Ecological site F105XY008WI
Moist Loamy-Clayey Lowland

Last updated: 2/23/2024
Accessed: 05/18/2024

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): 105X–Upper Mississippi River Bedrock Controlled Uplands and Valleys

The Northern Mississippi Valley Loess Hills area corresponds closely to the Western Coulees and Ridges and Southwest Savanna Ecological Landscapes. Some of the following brief overview is borrowed from the Wisconsin Department of Natural Resources Ecological Landscape publication (2015).

Fifty-two percent of the Upper Mississippi River Bedrock Controlled Uplands and Valleys MLRA is in Wisconsin; Iowa, Minnesota, and Illinois contain the rest. This region is the only area in Wisconsin that has not been covered by glaciers within the past 2.4 million years. The Wisconsin portion of this MLRA is approximately 7.4 million acres (11,600 square miles). The landscape is characterized by dissected topography with deeply-incised, steep-walled valleys between bedrock controlled ridges.

Though it’s called the “Driftless Region”, some glacial drift is found in the major river valleys of this region in the form of outwash, deposited by proglacial streams of glacial meltwater. Wisconsin’s most recent glaciations also impacted the sediment of the area through the deposition of loess. After the glacier receded and before vegetation established, the bare surfaces of the glaciated areas were highly susceptible to wind erosion. As a result, a veneer of loess (wind-blown silt) was deposited over the entire region. The thickest deposits—nearly five meters—are on ridges near the Mississippi River and gradually thin moving eastward. The loess caps in Dane and Green counties are generally 0.5-1.5 meters deep. Much of the loess has eroded downslope and collected in floodplains.

Bedrock is shallow throughout this MLRA and is a major influence on topography and hydrology. Most of the MLRA has bedrock within two meters, except in the deep river valleys that are filled with outwash and alluvium materials. Sandstone is the dominant bedrock type in MLRA 105, but the southernmost portion is dominated by dolomite. Military Ridge is an escarpment that straddles the boundary between sandstone and dolomite bedrock. The sandstone north of the ridge is weaker than the erosion-resistant dolomite south of the ridge. The sandstone is deeply cut and dissected into steep slopes and valleys. The dolomite-controlled ridges tend to be less dissected and broader with more gentle, south sloping topography. Geomorphic and fluvial processes formed these landscapes by way of sheet wash, soil creep, and flowage. These processes eroded the hillslopes, cut into bedrock, and transported the debris to streams, forming floodplains and terraces.

Underfit streams are common in MLRA 105, especially in the southern portion. These streams currently occupy large river valleys—especially those of the Black, Chippewa, Mississippi, and Wisconsin Rivers—that were carved by proglacial meltwater streams carrying much larger quantities of water than what’s present today. As the climate dried, waterflow decreased and the valleys filled with alluvial sediment. Narrow meanders were formed by the shrinking streams and are often dissimilar to the meanders of the larger valleys they occupy. Fluvial landforms – including terraces, oxbow lakes, sandbars, eroding bluffs, and large floodplain complexes – are found within these large valleys and are subject to varying flooding frequencies, intensities, and durations.
Karst topography formed in this region from dissolution of carbonate bedrock by surface and groundwater. Dolomite and limestone are more easily affected by dissolution, but karst topography also formed in sandstone. Erosion by water (stream meanders, rain/runoff, and groundwater), wind, and frost weaken joints and bedding planes that can

cause collapse. In addition, sandstone materials collapse into cavities in underlying dolomite or limestone.

Historically, MLRA 105 was dominated by oak forests and oak openings making up more than 50% of the area. Prairies were significant and covered 32% of the area south of Military Ridge. Maple-basswood forests covered 19% of the are north of Military Ridge. Dominant tree species were white oak (Quercus alba), bur oak (Quercus macrocarpa), black oak (Quercus velutina), and sugar maple (*Acer saccharum*).

