Ecological site F090AY009WI
Moist Sandy Upland

Last updated: 10/02/2023
Accessed: 05/07/2024

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): 090A–Wisconsin and Minnesota Thin Loess and Till

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 to 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 90A): Wisconsin and Minnesota Thin Loess and Till

USFS Subregions: Glidden Loamy Drift Plain (212Xa), Rib Mountain Rolling Ridges (212Qd), Green Bay Lobe Stagnation Moraine (212Ta), Brule and Paint Rivers Drumlinized Ground Moraine (212Xc), Bayfield Sand Plains (212Ka), Mille Lacs Uplands (212Kb)
Small sections occur in Perkinstown End Moraine (212Xe), Central-Northwest Wisconsin Loess Plains (212Xd), and Hayward Stagnation Moraines (212Xf)

Wisconsin DNR Ecological Landscapes: Forest Transition, Northern Central Forest, Northwest Lowlands, Northwest Sands

Ecological site concept

The Moist Sandy Upland ecological site is uncommon in MLRA 90A, located in depressions, drainageways, and flats on outwash and lake plains, ground moraines, and stream terraces. These sites are characterized by very deep, somewhat poorly drained soils formed in sandy outwash and alluvium with underlying lacustrine and till deposits. Precipitation, runoff from adjacent uplands, and groundwater discharge are the primary sources of water. Soils range from very strongly acid to neutral.

Moist Sandy Upland has sandy parent materials and textures that distinguish it from other sites with similar drainage. The deep sandy deposits distinguish this site from Moist Sandy Bedrock Uplands. The sandy materials have lower pH, less available water capacity, and lack carbonates that are found in the loamy and clayey somewhat poorly drained sites. These factors cause limitations for vegetative growth. The somewhat poor drainage differs this site from other sandy sites.

Associated sites

F090AY001WI	**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. They are wetter and occur lower on the drainage sequence than Moist Sandy Uplands.
F090AY005WI	**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. They are wetter and occur lower on the drainage sequence than Moist Sandy Upland.
F090AY013WI	**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 drier and occur higher on the drainage sequence than Moist Sandy Upland.
F090AY019WI	**Dry Sandy Upland** Dry Sandy Uplands 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 are much drier and occur higher on the drainage sequence than Moist Sandy Upland.

Similar sites

F090AY011WI	**Moist Loamy Lowland** Moist Loamy Lowland consist of deep sandy and loamy deposits derived from a mixture of alluvium, residuum, till, or lacustrine sources. The finer textures allow the soil to stay moist - but not saturated - for sustained periods during the growing season. They are found in similar landscape positions with the same drainage class as Moist Sandy Uplands but with finer textures. The vegetative communities they support have similar wetness preferences but higher nutrient requirements.
F090AY003WI	**Sandy Floodplain** Sandy Floodplain sites are found exclusively on floodplains in sandy and sometimes silty alluvium. These sites are somewhat poorly to poorly drained and are subject to flooding. Some sites may be saturated for long enough for hydric conditions to occur. They share particle size and sometimes drainage class with Moist Sandy Upland.
F090AY005WI	**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. They share particle size with Moist Sandy Upland. The vegetative communities they support have similar nutrient preferences but are sometimes wetter.

Table 1. Dominant plant species

Tree	(1) *Abies balsamea* (2) *Acer rubrum*
Shrub	(1) *Corylus cornuta* (2) *Vaccinium*
Herbaceous	(1) *Maianthemum canadense* (2) *Lycopodium*

Physiographic features

This site occurs on depressions, drainageways, and flats on outwash plains, lake plains, ground moraines, and stream terraces. Slopes range from 0 to 6 percent.

Sites are not subject to ponding or flooding. The soils have a seasonally high water table (episaturation) at a depth of 6 to 18 inches but the water table may drop below 80 inches during dry conditions. Runoff is negligible to low.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Backslope (3) Footslope
Slope shape across	(1) Concave
Slope shape up-down	(1) Linear
Landforms	(1) Depression (2) Drainageway (3) Flat (4) Outwash plain (5) Lake plain (6) Moraine (7) Stream terrace
Runoff class	Negligible to low
Flooding frequency	None
Ponding frequency	None
Elevation	591–1,001 ft
Slope	0–6%

