USDA Natural Resources Conservation Service

Ecological site F090AY012WI
Moist Clayey Lowland

Last updated: 10/02/2023
Accessed: 05/12/2025

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): 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)

Small sections occur in Mille Lacs Uplands (212Kb), Bayfield Sand Plains (212Ka), St. Croix Moraine (212Qa)

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

Ecological site concept

The Moist Clayey Lowland ecological site is found primarily in two small areas on the southern and west borders of MLRA 90A, located on lake plains. These sites are characterized by very deep, somewhat poorly drained soils that formed in lacustrine deposits. Precipitation, runoff from adjacent upland, and groundwater discharge are the primary sources of water. Soils range from very strongly acid to moderately alkaline.

Moist Clayey Lowland is distinguished from other ecological sites based on its clayey texture and somewhat poor drainage. Other somewhat poorly drained sites have sandy or loamy deposits. The clayey materials often have higher pH and available water capacity than coarser materials.

Associated sites

F090AY007WI	**Wet Clayey Lowlands** Wet Clayey Lowlands form in deep, loamy to clayey deposits derived from a mixture of alluvium, residuum, till, or lacustrine sources. These sites have a seasonally high water table at the surface, and some are subject to occasional ponding. Sustained saturation is enough for hydric conditions to occur. They are wetter and occur lower on the drainage sequence than Moist Clayey Lowland.
F090AY017WI	**Clayey Upland** Clayey Upland consist of loamy to clayey residuum or lacustrine deposits overlain by loess or sandy outwash. Bedrock contact may occur within two meters of the surface. These sites have a seasonally high water table within one meter of the surface, though they are not saturated for sustained periods. They are drier and occur higher on the drainage sequence than Moist Clayey Lowland.

Similar sites

F090AY010WI	**Moist Loamy Lowland with Carbonates** Moist Loamy Lowland with Carbonates consists of deep loamy till, sometimes with a loess mantle. Carbonates are present in these soils. 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 Clayey Lowland, but with finer particle sizes.

F090AY008WI	**Moist Sandy Bedrock Upland** Moist Sandy Bedrock Upland sites consist of sandy to clayey alluvium, till, or eolian deposits over residuum weathered from bedrock. Bedrock contact occurs within two meters of the surface. Sites have seasonally high water table within a meter of the surface. Perching of the water table may occur as a result of bedrock contact. They are found in similar landscape positions with the same drainage class as Moist Clayey Lowland, often with finer particle sizes.
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 Clayey Lowland, but with finer particle sizes.

Table 1. Dominant plant species

Tree	(1) *Acer rubrum* (2) *Acer saccharum*
Shrub	(1) *Ribes*
Herbaceous	(1) *Parthenocissus quinquefolia* (2) *Geranium maculatum*

Physiographic features

This site occurs on lake plains. Slopes range from 0 to 3 percent.

These sites are not subject to ponding or flooding. Soils have a perched seasonally high water table (episaturation) at depths of 6 to 12 inches but can drop below 80 inches during dry conditions. Runoff is low medium.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Backslope (3) Footslope (4) Shoulder
Slope shape across	(1) Concave (2) Convex
Slope shape up-down	(1) Linear
Landforms	(1) Lake plain
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	215–260 m
Slope	0–3%
Water table depth	15–30 cm
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 52 inches. The annual average maximum and minimum temperatures are 54°F and 34°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)	737-813 mm
Frost-free period (actual range)	42-116 days
Freeze-free period (actual range)	87-145 days
Precipitation total (actual range)	711-889 mm
Frost-free period (average)	90 days
Freeze-free period (average)	123 days
Precipitation total (average)	787 mm

