USDA Natural Resources Conservation Service

Ecological site F089XY009WI
Wet Clayey Lowlands

Last updated: 9/27/2023
Accessed: 05/20/2025

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): 089X–Wisconsin Central Sands

The Wisconsin Central Sands (MLRA 89) corresponds closely to Central Sand Plains Ecological Landscape published by the Wisconsin Department of Natural Resources (WDNR, 2015). Much of the following brief overview of this MLRA is borrowed from that publication.

The Wisconsin Central Sands MLRA is entirely in Wisconsin. The total land area is 2,187,100 acres (3,420 square miles, 8858 square kilometers). It is bordered to the east by Johnstown-Hancock end moraines, which were pushed to their extent by the west side of the Green Bay Lobe (Clayton & Attig, 1999). It is bordered to the southwest by highly eroded, unglaciated valleys and ridges. The dominant feature of this MLRA is the remarkably flat, sandy plain, composed of lacustrine deposits and outwash sand, that was once the main basin of Glacial Lake Wisconsin. It also features extensive pine and oak barrens and wetland complexes.

Glacial Lake Wisconsin was fed primarily by glacial meltwater from the north and east. The lake deposited silt overlain by tens of meters of sand (Clayton & Attig, 1989). The silty layers are closer to the surface in some areas, where they impede drainage and contribute to the formation of extensive wetland complexes. It is believed that Glacial Lake Wisconsin drained within several days after a breach in the ice dam that supported it. The catastrophic flood that followed flowed to the south and carved the scattered buttes and mesas protruding from the sandy plain in the southern portion of this MLRA. Before vegetation established after glacial recession, strong winds formed aeolian sand dunes that now support xeric pine and oak stands within the Wisconsin Central Sands.

The surface of the northwestern portion is mostly undulating. The sandy surface sediment was mostly deposited by meltwater during the Wisconsin glaciation. Gentle hills are a result of underlying bedrock topography. Valleys and floodplains are formed by stream action. The underlying bedrock controls the water table elevation and contributes to the formation of numerous wetlands.

Historically, the Wisconsin Central Sands were dominated by large wetland complexes, sand prairies, and oak forests, savannas, and barrens. Some pine and hemlock forests were found in the northwest portion. The Wisconsin Central Sands was subject to frequent fires, leading to today's need for prescribed burns to maintain the area.

Classification relationships

Major Land Resource Area (MLRA): Wisconsin Central Sands (89)

USFS Subregions: Central Wisconsin Sand Plain (222Ra)

Relationship to Established Framework and Classification Systems:
Wetland Forest Habitat Type Classification System for Northern Wisconsin (Kotar and Burger, 2017): The sites of this ES keyed out to one habitat type: Fraxinus nigra-Acer rubrum/Impatience, Ilex variant (FnArI-Ix). This is a wetland habitat type for Northern Wisconsin and was used in lieu of Southern Wisconsin wetland habitat types. However, their overstory vegetation is similar to types that suggest White Pine and Red Maple will dominate the overstory.

Biophysical Settings (Landfire, 2014): This ES is largely mapped as North-Central Interior Dry Oak Forest and Woodland and Eastern Cool Temperate Row Crop.

WDNR Natural Communities (WDNR, 2015): This ES is most similar to the Northern Hardwood Swamp and Mesic Forest communities.

Ecological site concept

The Wet Clayey Lowlands ecological site is an uncommon site but exists in the southwest portion of MLRA 89 in depressions and drainageways on the glacial lake basin and along stream terraces. These sites are characterized by very deep, poorly drained soils formed in silty alluvium over clayey lacustrine deposits, almost exclusively along the Lemonweir River in Monroe and Jueneau counties. Sites are occasionally subject to brief to very long ponding. Precipitation, runoff from adjacent uplands, and groundwater discharge are the primary sources of water. Soils can range from neutral to moderately alkaline. Some sites may be wetlands.

Current vegetation is mostly woodlands, typically dominated by red maple (Acer rubrum), both, in the overstory and the reproductive layer. Common associates are red oak (Quercus rubra), trembling aspen (Populus tremuloided), paper birch (Betula papyrifera),

yellow birch (*Betula alleghaniensis*) and white pine (*Pinus strobus*). Some sites have been cleared, drained and converted to agricultural production. Common crops are corn, oats and hay.

