Ecological site F090AY005WI
Wet Sandy Lowland

Last updated: 10/02/2023
Accessed: 04/27/2024

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

MLRA 90A is part of the recently glaciated till and outwash plains of central Minnesota and northern Wisconsin. The area was covered with loamy alluvium or loess after glaciation. It is in Wisconsin (56 percent), Minnesota (40 percent), and Michigan (4 percent). It makes up about 21,967 square miles (56,901 square kilometers).

This MLRA has distinct boundaries to the north where it borders tills of a dissimilar origin on the less morainic landscapes of MLRAs 88, 92, and 93A. The boundary to the west is where the MLRA transitions to the calcareous tills of the Des Moines Lobe, in MLRA 57. To the south, MLRA 90A borders MLRA 90B, which has older soils and better-defined drainage patterns, and MLRA 91, which has the distinct lower landscape relief of an outwash channel.

The part of this area in Minnesota is mostly in the Western Lake section of the Central Lowland province of the Interior Plains. Nearly all the parts in Wisconsin and Michigan are in the Superior Upland province of the Laurentian Upland. Four distinct lobes of the Laurentide Ice Sheet (Rainy, Superior, Chippewa, and Green Bay) played major roles in shaping the landscape in this area. The landscape is characterized by gently undulating to rolling, loess-mantled till plains, drumlin fields, and end moraines mixed with outwash plains associated with major glacial drainageways, swamps, bogs, and fens. In some areas lake plains and ice-walled lakes are significant. Steeper areas occur mostly as valley side slopes along flood plains and as escarpments along the margins of lakes.

Lakes, ponds, and marshes are common throughout the area, and streams generally have a dendritic pattern. The major rivers in this area are the Chippewa, St. Croix, Mississippi, and Wisconsin Rivers. Elevation ranges from 1,100 to 1,950 feet (335 to 595 meters). Local relief is mainly less than 10 feet to 20 feet (3 to 6 meters), but some major valleys and hills are 200 feet (60 meters) above the adjacent lowland.

Precambrian-age bedrock underlies most of the glacial deposits in this MLRA. The bedrock is a complex of folded and faulted igneous and metamorphic rocks. The bedrock terrain has been modified by glaciation and is covered in most areas by Pleistocene deposits and windblown silts. The glacial deposits form an almost continuous cover in most areas. The drift is several hundred feet thick in many areas. Loess covered the area shortly after the glacial ice melted.

Ground water is abundant in deep glacial deposits in most of this area. It also occurs in sedimentary and volcanic rock in the western part of the area. It is scarce where the layer of drift is thin. The water meets the domestic, agricultural, municipal, industrial, rural, and irrigation needs of the area. The content of dissolved solids in the ground water from all the various aquifers in this area is low, and the water generally is moderately hard or hard. The level of total dissolved solids in some of the water can be much higher because of a high content of limestone in some of the glacial deposits. Most of this area obtains ground water from unconsolidated glacial sand and gravel deposits on or very near the surface. Some wells tap the Cambrian sandstone in the southwestern part of the area, in Wisconsin.

In northwest Wisconsin (Ashland and Bayfield Counties) where there are no glacial deposits and in much of the part of this area in Minnesota, ground water from sedimentary and volcanic rock aquifers is used. This water is of very good quality; however, many soils have very porous layers that are poor filters of domestic waste and agricultural chemicals, so there is a risk of contamination from development and agriculture. Minor water concerns are hardness and, in some areas, high concentrations of iron. Yields of water from the glacial deposits vary.

The dominant soil orders are Alfisols, Entisols, Histosols, and Spodosols. The soils in the area have a frigid temperature regime, a udic or aquic moisture regime, and mixed mineralogy.

This area has a significant acreage of public and private forestland used to support the paper and lumber industry Sap collection from sugar maple and syrup production are important forestry enterprises. Agricultural enterprises include row crops, dairy farms, and beef operations. Crops include corn, soybeans, oats, wheat, and alfalfa. Tourism, recreation, and wildlife management are important. Hunting, fishing, snowmobiling, hiking, and skiing are popular activities because of the area's abundance of water, the many acres of national and county forests, and public hunting grounds. (United States Department of Agriculture, Natural Resources Conservation Service, 2022)