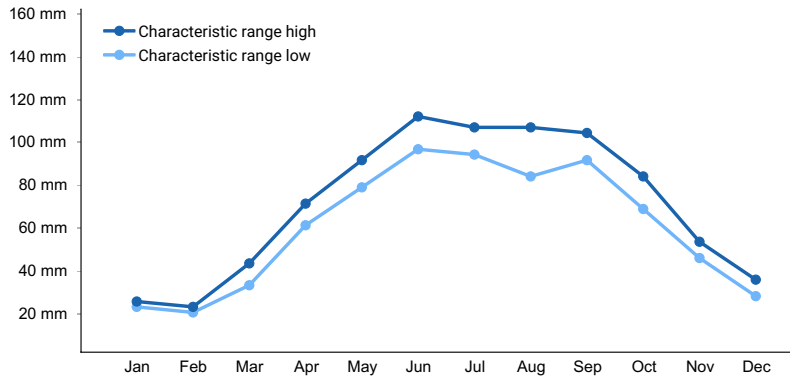


Figure 1. Monthly precipitation range

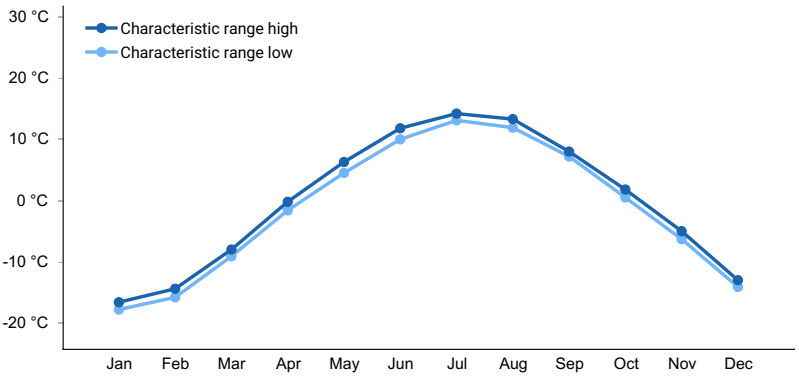


Figure 2. Monthly minimum temperature range

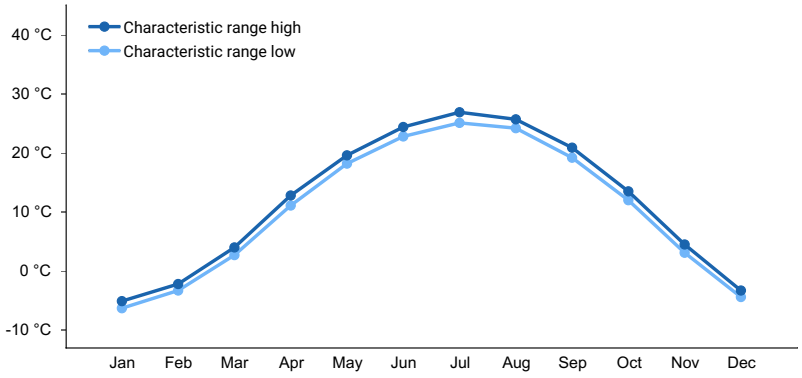


Figure 3. Monthly maximum temperature range

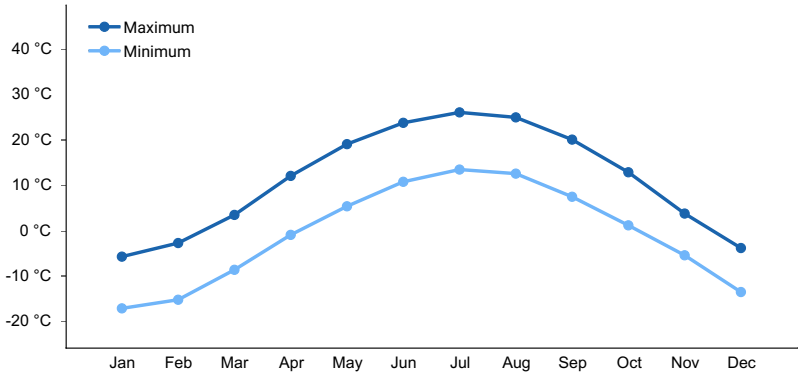


Figure 4. Monthly average minimum and maximum temperature

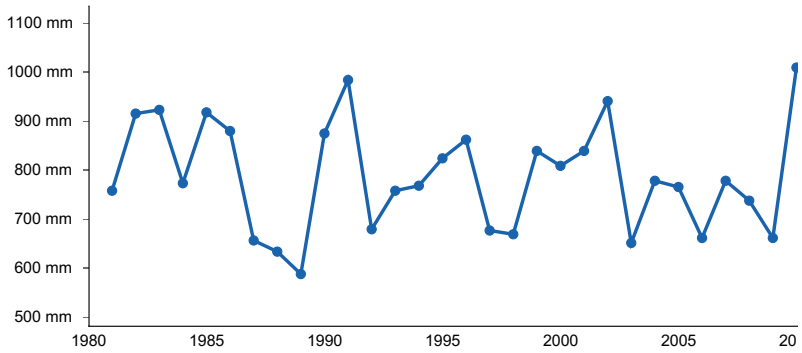


Figure 5. Annual precipitation pattern

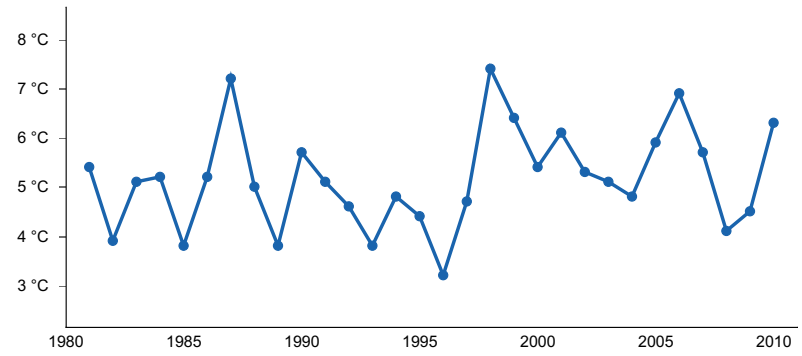


Figure 6. Annual average temperature pattern

Climate stations used

- (1) HOLCOMBE [USC00473698], Holcombe, WI
- (2) ROSHOLT 9 NNE [USC00477349], Wittenberg, WI
- (3) 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 these sites is very low.
Hydrologic Group: D, C/D
Hydrogeomorphic Wetland Classification: None
Cowardin Wetland Classification: None

Soil features

These sites are represented by the Alango and Siren soil series, classified as Chromic Vertic Epiaqualfs and Aquic Glossudalfs, respectively.

These soils formed in lacustrine deposits. Soils are very deep and somewhat poorly drained. They do not meet hydric requirements.