Water table depth	6–18 in
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 31 inches. The average annual snowfall is 54 inches. The annual average maximum and minimum temperatures are 53°F and 31°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	84-108 days
Freeze-free period (characteristic range)	115-136 days
Precipitation total (characteristic range)	29-32 in
Frost-free period (actual range)	42-116 days
Freeze-free period (actual range)	87-145 days
Precipitation total (actual range)	28-35 in
Frost-free period (average)	90 days
Freeze-free period (average)	123 days
Precipitation total (average)	31 in

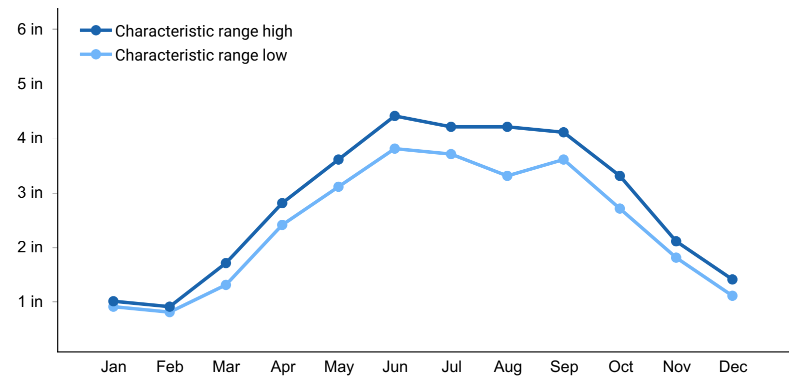


Figure 1. Monthly precipitation range

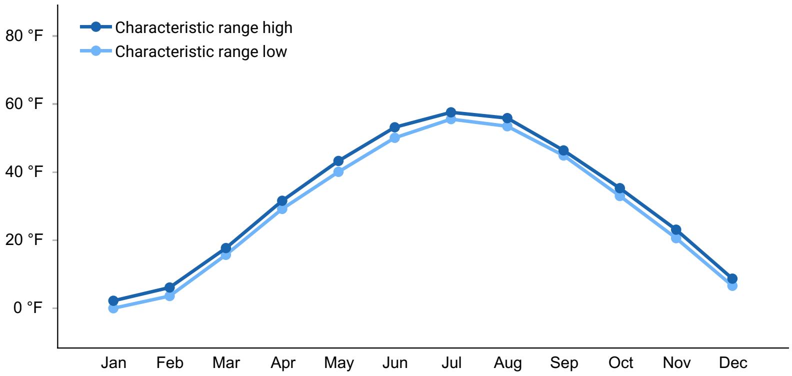


Figure 2. Monthly minimum temperature range

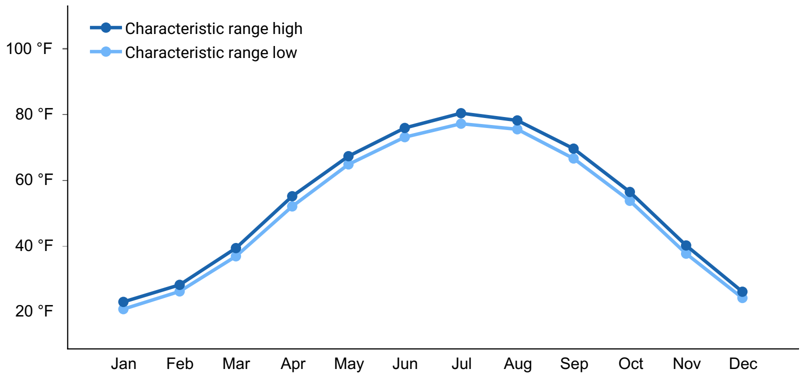


Figure 3. Monthly maximum temperature range

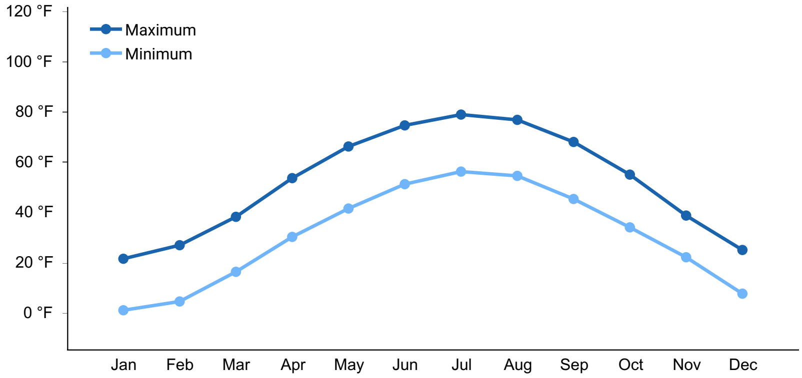


Figure 4. Monthly average minimum and maximum temperature

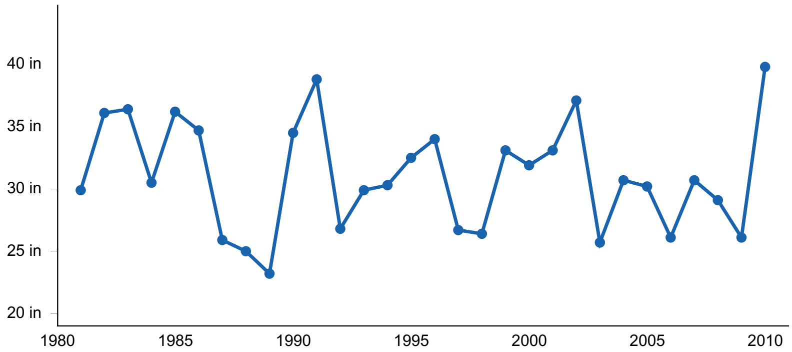


Figure 5. Annual precipitation pattern

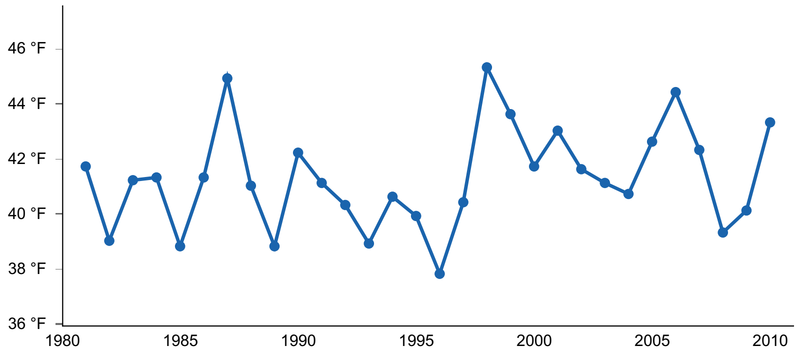


Figure 6. Annual average temperature pattern

Climate stations used

- (1) HOLCOMBE [USC00473698], Holcombe, WI
- (2) ROSHOLT 9 NNE [USC00477349], Wittenberg, WI
- (3) LAONA 6 SW [USC00474582], Laona, WI

- (4) STAMBAUGH 2SSE [USC00207812], Iron River, MI
- (5) PARK FALLS DNR HQ [USC00476398], Park Falls, WI
- (6) BIG FALLS HYDRO [USC00470773], Glen Flora, WI
- (7) COUDERAY 7 W [USC00471847], Stone Lake, WI
- (8) ISLE 12N [USC00214103], Isle, MN
- (9) MOOSE LAKE 1 SSE [USC00215598], Moose Lake, MN