Wet Clayey Lowlands differs from other sites by its drainage and texture. Other poorly drained sites are sandy or loamy. Clayey soils often have higher pH and available water capacity than sandy and loamy textures. The poor drainage differentiates this site from other clayey sites.

Associated sites

F089XY015WI	**Moist Clayey Uplands** Moist Clayey Uplands consist of deep clayey lacustrine deposits overlain by sandy or loamy alluvium. They are somewhat poorly drained and are subject to neither flooding nor ponding. These sites are primarily found in the northwestern portion of the Wisconsin Central Sands MLRA, especially in Juneau County adjacent to the Lemonweir River. They occur higher on the drainage sequence than Wet Clayey Lowlands.

Similar sites

F089XY004WI	**Loamy Floodplains** Loamy Floodplains are found exclusively on floodplains in loamy alluvium underlain by sandy alluvium. Soils are somewhat poorly to poorly drained and are subject to flooding. These sites occur primarily along tributaries to the Yellow River in central Wood County and along the Lemonweir River. Their vegetative communities have similar moisture and nutrient preferences as those of Wet Clayey Lowlands.
F089XY008WI	**Wet Loamy Lowlands** Wet Loamy Lowlands form in a loamy or silty mantle 10 to 40 inches (25 to 100 cm) thick overlying sandy residuum weathered from sandstone and shale. Bedrock contact may occur as high at 26 inches (66 cm). These soils are poorly drained, remain saturated for much the growing season, and are sometimes subject to ponding. They are exclusive to the northern third of the Wisconsin Central Sands MLRA, which was covered in loamy glacial deposits prior to the most recent glacial advance. Their vegetative communities are similar to those of Wet Clayey Lowlands.
F089XY015WI	**Moist Clayey Uplands** Moist Clayey Uplands consist of deep clayey lacustrine deposits overlain by sandy or loamy alluvium. The wetness and water features differ between these otherwise very similar sites. They are somewhat poorly drained and are subject to neither flooding nor ponding. These sites are primarily found in the northwestern portion of the Wisconsin Central Sands MLRA, especially in Juneau County adjacent to the Lemonweir River. Their vegetative communities show a preference for slightly drier sites compared to the vegetative communities of Wet Clayey Lowlands.

Table 1. Dominant plant species

Tree	(1) *Pinus strobus* (2) *Acer rubrum*
Shrub	(1) *Ilex verticillata*
Herbaceous	(1) *Rubus hispidus*

Physiographic features

This site occurs in depressions and drainageways in silty alluvium over clayey deposits on glacial lake basins and stream terraces. Slopes range from 0 to 2 percent. Elevation ranges from 705 to 1,394 feet (215 to 425 meters) above sea level.

Sites are subject to occasional ponding throughout the year. The ponding duration ranges from brief (2 to 7 days) to very long (more than 30 days), with depths up to 12 inches (30 cm) above the soil surface. These sites do not flood. The soils have an apparent seasonally high water table (endosaturation) at the soil surface, but the water table may drop to 60 inches (150 cm) during dry conditions. Runoff is negligible to low.

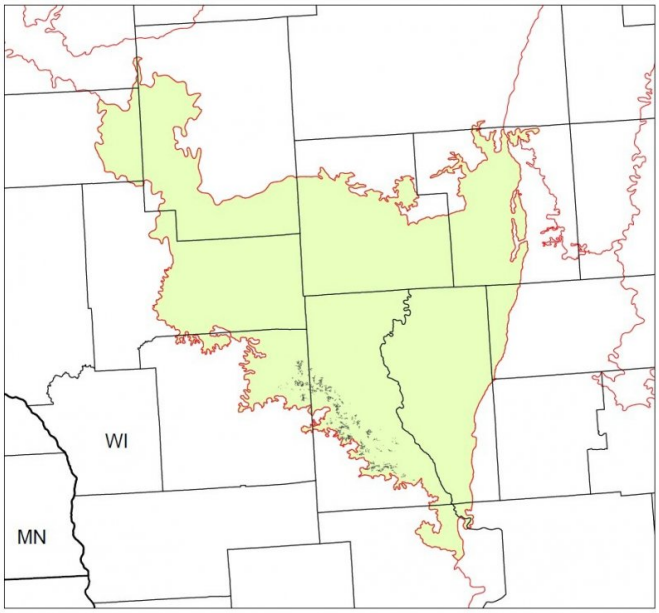


Figure 1. Distribution of Wet Clayey Lowlands in the Wisconsin Central Sands MLRA (89).