The surface textures of these sites is clay loam or loam. Subsurface textures include clay, sandy loam, and sandy clay loam. Soil pH ranges from very strongly acid to moderately alkaline with values of 4.8 to 8.3. Carbonates are present up to 25 percent beginning at 28 inches.

Figure 7. Siren soil series photograph courtesy of UWSP taken on 7/17/2019 in Burnett County, WI.

Table 4. Representative soil features

Parent material	(1) Lacustrine deposits
Surface texture	(1) Loam (2) Clay loam
Drainage class	Somewhat poorly drained
Permeability class	Very slow

Soil depth	201–249 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-154.9cm)	7.14–8.64 cm
Calcium carbonate equivalent (0-100.1cm)	0–25%
Soil reaction (1:1 water) (0-100.1cm)	4.8–8.3
Subsurface fragment volume <=3" (Depth not specified)	1–12%
Subsurface fragment volume >3" (Depth not specified)	0–1%

Ecological dynamics

Mature forests on this ecological site were likely composed of a mixture of Sugar maple, Red maple, Basswood, Ashes, and Yellow birch. Several other associates including elms, oaks, and White birch may occur as well. White pine may be present in some stands as well. Shrub layers are usually poorly developed or altogether absent on this ES and may only contain gooseberries. Ground flora is likely to consist of ferns, jewelweed, hog peanut, wild geranium, virginia creeper, and sweet cicely.