Classification relationships

Relationship to Established Framework and Classification Systems:

Habitat Types of S. Wisconsin (Kotar, 1996): The sites of this ES keyed out to *Acer saccharum*-Tilia/Caulophyllum[ATiCa] and *Acer saccharum*-Tilia/Desmodium [ATiDe].

Biophysical Settings (Landfire, 2014): This ES is largely mapped as North-Central Interior Maple-Basswood Forest, Central Interior and Appalachian Floodplain Forest, Eastern Cool Temperate Developed Ruderal Deciduous Forest, Eastern Cool Temperate Pasture and Hayland, and Eastern Cool Temperate Row Crop

Hierarchical Framework Relationships:

Major Land Resource Area (MLRA): Upper Mississippi River Bedrock Controlled Uplands and Valleys (105)

USFS Subregions: Menominee Eroded Pre-Wisconsin Till (222La), Melrose Oak Forest and Savannah (222Lb), Mississippi-Wisconsin River Ravines (222Lc), Kickapoo-Wisconsin River Ravines (222Ld), Mineral Point Prairie-Savannah (222Le)

Wisconsin DNR Ecological Landscapes: Western Coulee and Ridges, Southwest Savannah

Ecological site concept

The Moist Loamy-Clayey Lowlands ecological site occupies approximately 308,000 acres across MLRA 105, or about 4.5% of total land area. It is the fifth-most extensive site in MLRA 105. It is found in lower landscape positions on diverse landforms throughout the MLRA.

This site is characterized by somewhat poorly to moderately well drained soils formed in loamy to clayey materials of various origin. It lacks the deep, dark surface horizon (mollic epipedon) that defines Moist Mollic Loamy-Clayey Lowlands, which is otherwise a very similar site.

Associated sites

F105XY005WI	**Wet Loamy-Clayey Lowland** These sites form in depressions, drainageways, and swales in deep loamy alluvium deposits or in clayey residuum. They are very poorly or poorly drained and are saturated long enough for hydric conditions to occur. They may be found adjacent to Moist Loamy-Clayey Lowlands in lower landscape positions.
F105XY012WI	**Shallow Loamy-Silty Upland** These sites form in loamy to silty materials, often silty loess and residuum. They have bedrock contact within one meter of the soil surface. They are moderately well to well drained. They may be found adjacent to Moist Loamy-Clayey Lowlands in higher landscape positions.
F105XY013WI	**Loamy-Silty Upland** These sites form in loamy to silty materials, often silty loess and residuum. They are moderately well to well drained. They may be found adjacent to Moist Loamy-Clayey Lowlands in higher landscape positions.
F105XY016WI	**Clayey Upland** These sites form in deep clayey materials, often clayey pedisediment and residuum. They are moderately well to well drained. They may be found adjacent to Moist Loamy-Clayey Lowlands in higher landscape positions.

Similar sites

F105XY008WI	**Moist Loamy-Clayey Lowland** These sites form in loamy and clayey materials, often alluvium. They have deep, dark surfaces. They are somewhat poorly drained. They are very similar to Moist Loamy-Clayey Lowlands but have deeper surface horizons of dark, organic-enriched soil (mollic rather than ochric epipedons).
F105XY006WI	**Moist Sandy Lowland** These sites form in sandy outwash deposits along major waterways. They are somewhat poorly drained. They are found in similar landscape positions as Moist Loamy-Clayey Lowlands but have coarser textures and a lower nutrient status.

Table 1. Dominant plant species

Tree	(1) *Acer saccharum* (2) *Tilia americana*
Shrub	Not specified
Herbaceous	(1) *Parthenocissus quinquefolia* (2) *Geranium*

Physiographic features

These sites are found on loess hills in the footslope or toeslope positions. Slope shape is concave to linear. Slopes range from 0 to 12 percent. Elevation of the landform ranges from 705 to 1001 feet (215 to 305 meters) above sea level.

Some sites may be subject to rare or occasional flooding for a period of 2 days or less. Sites are not subject to ponding. The seasonally high water table is generally found between 18 to 54 inches (46 and 137 cm) below to soil surface. Runoff potential may be low to high.