Classification relationships

Major Land Resource Area (MLRA 90A): Wisconsin and Minnesota Thin Loess and Till

USFS Subregions: Rib Mountain Rolling Ridges (212Qd), Green Bay Lobe Stagnation Moraine (212Ta), Brule and Paint Rivers Drumlinized Ground Moraine (212Xc), St. Croix Moraine (212Qa), Glidden Loamy Drift Plain (212Xa) Small sections occur in Central-Northwest Wisconsin Loess Plains (212Xd) and Rosemont Baldwin Plains and Moraines (222Md)

Wisconsin DNR Ecological Landscapes: Forest Transition, North Central Forest

Ecological site concept

The Wet Sandy Lowland ecological site occurs primarily in the southeast portion of MLRA 90A in depressions and drainageways on outwash plains, floodplains, and stream terraces. These sites are characterized by very deep, very poorly or poorly drained soils that formed in sandy outwash, lacustrine, or alluvium deposits. Sites are subject to frequent ponding or flooding during the spring and fall. Soils remain saturated for long periods during the growing season and meet hydric soil requirements. Precipitation, runoff from adjacent uplands, groundwater discharge, and stream inflow are the primary sources of water. Soils range from extremely acid to neutral.

Wet Sandy Lowland are differentiated from other ecological sites by its deep sandy deposits and very poorly or poorly drained soils. Other very poorly or poorly drained sites have loamy or clayey deposits. These sites have lower pH and available water capacity than their loamy and clayey counterparts, which can limit vegetative growth.

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 Wet Sandy Lowlands.
F090AY009WI	**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. They are somewhat drier and occur higher on the drainage sequence than Wet Sandy Lowlands.
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 Wet Sandy Lowlands.

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 Wet Sandy Lowlands.

Similar sites

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. These sites are found on different landforms, but they share their particle size class and drainage capability. Sandy Floodplain can support similar vegetative communities as Wet Sandy Lowland.
F090AY006WI	**Wet Loamy Lowland** Wet Loamy Lowland consist primarily of deep loamy deposits derived from a mixture of outwash, alluvium, loess, and lacustrine sources. Some sites may have bedrock contact within two meters of the surface. These sites are seasonally ponded depressions that remain saturated for sustained periods, allowing hydric conditions to occur. They are found in similar landforms as Wet Sandy Lowland and have similar drainage capabilities but with finer textures. These sites can support vegetative communities with higher nutrient demand.
F090AY009WI	**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, though they are not subject to ponding. The vegetative communities they support may be similar to those found on Wet Sandy Lowland.

Table 1. Dominant plant species

Tree	(1) *Acer rubrum* (2) *Abies balsamea*
Shrub	(1) *Cornus canadensis* (2) *Alnus*
Herbaceous	(1) *Osmunda cinnamomea*

Physiographic features

These sites occur in depressions and drainageways on outwash plains, floodplains, and stream terraces. Sites have an apparent seasonally high water table (endosaturation) at 0 inches. The water table can drop below 80 inches during dry conditions. Surface runoff is negligible to very low.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope
Slope shape across	(1) Linear
Slope shape up-down	(1) Concave
Landforms	(1) Depression (2) Drainageway (3) Outwash plain (4) Flood plain (5) Stream terrace
Runoff class	Negligible to very low
Flooding duration	Very brief (4 to 48 hours) to long (7 to 30 days)
Flooding frequency	None to frequent
Ponding duration	Long (7 to 30 days) to very long (more than 30 days)

Ponding frequency	None to frequent
Elevation	558–902 ft
Slope	0–2%
Ponding depth	0–12 in
Water table depth	0 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 this MLRA is udic (humid climate). The soil temperature regime is frigid and cryic.

Table 3. Representative climatic features

Frost-free period (characteristic range)	83-96 days
Freeze-free period (characteristic range)	111-129 days
Precipitation total (characteristic range)	30-33 in
Frost-free period (actual range)	61-104 days
Freeze-free period (actual range)	100-134 days
Precipitation total (actual range)	29-34 in
Frost-free period (average)	88 days
Freeze-free period (average)	119 days
Precipitation total (average)	31 in