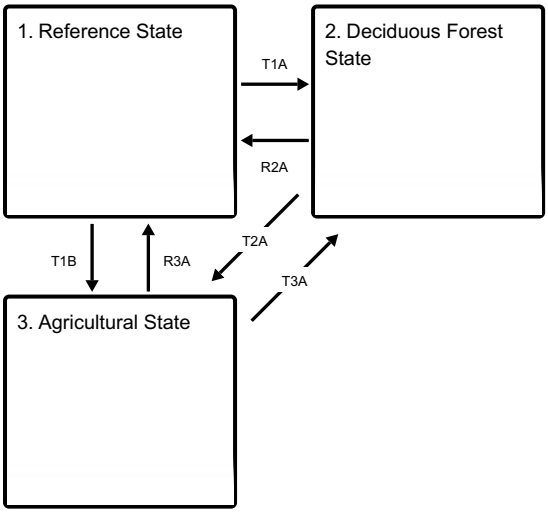
While these sites at present are wetter than may be optimal for Sugar maple, once established in full succession canopy trees are likely to “dry” the site due to increased evapotranspiration allowing Sugar maple to become a dominant canopy member on these sites. The opposite condition of “swamping” has been noted on these sites, where heavy cutting on these sites leads to an elevated water table. Due to their connection to water table elevation, soil wetness, and evapotranspiration of a full canopy these sites have a variety of species mixtures at present. Additionally many soils in this ES may experience infrequent flooding that could affect species composition. Greater soil wetness may tilt this site towards species such as Black ash rather than Sugar maple.

Current stands on this Ecological Site can represent a broad array of species composition and all potential successional stages, however, the Advanced Successional stage of the Reference State is uncommon and instead the Deciduous Forest State (Aspen – Red maple) is likely to be the most common state that one finds.

While this ES is similar to Moist Loamy Lowlands it is distinctly more nutrient rich and often wetter leading to an increased abundance of Black ash. Due to increased wetness from the fine textured soils of this ES there is often decreased productivity in spite of the richness of the soils in this ES.

State and transition model

Ecosystem states



T1A - Stand replacing disturbance that includes fire.

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

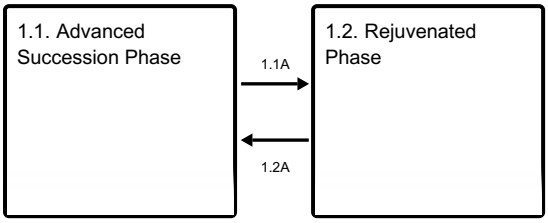
R2A - Conifers slowly increase in abundance in the deciduous forest community.

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.

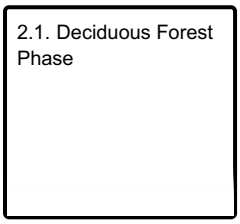
State 1 submodel, plant communities



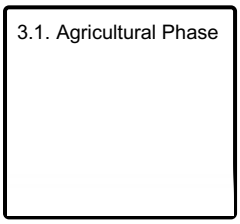
1.1A - Blow-downs and ice storms leaving canopy openings.

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

State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

The reference plant community is categorized as mesic to wet-mesic forest community dominated by mixed deciduous species, primarily Sugar maple, Red maple, Basswood, Ashes, and Yellow birch. Several other associates including elms, oaks, and White birch may occur as well. White pine may be present in some stands as well. Shrub layers are usually poorly developed or altogether absent on this ES and may only contain gooseberries. Ground flora is likely to consist of ferns, jewelweed, hog peanut, wild geranium, virginia creeper, and sweet cicely. Although forest communities can vary greatly in terms of species composition and stand structure, depending on type, degree, and frequency of disturbance, two common phases predominate:

Community 1.1
Advanced Succession Phase

In the absence of major, stand-replacing disturbance this community is dominated by sugar maple, red maple, basswood, ashes, and yellow birch. The tree sapling and shrub layer in this community is not well developed due to dense shade created by multi-story tree canopy. Commonly the shrub layer may contain only gooseberries. The herb layer is likely to consist of ferns (lady fern, interrupted fern, maidenhair fern, and sensitive fern), jewelweed, hog peanut, wild geranium, virginia creeper, and sweet cicely.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- red maple (*Acer rubrum*), tree
- black ash (*Fraxinus nigra*), tree
- currant (*Ribes*), shrub
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous
- geranium (*Geranium*), other herbaceous

Community 1.2
Rejuvenated Phase

Figure 8. Photo courtesy of UWSP taken on 7/17/2019 in Burnett County, WI.