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope (2) Toeslope
Slope shape across	(1) Convex
Slope shape up-down	(1) Linear
Landforms	(1) Loess hill (2) Pediment (3) Lake plain (4) Kame terrace (5) Valley train (6) Outwash plain (7) Stream terrace (8) Strath terrace (9) Sand sheet (10) Dune
Runoff class	Low to high
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	None to occasional
Ponding frequency	None
Elevation	215–305 m
Slope	0–12%
Water table depth	46–137 cm
Aspect	Aspect is not a significant factor

Climatic features

The climate of the Upper Mississippi River Bedrock Controlled Uplands and Valleys MLRA is typical of southern Wisconsin, with warmer winters, warmer summers, and higher precipitation rates than MLRA in northern Wisconsin. The MLRA stretches over about 2.9 degrees of latitude, or nearly 200 miles, from its northern tip in Barron county to its southern Wisconsin extent on the border of Illinois. This results in considerable variation in climate throughout the MLRA. The growing season ranges from 117 to 181 growing degree days, with longer growing seasons in the southern portion.

The average annual precipitation for this ecological site is 35 inches. The average annual snowfall is 42 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)	116-124 days
Freeze-free period (characteristic range)	136-163 days
Precipitation total (characteristic range)	864-940 mm
Frost-free period (actual range)	107-142 days
Freeze-free period (actual range)	128-172 days
Precipitation total (actual range)	864-965 mm
Frost-free period (average)	121 days
Freeze-free period (average)	149 days
Precipitation total (average)	889 mm