- (10) MILACA [USC00215392], Milaca, 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 the soils range from slow to rapid.
Hydrologic Group: A/D, C/D
Hydrogeomorphic Wetland Classification: None
Cowardin Wetland Classification: None

Soil features

These sites are represented by the Au Gres, Augwood, Flink, Freya, Ingalls, Meehan, and Pequaming soil series. Some sites are represented by Aquepts that are not classified to a series. Au Gres, Ingalls, and Wormet are classified as Typic Endoaquods; Augwood and Flink are Typic Epiaquods; Pequaming is an Alfic Haplaquod; Freya is an Aquic Argiudoll; Meehan is an Aquic Udipsamment.

These soils formed in various parent materials including sandy outwash; sandy, loamy, silty, clayey lacustrine deposits; loamy till; sandy- and loamy-skeletal deposits; sandy alluvium. Soils are very deep. These sites are somewhat poorly drained. They do not meet hydric soil requirements.

The surface of these sites loamy sand, loamy fine sand, highly or moderately decomposed plant material. Subsurface horizons include loamy sand, sand, sandy loam, silt, silty clay loam, and clay textures. Some horizons have fine or very fine sand. Gravelly modifiers are also present. Soil pH is very strongly acid to neutral in the profile with a range of 4.7 to 7.3. Surface fragments less than three inches may be present up to 5 percent cover, and fragments greater than 3 inches may be present up to 2 percent. Subsurface fragments less than 3 inches can be present up to 25 percent by volume, and fragments greater than 3 inches can be present up to 17 percent. Sites are absent of carbonates within 80 inches.