Disturbances described in Pathway 1.1A lead to increased species and structural diversity of the forest community. Depending on seed source, red oak and red maple regenerate in the canopy openings and in time join sugar maple and hemlock in the dominant canopy. Basswood is also commonly present. The relative density of the shrub and herb layers also increases during this stage. Species composition remains relatively unchanged, but abundance changes can be significant. Particularly beaked hazelnut can form dense thickets. Many other herb species that were present with very low abundance in the advanced-succession community typically form much larger population clusters as there is more light penetrating the canopy.

Dominant plant species

- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), tree
- black ash (*Fraxinus nigra*), tree
- basswood (*Tilia*), tree
- currant (*Ribes*), shrub
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous
- geranium (*Geranium*), other herbaceous

Pathway 1.1A

Community 1.1 to 1.2

Natural mortality in the oldest age classes—sporadic small-scale blow-downs and ice storms—create openings for entry of red maple, ashes, elms, and basswood.

Pathway 1.2A
Community 1.2 to 1.1

In the absence of canopy reducing disturbances natural succession leads to community dominance by the most shade-tolerant species resulting in return to community phase 1.1. The longer the time without disturbance the more likely that Sugar maple will dominate.

State 2
Deciduous Forest State

Post disturbance pioneer community of aspen and red maple with mixtures of other species from available seed sources (ashes, elms, white birch) are common in this state. This state can have broad variation depending on what seed sources are available as these sites readily supply water and nutrients in quantities that many species can thrive with. Depending on age and tree species composition the shrub and herb layer in this state can vary considerably. Namely with the dominance of aspen there is likely to be very little in the shrub layer.

Community 2.1
Deciduous Forest Phase

Figure 9. Photo courtesy of UWSP taken on 7/16/2019 in Burnett County, WI.

A pure aspen, sometimes with paper birch, community replaces the reference state community. If seed source is present, red maple and readily becomes a member of this community. Early in this phase the shrub and herb layer may be minimal with the presence of an aspen thicket. Other trees likely to be present as long as the seed source is present include ashes and elms.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- red maple (*Acer rubrum*), tree
- Canadian gooseberry (*Ribes oxyacanthoides*), shrub
- sedge (*Carex*), grass
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

State 3
Agricultural State

Indefinite period of applying agricultural practices. Cropping systems vary on these sites and likely include tillage, row crops, hay or pasture, and specialty crops. Agricultural development of these sites could include drainage.

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. Agricultural drainage may be a component of the practices used on these sites.

Transition T1A
State 1 to 2

Major stand-replacing disturbance. In pre-European settlement time, the event was most often a severe blow down, only very occasionally followed by fires on these sites due to wetness. Such blow downs have been estimated to occur in this part of Wisconsin every 300 to 400 years (Schulte and Mladenoff, 2005), but may have occurred more often on wet sites such as those in this ES. In post settlement virtually every acre has been logged either by clear cutting or successive cuts targeting species marketable at that time. These disturbances created the environment suitable for natural regeneration of many shade-intolerant species and for commercial planting. The history of cutting has lead many of these sites to be “swamped” as well leading to less Sugar maple in the Deciduous Forest State.

Transition T1B
State 1 to 3

Removal of forest cover, tilling and application of other agricultural techniques to grow agricultural crops.

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, tilling and application of other agricultural techniques to grow agricultural crops.

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. This direct restoration pathway is likely slow and uncommon unless there has been drainage and adjacent seed sources exist.

Transition T3A
State 3 to 2

Abandonment of agricultural practices and allowing natural vegetation to colonize the site or apply artificial afforestation. The site can return much more quickly to the Deciduous Forest State as compared to the Reference State.

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 one habitat type: Acer saccharum/Sanguinaria-Impatiens (ASaI)

Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Northern Hardwoods Forest, Eastern Cool Temperate Row Crop, Eastern Cool Temperate Close Grown Crop, and Eastern Cool Temperate Pasture and Hayland

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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	05/12/2025
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):

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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:**