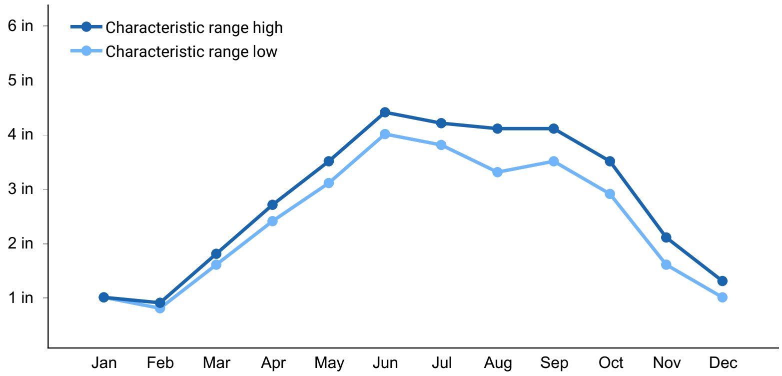


Figure 1. Monthly precipitation range

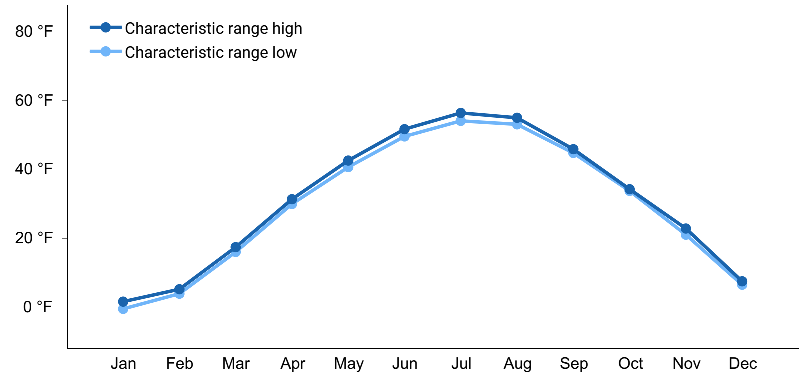


Figure 2. Monthly minimum temperature range

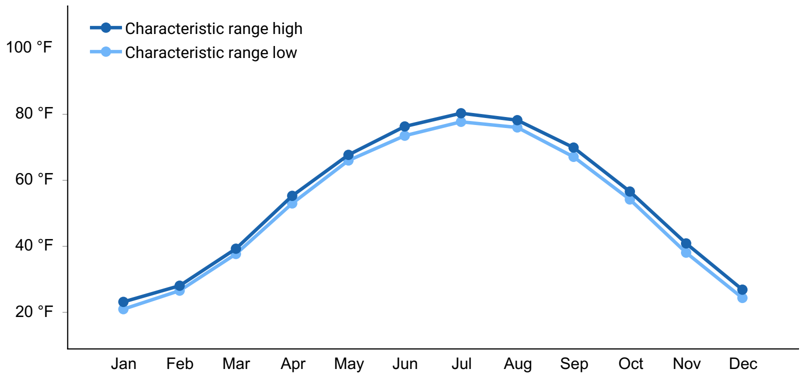


Figure 3. Monthly maximum temperature range

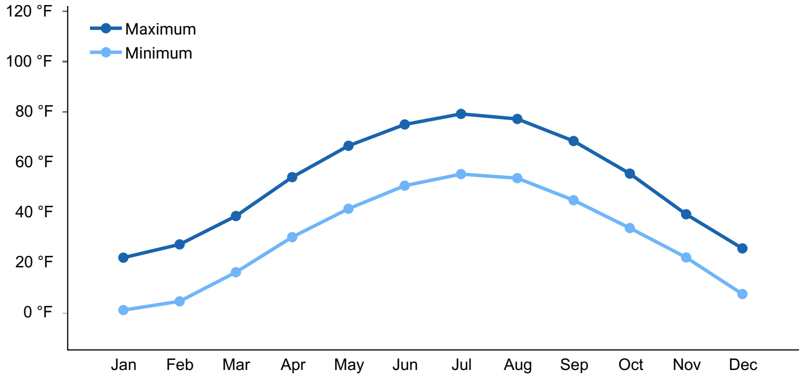


Figure 4. Monthly average minimum and maximum temperature

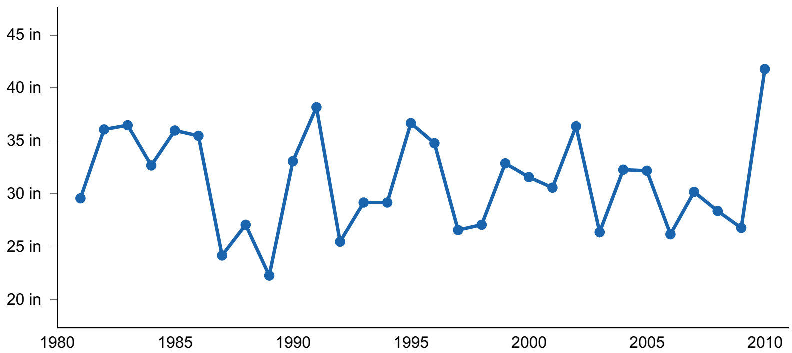


Figure 5. Annual precipitation pattern

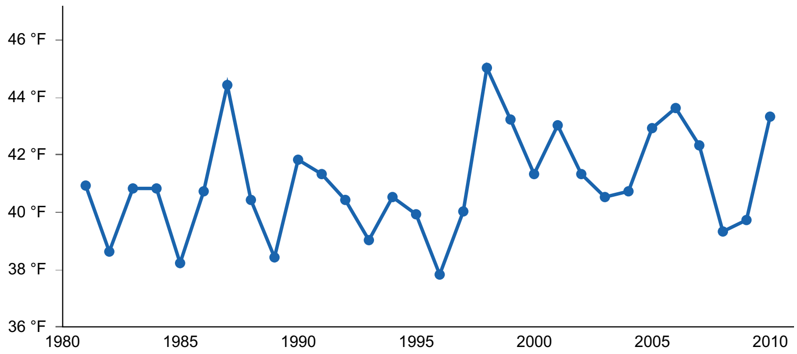


Figure 6. Annual average temperature pattern

Climate stations used

- (1) ROSHOLT 9 NNE [USC00477349], Wittenberg, WI
- (2) LADYSMITH 3W [USC00474391], Ladysmith, WI
- (3) STAMBAUGH 2SSE [USC00207812], Iron River, MI
- (4) WINTER [USC00479304], Ojibwa, WI
- (5) PARK FALLS DNR HQ [USC00476398], Park Falls, WI
- (6) MORA [USC00215615], Mora, MN
- (7) AITKIN 2E [USC00210059], Aitkin, MN

Influencing water features

Water is received through precipitation, runoff from adjacent uplands, groundwater discharge, and stream inflow. Water levels are greatly influenced by precipitation rates and runoff from upland sites. Water is lost from the site primarily through evapotranspiration and groundwater recharge. These sites are wetlands.

Wetland description

Under the Cowardin System of Wetland Classification, or National Wetlands Inventory (NWI), the wetlands can be classified as:
1) Palustrine, forested, broad-leaved deciduous, saturated, or
2) Palustrine, forested, needle-leaved evergreen, saturated, or