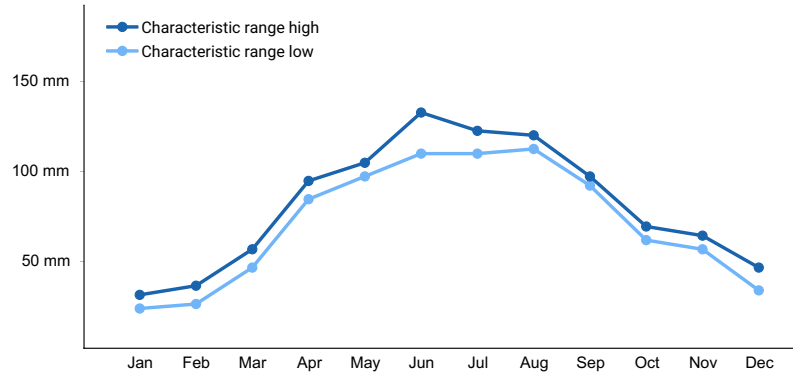


Figure 1. Monthly precipitation range

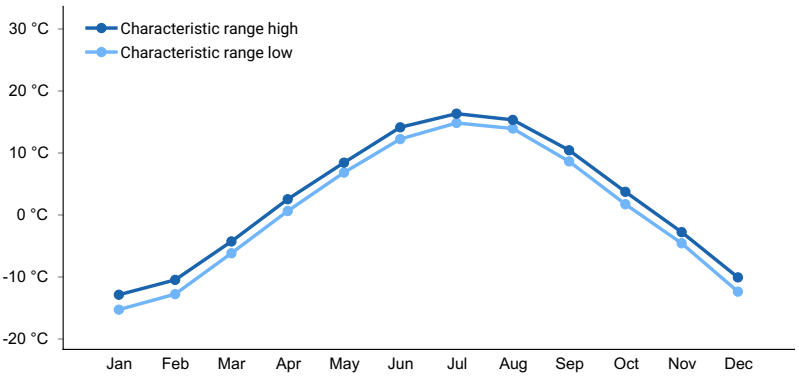


Figure 2. Monthly minimum temperature range

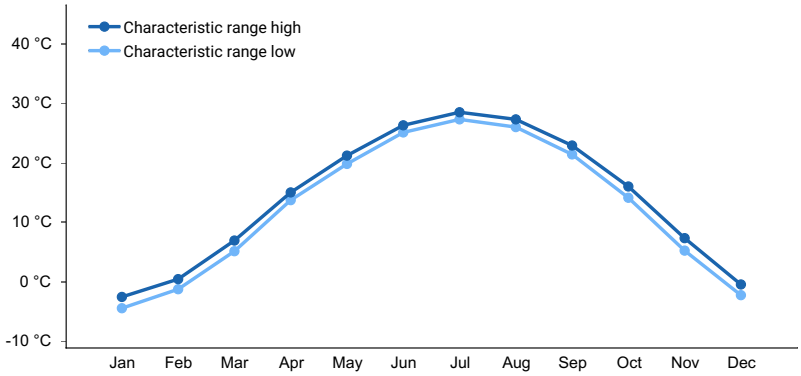


Figure 3. Monthly maximum temperature range

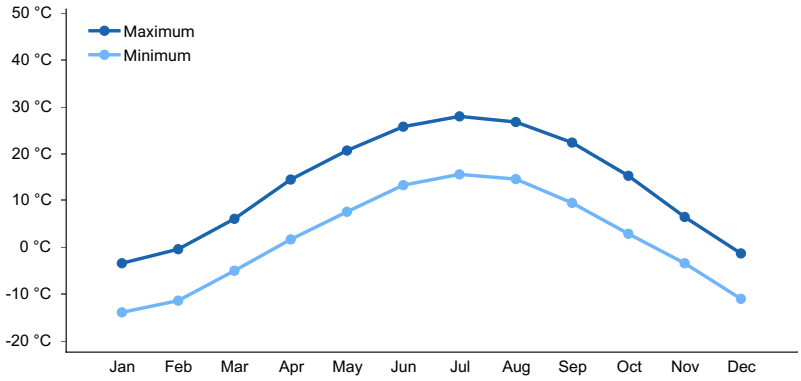


Figure 4. Monthly average minimum and maximum temperature

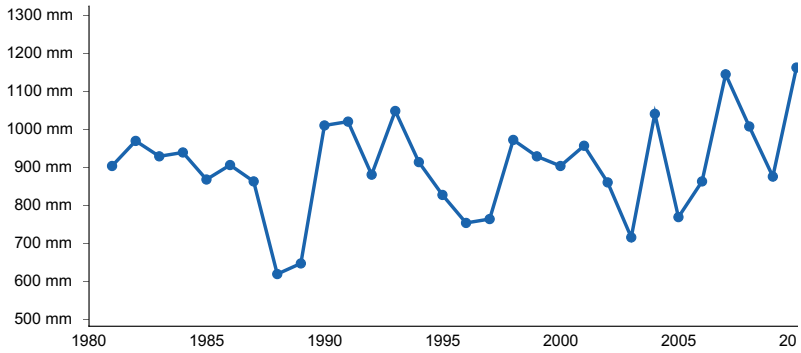


Figure 5. Annual precipitation pattern

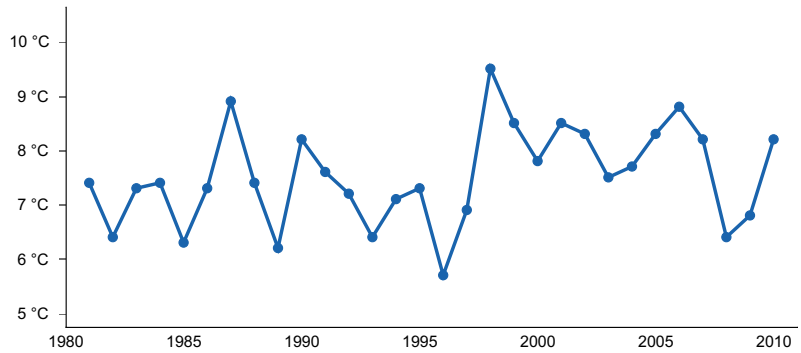


Figure 6. Annual average temperature pattern

Climate stations used

- (1) RIDGELAND 1 NNE [USC00477174], Dallas, WI
- (2) MONDOVI [USC00475563], Mondovi, WI
- (3) GAYS MILLS [USC00473022], Gays Mills, WI