Table 2. Representative physiographic features

Slope shape across	(1) Linear
Slope shape up-down	(1) Concave
Landforms	(1) Lake plain > Lake plain (2) Valley > Terrace
Runoff class	Negligible to very low
Flooding frequency	None

Ponding duration	Brief (2 to 7 days) to very long (more than 30 days)
Ponding frequency	None to occasional
Elevation	705–1,394 ft
Slope	0–2%
Ponding depth	0–12 in
Water table depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

The continental climate of the Wisconsin Central Sands is typical of the southern half of the state – cold winters and warm summers. Precipitation is well-distributed throughout the year with a slight peak in the summer months. Snowfall covers the ground from late fall to early spring. The soil moisture regime of MLRA 89 is udic (humid climate). The soil temperature regime is mostly frigid, with a small portion of mesic in the southern tip. Neither precipitation nor temperature vary greatly across this MLRA. More so than latitude, local topography seems to be an important predictor of growing season length, with fewer growing degree days in lower-lying areas.

This site sometimes occurs on landscape depressions, where the local topography is expected to influence growing season length. In landscape depressions, the freeze-free and frost-free periods may be shorter than what is represented here.

The average freeze-free period at this weather station is 17 days longer than the average of the ten other weather stations within this MLRA (136 days). The average frost-free period is 16 days longer (115 days). The average annual precipitation for this PESD is 34 inches. The average annual snowfall is 48 inches. The annual average maximum and minimum temperatures are 56°F and 35°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	125 days
Freeze-free period (characteristic range)	150 days
Precipitation total (characteristic range)	34 in
Frost-free period (actual range)	125 days
Freeze-free period (actual range)	150 days
Precipitation total (actual range)	34 in
Frost-free period (average)	125 days
Freeze-free period (average)	150 days

