do not support the highly shade tolerant species Sugar maple, American beech, Basswood, American hophornbeam, and hemlock.

Though similar to Dry Sandy Uplands this site is likely to have lower net primary production and a more open canopy due to bedrock restricting roots and a reduction in available water and nutrients due to the shallower soil profile. Additionally it may be less likely to contain successful Red maple in the Reference State. This ES is also less likely to be in the Advanced Succession Phase of the Reference State, as compared to Dry Sandy Uplands, due to being prone to blow downs.

State and transition model

Ecosystem states



T1A - Major stand replacing disturbance such as blow-down or clear-cutting in conjunction with fire.

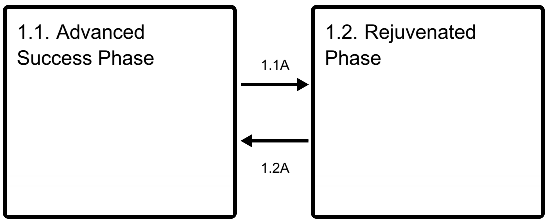
T1B - Removal of forest vegetation and tilling.

R2A - Disturbance-free period 70+ years.

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

T3A - Clear cutting and tillage to establish agriculture.

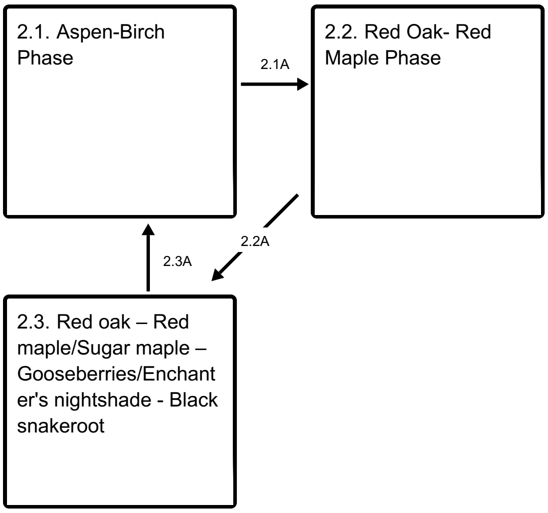
State 1 submodel, plant communities



1.1A - Natural mortality in the oldest age classes, sporadic small-scale blow-downs and ice storms, or low intensity fire create openings for entry of younger trees

1.2A - Time and natural succession. No fire or long fire return interval with low intensity fire.

State 2 submodel, plant communities

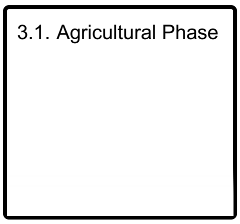


2.1A - Red oak and red maple regenerating under aspen -- paper birch canopy

2.2A - Time and natural succession. No fire or long fire return interval with low intensity fire.

2.3A - Clear cutting or stand-replacing fire.

State 3 submodel, plant communities



State 1
Reference State

Tree species on these sites are mostly fire adapted and it is likely that the intensity and frequency of fires controlled the plant community composition in presettlement time. It is likely though that the same species, perhaps with the exception of Jack pine, could maintain themselves on these sites. White pine would have likely dominated these sites in the advanced reference state. Red maple would be less likely with more frequent or higher intensity fire.

Community 1.1
Advanced Success Phase

Common forest cover types include mixtures of White oak, Black oak, Pin oak, and White pine. Jack pine may be present and is more likely with greater prevalence of fire. Red maple and Black cherry may also be common, but the latter does not usually develop to its full potential. The shrub layer (commonly present) most likely includes gray dogwood, Choke cherry, Service berry, and hazelnuts along with blackberries and raspberries. Ground flora is usually sparse but may include Wild sarsaparilla, Solomon’s seal, and Virginia creeper.

Dominant plant species

- eastern white pine (*Pinus strobus*), tree
- northern red oak (*Quercus rubra*), tree
- black cherry (*Prunus serotina*), shrub
- blackberry (*Rubus*), shrub
- enchanter's nightshade (*Circaea ×intermedia*), other herbaceous
- Virginia creeper (*Parthenocissus quinquefolia*), 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
- blackberry (*Rubus*), shrub
- red elderberry (*Sambucus racemosa*), shrub
- enchanter's nightshade (*Circaea ×intermedia*), other herbaceous
- Virginia creeper (*Parthenocissus quinquefolia*), 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 White pine, 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/Enchanter's nightshade - Black snakeroot

This community phase represents a distinct transition into mid-successional state, by strong presence in second canopy, or in reproductive layers, White pine and possibly of Sugar maple. This phase also includes the development of understory plants in greater abundance.

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

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

These two community phase pathways both require the passage of time without disturbance. In this case allowing for full canopy development.

Pathway 2.3A
Community 2.3 to 2.1

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

State 3
Agricultural State

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

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.

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

This pathway relies on natural succession with only minor disturbances for 70+ years to allow full canopy development. Particularly this pathway is allowing for the regeneration and growth of a White pine super canopy and greater development of the understory species present.

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 S. Wisconsin (Kotar, 1996): The sites of this ES keyed out to one habitat types: Pinus/Vaccinium-Cornus (PVCr)
Biophysical Settings (Landfire, 2014): This ES is largely mapped as North-Central Interior Maple-Basswood Forest, North-Central Interior Dry-Mesic Oak Forest and Woodland, North-Central Interior Dry Oak Forest and Woodland, and Eastern Cool Temperate Pasture and Hayland
WDNR Natural Communities (WDNR, 2015):

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Approval

Suzanne Mayne-Kinney, 11/16/2023

Acknowledgments

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

Rangeland health reference sheet

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

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

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

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

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

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

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

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

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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:**