- (4) AUGUSTA RS [USC00470382], Augusta, WI
- (5) LANCASTER 4 WSW [USC00474546], Bloomington, WI
- (6) PLATTEVILLE [USC00476646], Platteville, WI
- (7) DODGEVILLE [USC00472173], Dodgeville, WI
- (8) LA CROSSE WFO [USC00474373], La Crosse, WI
- (9) ARGYLE [USC00470287], Argyle, WI
- (10) DARLINGTON [USC00472001], Darlington, WI
- (11) CASHTON [USC00471280], Cashton, WI
- (12) SPARTA [USC00477997], Sparta, WI
- (13) RICHLAND CTR [USC00477158], Richland Center, WI
- (14) REEDSBURG [USC00477052], Reedsburg, WI
- (15) BLAIR [USC00470882], Blair, WI
- (16) DODGE [USC00472165], Arcadia, WI
- (17) HILLSBORO [USC00473654], Elroy, WI

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 is lost from the site primarily through runoff, evapotranspiration, and groundwater recharge.

Permeability of the soil is impermeable to moderate. The hydrologic groups for this site are B, C, B/D, and C/D.

Wetland description

Not Applicable.

Soil features

This site is represented by the Arenzville, Boaz, Chaseburg, Curran, Dells, Norwalk, Orion, Reedsburg, Sechler, Shiffer, Siouxcreek, Sooner, Stronghurst, and Vasa soil series, as well as variants of the Baraboo, Derinda, and Shiffer soil series. Udifluvents make up 84% of the acreage of this site. Most of the remaining 16% acreage is made up of Endoaqualfs, Paleudalfs, and Hapludalfs.

The soils of this site largely formed in silty or loamy alluvium deposits, sometimes underlain by sandy alluvium or sandy outwash. They also formed in silty loess deposits, sometimes underlain by clayey or loamy residuum. They sometimes have contact with the underlying bedrock, which may be composed of sandstone, shale, dolomite, or – in the Baraboo Hills – quartzite. Subsurface fragments smaller than 3 inches in diameter (gravel) may occupy up to 22 percent volume. Larger fragments may occupy up to 10 percent volume. The fragments may be composed of weathered bedrock fragments or of mixed rocks deposited by flowing water.

These soils are very strongly acid to neutral. Some may have secondary carbonates starting at 30 inches (77 cm) below the soil surface. They are somewhat poorly to moderately well drained. They do not meet hydric soil requirements.

Table 4. Representative soil features

Parent material	(1) Alluvium (2) Outwash (3) Pedisediment (4) Residuum (5) Till
Surface texture	(1) Loam (2) Silt loam (3) Sandy loam
Drainage class	Somewhat poorly drained to moderately well drained
Permeability class	Moderate

Soil depth	76–201 cm
Surface fragment cover <=3"	0–1%
Surface fragment cover >3"	0%
Available water capacity (0-150.1cm)	3.51–12.5 cm
Calcium carbonate equivalent (0-100.1cm)	0–8%
Soil reaction (1:1 water) (0-100.1cm)	4.5–7
Subsurface fragment volume <=3" (0-100.1cm)	0–22%
Subsurface fragment volume >3" (0-100.1cm)	0–10%