Precipitation total (average)	34 in

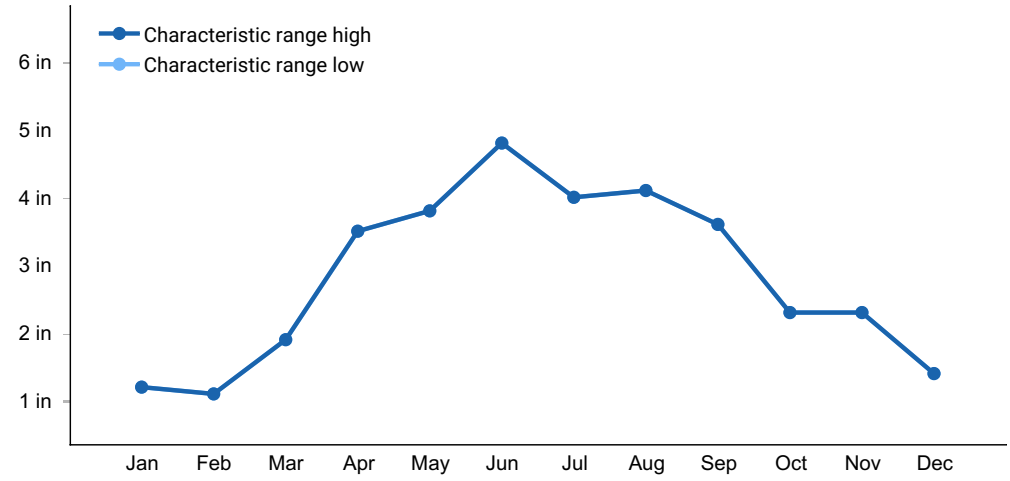


Figure 2. Monthly precipitation range

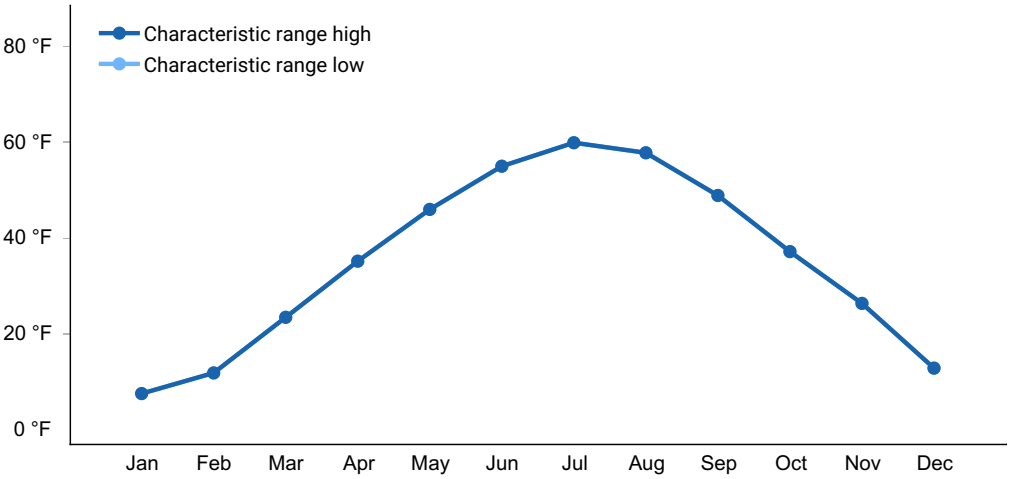


Figure 3. Monthly minimum temperature range

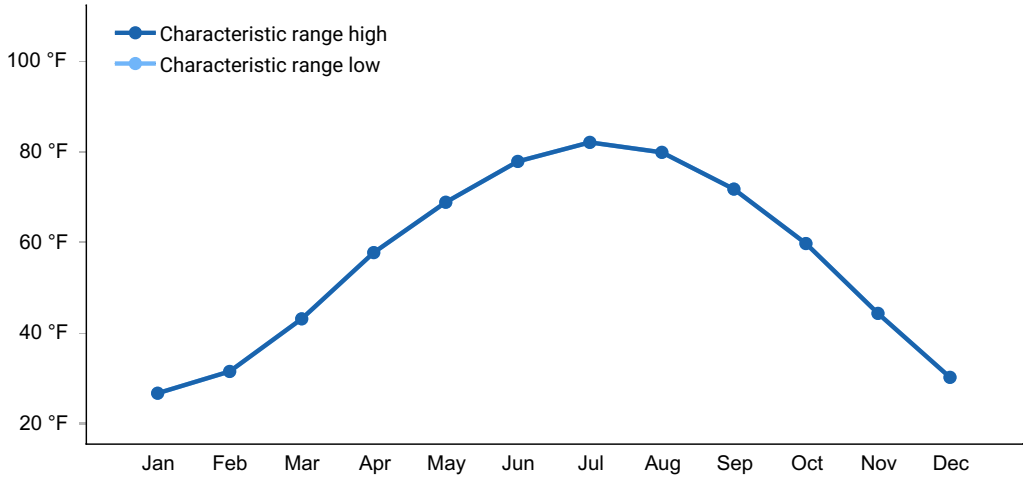


Figure 4. Monthly maximum temperature range

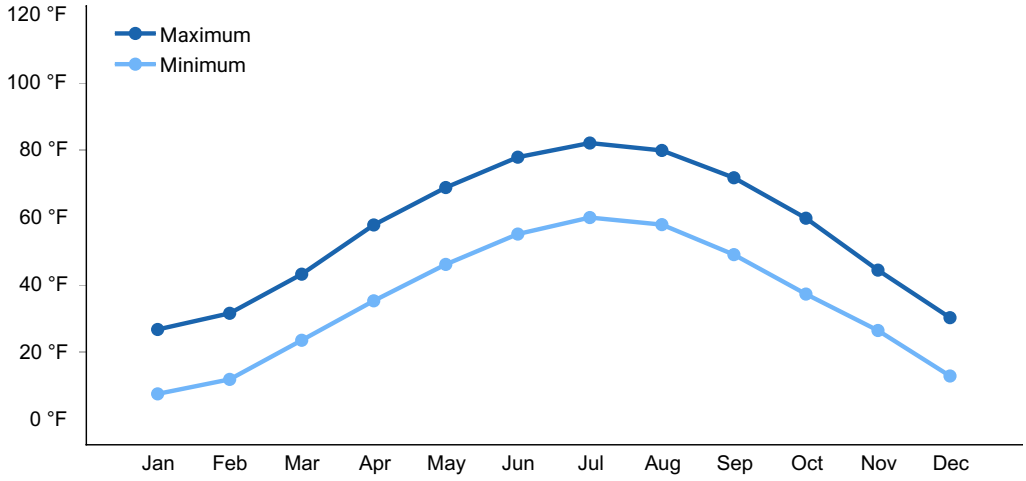


Figure 5. Monthly average minimum and maximum temperature

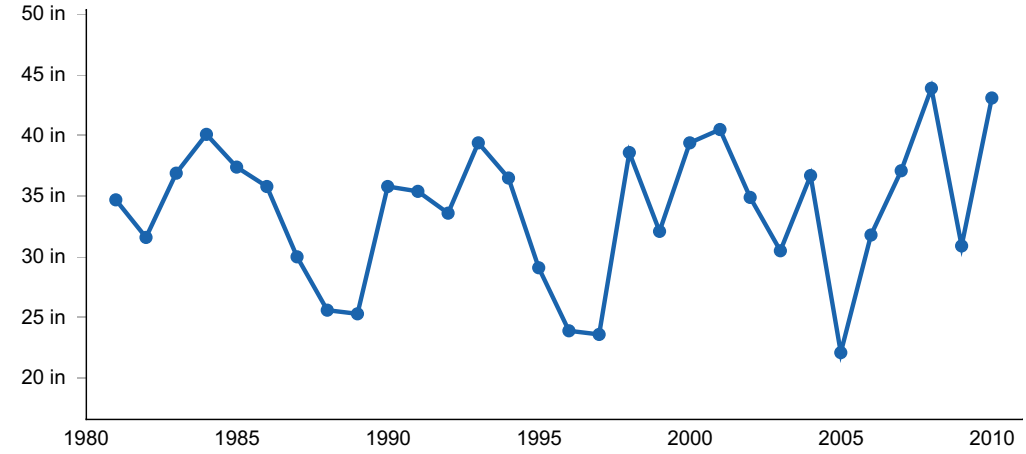


Figure 6. Annual precipitation pattern

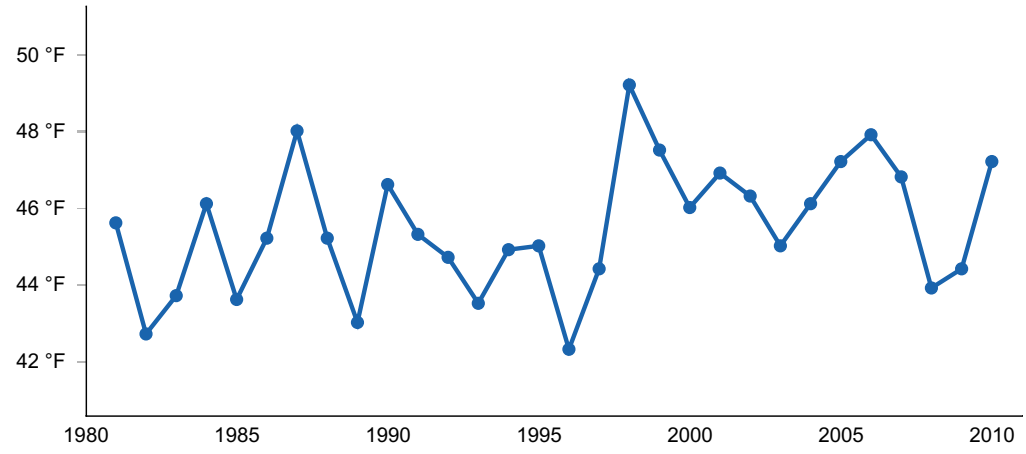


Figure 7. Annual average temperature pattern

Climate stations used

- (1) MAUSTON 1 SE [USC00475178], Mauston, WI

Influencing water features

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

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 emergent, persistent, saturated

Under the Hydrogeomorphic Classification System (HGM), the wetlands can be classified as:
1) Depressional, forested/clayey, or
2) Depressional, scrub-shrub/clayey
Permeability of the soils is impermeable. The hydrologic soil group of these sites is C/D.

Soil features

These sites are represented by the Menasha soil series, classified as a Typic Endoaquoll.

These sites formed in clayey lacustrine deposits overlain by a mantle of silty alluvium ranging from 0 to16 inches (0 to 40 cm) in depth. The soils are very deep, poorly drained, and remain saturated for much of the growing season. They meet hydric soil requirements.