Figure 7. Pequaming soil series photograph courtesy of UWSP taken on 17/15/2019 in Onieda County, WI.

Table 4. Representative soil features

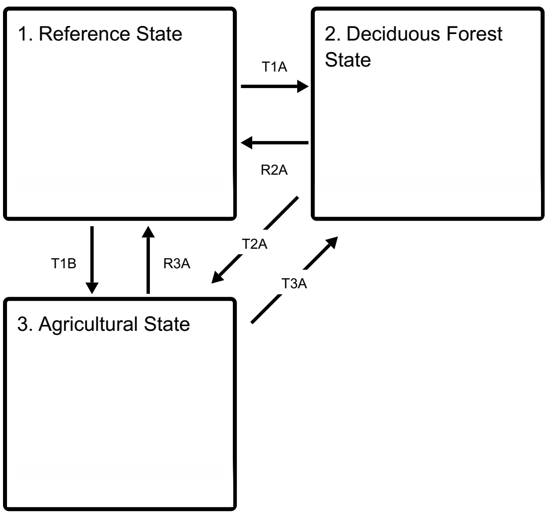
Parent material	(1) Outwash (2) Lacustrine deposits (3) Alluvium (4) Till
Surface texture	(1) Loamy sand
Drainage class	Somewhat poorly drained
Permeability class	Slow to rapid
Soil depth	79–98 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	2%
Available water capacity (0-61in)	1.35–3.19 in
Calcium carbonate equivalent (0-39.4in)	0%
Soil reaction (1:1 water) (0-39.4in)	4.7–7.3
Subsurface fragment volume <=3" (Depth not specified)	0–25%
Subsurface fragment volume >3" (Depth not specified)	0–17%

Ecological dynamics

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. Red maple is sensitive to fire, but in its absence, it has the ability to dominate sites based on its shade tolerance and prolific seed production.

State and transition model

Ecosystem states



T1A - Stand replacing disturbance that includes fire.

T1B - Removal of forest cover and tilling for agricultural crop production.

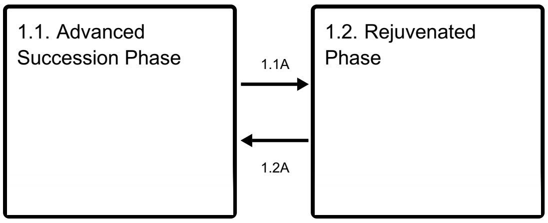
R2A - Conifers slowly increase in abundance in the deciduous forest community.

T2A - Removal of forest cover and tilling for agricultural crop production.

R3A - Cessation of agricultural practices leads to natural reforestation, or site is replanted.

T3A - Cessation of agricultural practices leads to natural reforestation, or site is replanted.

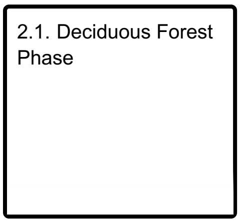
State 1 submodel, plant communities



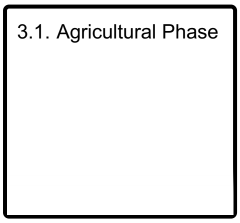
1.1A - Light to moderate intensity fires, blow-downs, ice storms.

1.2A - Disturbance-free period for 30+ years.

State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

Reference state is a forest community dominated by balsam fir (*Abies balsamea*) and red maple (Acer rubrun). 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 Succession Phase

Figure 8. Photo courtesy of UWSP taken on 7/15/2019 in Onieda County, WI.

In the absence of major disturbance—particularly fire—these sites are dominated by a canopy of balsam fir and red maple. Red oak (*Quercus rubra*) may be present, but has low coverage and is only able to regenerate in gaps. The shrub layer is not well developed and dominated by red maple saplings and beaked hazelnut (*Corylus cornuta*) and blueberries (Vaccinium, spp.). The ground layer is dominated by Canada mayflower (*Maianthemum canadense*) and clubmosses (Lycopodium, spp.). Other common herbs include American starflower (*Trientalis borealis*), bluebead lily (*Clintonia borealis*), and bracken fern (Pteridium aquillinum).