3) Palustrine, scrub-shrub, broad-leaved deciduous, saturated, or
4) Palustrine, scrub-shrub, needle-leaved evergreen, saturated, or
5) Palustrine emergent, persistent, saturated

Under the Hydrogeomorphic Classification System (HGM), the wetlands can be classified as:
1) Depressional, forested/organic, or
2)Depressional, scrub-shrub/organic

Permeability of the soils is slow to rapid.
Hydrologic Group: A/D
Hydrogeomorphic Wetland Classification: Depressional, forested/organic; Depressional, scrub-shrub/organic
Cowardin Wetland Classification: PFO1B, PFO4B, PSS1B, PSS4B, PEM1B

Soil features

These sites are represented by the Ausable, Kinross, and Newson soil series. Ausable is classified as a Histic Humaquept, Kinross is a Typic Endoaquod, and is a Humaqueptic Psammaquent.

These soils formed in sandy outwash, lacustrine, or alluvium. Soils are very deep and are very poorly or poorly drained. These sites meet hydric soil requirements.

Surface textures of these sites is muck, moderately decomposed plant material, loamy fine sand, and mucky loamy sand. Subsurface textures include mucky sandy loam, loamy sand, and sand. Soil pH ranges from extremely acid to neutral with values of 4.0 to 7.1. Surface fragments are absent. Subsurface fragments less than 3 inches can be present up to 7 percent volume, but fragments greater than 3 inches are absent. Carbonates are absent within 80 inches.

Figure 7. Kinross soil series photograph courtesy of UWSP taken on 7/13/2019 in Forest County, WI.