The surface of these sites is silty clay loam. Subsurface horizons are silty clay loam and silty clay. Soil pH is neutral to moderately alkaline in the profile with a range of 7.0 to 7.9. Soil fragments are absent from the profile. Carbonates can be present beginning at 8 inches (20 cm) and up to 18 percent by volume.

Table 4. Representative soil features

Parent material	(1) Alluvium (2) Lacustrine deposits
Surface texture	(1) Silty clay loam
Drainage class	Poorly drained
Permeability class	Very slow
Soil depth	78 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	7.6–7.8 in

Calcium carbonate equivalent (Depth not specified)	0–18%
Soil reaction (1:1 water) (Depth not specified)	7–7.9
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

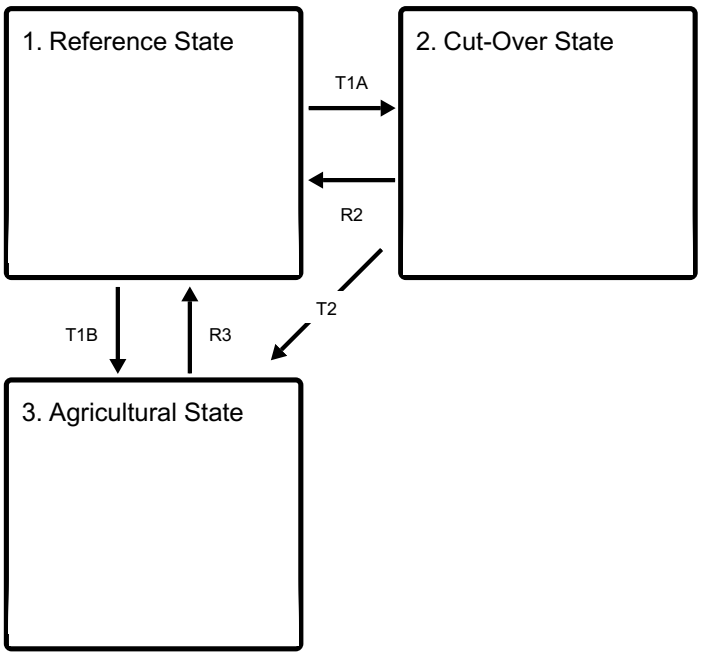
Ecological dynamics

In pre-European settlement time wild fire was the main controlling factor of forest community dynamics. Following a severe, stand-replacing fire, any of the species present on the landscape could become established, depending on seed source availability and specific conditions of post-fire seedbed. The newly established young stands of any species were easily eliminated by recurring fires, but differences in fire-resisting properties among the species began to play a role in any species' survival success. White pine (*Pinus strobus*) is best adapted for long-term success on this Ecological Site. Although vulnerable to damage or elimination by fire in early life it eventually develops thick fire-resistant bark which helps to extend its longevity, in some cases for up to four centuries or more. These survival properties assure the species' relatively continuous seed source in the region as a whole. White pine is also moderately shade-tolerant, which means that it can become established in some pioneer communities, such as aspen – white birch stands, or in poorly stocked oak and red maple dominated communities.

Red maple has not been identified by Finley (1976) as an important component of pre-settlement pine or oak forests, but it is a prominent member in current stands. Absence of fire since the original logging era is probably the main reason. Red maple is extremely sensitive to fire damage, but is a prolific and early seed producer. Stems of 2-4 inches in diameter can produce large amounts of seed (USDA Forest Service, 1990). It is sufficiently shade-tolerant to become established in the understories of most communities on sandy soils. On this Ecological Site it behaves similarly to white pine, but because of its much smaller stature at maturity, it does not compete with white pine in the upper canopy.
Other tree species occurring as sporadic associates on this site type include red oak (Q. rubra), white oak (Q. alba) and yellow birch (*Betula alleghaniensis*).

State and transition model

Ecosystem states



T1A - Clearcutting or stand-replacing natural disturbance. Pioneer species seed in.

T1B - Removing forest vegetation and tilling.

R2 - Natural succession.

T2 - Removing forest vegetation and tilling.

R3 - Abandonment of agricultural practices, natural or artificial afforestation.