Dominant plant species

- balsam fir (*Abies balsamea*), tree
- red maple (*Acer rubrum*), tree
- beaked hazelnut (*Corylus cornuta*), shrub
- blueberry (*Vaccinium*), shrub
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- clubmoss (*Huperzia*), other herbaceous

Community 1.2
Rejuvenated Phase

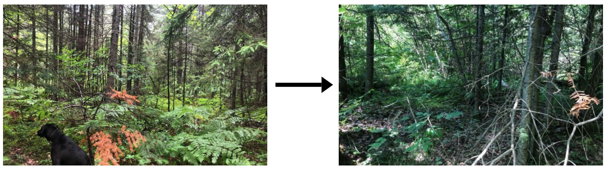
Figure 9. Photo courtesy of UWSP taken on /714/2019 in Langlade County, WI.

The canopy of the rejuvenated community is still dominated by original species, but the understory now also includes a well-established younger cohort and perhaps a few additional seedlings and saplings of less shade tolerant species. Red oak and green ash (*Fraxinus pennsylvanica*) are common on sites, but have moderate shade tolerance and require canopy breaks to regenerate. They are unable to compete with red maple and balsam fir to maintain a co-dominant position in the canopy in advanced succession, but individuals may be maintained.

Dominant plant species

- red maple (*Acer rubrum*), tree
- balsam fir (*Abies balsamea*), tree
- beaked hazelnut (*Corylus cornuta*), shrub
- blueberry (*Vaccinium*), shrub
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- clubmoss (*Huperzia*), other herbaceous

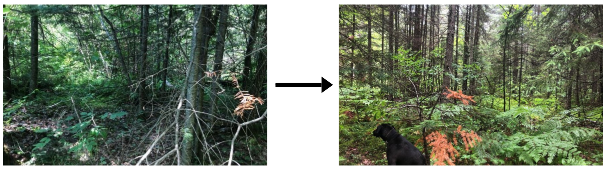
Pathway 1.1A
Community 1.1 to 1.2



Advanced Succession Phase → **Rejuvenated Phase**

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



Rejuvenated Phase → **Advanced Succession Phase**

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
Deciduous Forest State

Post disturbance pioneer community of aspen and paper birch with mixtures of other species from available seed sources.

Community 2.1
Deciduous Forest Phase

Figure 10. Photo courtesy of UWSP taken on 7/13/2019 in Forest County, WI.

Pure, or mixed, aspen – paper birch community replaces the reference state community. If seed source is present, red maple and young cohorts of balsam fir readily becomes member of this community.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- European white birch (*Betula pendula*), tree
- red maple (*Acer rubrum*), tree
- balsam fir (*Abies balsamea*), shrub
- beaked hazelnut (*Corylus cornuta*), shrub
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- clubmoss (*Huperzia*), other herbaceous

State 3
Agricultural State

Indefinite period of applying agricultural practices.

Community 3.1
Agricultural Phase

Indefinite period of applying agricultural practices. Crops likely include alfalfa, corn, soybeans, and hay or pasture. It is possible that some areas are or have been in ginseng production as well.

Transition T1A
State 1 to 2

Stand replacing disturbance that must include fire to create conditions for aspen and paper birch to colonize the site.

Transition T1B
State 1 to 3

Removal of forest cover and tilling for agricultural crop production.

Restoration pathway R2A
State 2 to 1

Conifers slowly increase in abundance in the deciduous forest community.

Transition T2A
State 2 to 3

Removal of forest cover and tilling for agricultural crop production.

Restoration pathway R3A
State 3 to 1

Abandonment of agricultural practices and allowing natural vegetation to colonize the site or apply artificial afforestation. The time required for forest community to reach the reference state conditions may exceed 100 years. Unless understory plants are seeded naturally or artificially it may take some time before the understory is restored.

Transition T3A
State 3 to 2

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

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 three habitat types: Acer rubrum-*Abies balsamea*/Cornus (ArAbCo); Acer rubrum-*Abies balsamea*/Vaccinium-Coptis (ArAbVC); Tsuga/Maianthemum-Coptis (TMC)

Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian Oak Barrens, Laurentian-Acadian Northern Hardwoods Forest, Boreal White Spruce-Fir Forest, and Laurentian-Acadian Alkaline Conifer-Hardwood Swamp Forest

WDNR Natural Communities (WDNR, 2015):

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Approval

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Acknowledgments

NRCS contracted UWSP to write ecological sites in MLRA 90A, 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	05/07/2024
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:**

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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:**