Table 4. Representative soil features

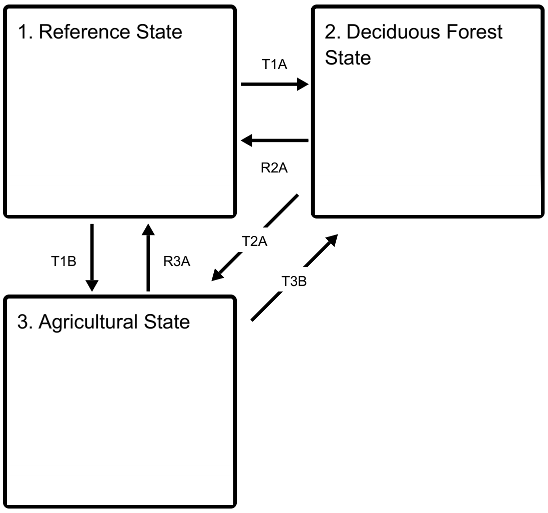
Parent material	(1) Lacustrine deposits (2) Alluvium (3) Glaciolacustrine deposits
Surface texture	(1) Mucky sand (2) Mucky loamy sand
Drainage class	Very poorly drained to poorly drained
Permeability class	Slow to rapid
Soil depth	79–98 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-61in)	1.85–2.94 in
Soil reaction (1:1 water) (0-39.4in)	4–7.1
Subsurface fragment volume <=3" (Depth not specified)	0–7%
Subsurface fragment volume >3" (Depth not specified)	Not specified

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 the species that are fire-tolerant 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 may 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.

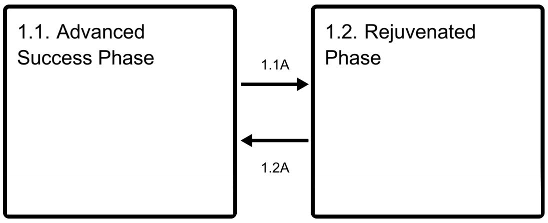
R2A - Conifers slowly increase in abundance in the deciduous forest community.

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

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

T3B - 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 1
Reference State

Reference state is a forest community dominated by red maple (*Acer rubrum*) with groups of balsam fir (*Abies balsamea*). 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 Phase

In the absence of major disturbance—particularly fire—these sites are dominated by a canopy of red maple and balsam fir. Sites may have a super-canopy of large white pine that might be able to maintain itself in few numbers through regeneration in gaps. White pine (*Pinus strobus*) has a moderate shade tolerance and grow to be much larger than red maple and balsam fir at maturity and typically live longer. The shrub layer is not well developed and dominated by red maple sapling and tag alder (*Alnus incana*). The ground layer is covered by cinnamon fern (Osmunda cinamomea), bunchberry (*Cornus canadensis*), Canada mayflower (*Maianthemum canadense*), and blueberry (Vaccinium, spp.) are common.

Dominant plant species

- red maple (*Acer rubrum*), tree
- balsam fir (*Abies balsamea*), tree
- alder (*Alnus*), shrub
- cinnamon fern (*Osmunda cinnamomea*), other herbaceous
- bunchberry dogwood (*Cornus canadensis*), other herbaceous

Community 1.2
Rejuvenated Phase

Figure 8. Photo courtesy of UWSP taken on 7/13/2019 in Forest 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. Black spruce (*Picea mariana*) may occur sporadically on sites, but is unable to compete with red maple and balsam fir with the lack of fire or other disturbance.

Dominant plant species

- red maple (*Acer rubrum*), tree
- balsam fir (*Abies balsamea*), tree
- black spruce (*Picea mariana*), tree
- alder (*Alnus*), shrub
- common winterberry (*Ilex verticillata*), shrub
- cinnamon fern (*Osmunda cinnamomea*), other herbaceous
- bunchberry dogwood (*Cornus canadensis*), 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 advanced 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
Deciduous Forest State


Figure 9. Photo courtesy of UWSP taken on 7/08/2019 in Sawyer 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
- birch (*Betula*), tree
- red maple (*Acer rubrum*), tree
- alder (*Alnus*), shrub
- balsam fir (*Abies balsamea*), shrub
- cinnamon fern (*Osmunda cinnamomea*), other herbaceous
- bunchberry dogwood (*Cornus canadensis*), other herbaceous

State 3
Agricultural State

Hay or cultivated crops.

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

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

Transition T3B
State 3 to 2

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

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), Wetland Forest Habitat Type Classification System for Northern Wisconsin (Kotar and Burger, 2017): The sites of this ES keyed out to four habitat types: *Acer rubrum-Abies balsamea*/Vaccinium-Coptis (ArAbVC); *Acer rubrum*-Fraxinus nigra/Rubus hispidus (ArFnRh); Pinus-*Acer rubrum*-Gaylussacia (PArGy); *Picea mariana*-Larix/Nemopanthus (PmLNe)

Biophysical Settings (Landfire, 2014): This ES is mapped as Laurentian-Acadian Northern Hardwoods Forest-Hemlock; the central concepts are similar

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Approval

Suzanne Mayne-Kinney, 10/02/2023

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	04/27/2024
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:**