State 1 submodel, plant communities

1.1. Mature or Advanced Succession Phase

State 2 submodel, plant communities

2.1. Aspen or Paper Birch Forest

State 3 submodel, plant communities

3.1. Agricultural Community

State 1
Reference State

Reference state of this Ecological Site is characterized by strong presence of red maple and white pine. Either species may represent the dominant canopy and/or reproductive layer, depending on history of stand disturbance and availability of seed sources. Although current stands are almost always dominated by red maple, large, old, white pine stumps are frequently present, verifying the species' presence in the pre-logging forest communities. Seed sources of both, white pine and red maple, have been greatly reduced by early logging, however, red maple had an early advantage in its re-establishment, because of its ability to sprout from stumps and to produce seed at very young stage. Stems as small as two inches d.b.h. produce viable seeds (USDA, 1990). In contrast, white pine reproduces only by seed and not until cone-bearing trees are 20 to 30 feet tall. With time, however, white pine trees become abundant seed producers, leading to eventual white pine dominance on this ecological site.

Dominant plant species

- eastern white pine (*Pinus strobus*), tree
- red maple (*Acer rubrum*), tree
- common winterberry (*Ilex verticillata*), shrub
- bristly dewberry (*Rubus hispidus*), other herbaceous

Community 1.1
Mature or Advanced Succession Phase

Reference state of this Ecological Site is characterized by strong presence of red maple and white pine. Either species may represent the dominant canopy and/or reproductive layer, depending on history of stand disturbance and availability of seed sources. Although current stands are almost always dominated by red maple, large, old, white pine stumps are frequently present, verifying the species' presence in the pre-logging forest communities. Seed sources of both, white pine and red maple, have been greatly reduced by early logging, however, red maple had an early advantage in its re-establishment, because of its ability to sprout from stumps and to produce seed at very young stage. Stems as small as two inches d.b.h. produce viable seeds (USDA, 1990). In contrast, white pine reproduces only by seed and not until cone-bearing trees are 20 to 30 feet tall. With time, however, white pine trees become abundant seed producers, leading to

eventual white pine dominance on this ecological site.

Dominant plant species

- eastern white pine (*Pinus strobus*), tree
- red maple (*Acer rubrum*), tree
- common winterberry (*Ilex verticillata*), shrub
- bog dewberry (*Rubus hispidoides*), other herbaceous

State 2
Cut-Over State

If not planted to other species, cut over and burned stands were historically most often colonized by trembling aspen and frequently also by paper birch. Aspen is often perpetuated by clearcutting, but paper birch tends to drop out in the process as it does not compete well with vigorous aspen sprouting.

Dominant plant species

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

Community 2.1
Aspen or Paper Birch Forest

This community has been cut over or burned and has an early successional community dominated by quaking aspen and paper birch.

Dominant plant species

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

State 3
Agricultural State

Site in agricultural cultivation. Species vary depending on landowner goals. The site may be planted in row crops or used for pasture or hay production.

Dominant plant species

- corn (*Zea mays*), grass
- oat (*Avena hybrida*), grass

Community 3.1
Agricultural Community

This community is characterized by agricultural production. The site may be seeded with many different row crop, small grain, or forage species.

Dominant plant species

- corn (*Zea mays*), grass
- wheat (*Triticum araraticum*), grass

Transition T1A
State 1 to 2

Clear-cutting, especially if followed by fire, or stand-replacing wild fire, create conditions favorable for pioneering species to seed in.

Transition T1B
State 1 to 3

Considerable acreage of this Ecological Site has been cleared of forest vegetation and converted to agricultural use.

Restoration pathway R2
State 2 to 1

If not repeatedly cut over, aspen-birch stands gradually succeed to more shade tolerant species. Most successful species in this process is red maple, but white pine can be well represented if adequate seed sources exist in the area. This process transforms forest community to reference state conditions.

Transition T2
State 2 to 3

Considerable acreage of this Ecological Site has been cleared of forest vegetation and converted to agricultural use.

Restoration pathway R3
State 3 to 1

Abandonment of agricultural practices, without additional human intervention, restores the reference state condition through the process of natural succession. However, this may be a long process as many “weed species”, herbaceous and woody, may first colonize the site for long periods of time. Return to forest condition can be accelerated by planting and control of weedy species.

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.

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Contributors

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Approval

Suzanne Mayne-Kinney, 9/27/2023

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	09/27/2023
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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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):**

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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:**