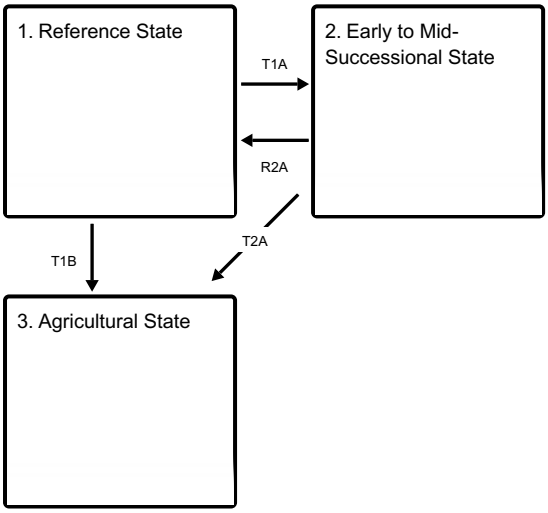
Ecological dynamics

Historically, mature forests on this ecological site were dominated by shade tolerant sugar maple and Basswood, often with an admixture of Ashes and a few Red oaks. This association was self-maintained with new cohorts of advance regeneration gaining canopy status through gaps formed by small-scale disturbances and natural mortality in the dominant canopy.

Current stands on this Ecological Site represent the entire array of potential successional stages from pure aspen, or aspen-white birch, stands to sugar maple dominated stands. Succession to sugar maple dominance is evident everywhere that seed sources are present. In the absence of sugar maple seed source these sites will be a mixture of red and white oak, red maple, hickories, and possibly elms.

State and transition model

Ecosystem states



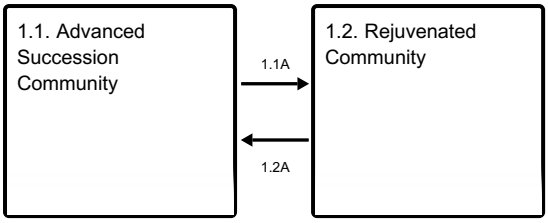
T1A - Clear cutting or stand-replacing fire.

T1B - Removal of forest vegetation and tilling.

R2A - Disturbance-free period 70+ years.

T2A - Removal of forest vegetation and tilling.

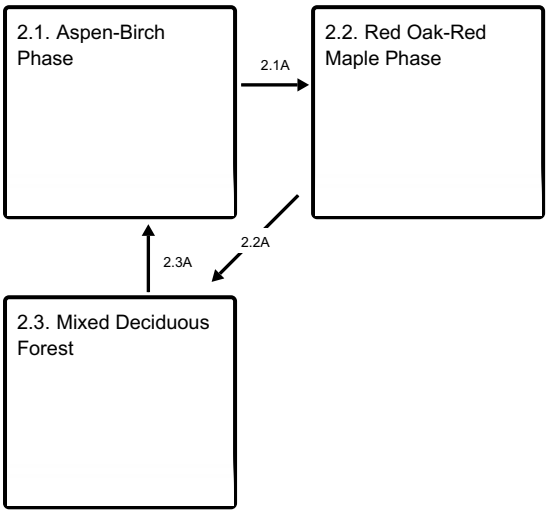
State 1 submodel, plant communities



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

1.2A - Disturbance-free period 30+ years

State 2 submodel, plant communities

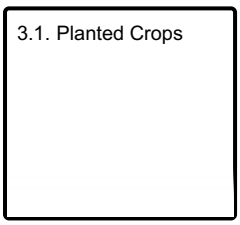


2.1A - Immigration and establishment of red oak and red maple.

2.2A - Immigration and establishment of red oak and red maple.

2.3A - Clear cutting or stand-replacing fire.

State 3 submodel, plant communities



State 1
Reference State

The reference plant community is categorized as mesic forest community dominated by mixed deciduous species, primarily sugar maple (*Acer saccharum*) and Basswood (*Tilia americana*), with sporadic occurrence of, Red oak (*Quercus rubra*), Ashes (Fraxinus spp.), and Hickories (Carya spp.). 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 Community

In the absence of major, stand-replacing disturbance this community is dominated by Sugar maple and Basswood. This was the most common condition in pre-European settlement forests, but no longer predominates. Though not dominant community members Red oak and Ashes may be present. Bitternut Hickory and Shagbark Hickory may be occasionally present. The tree sapling and shrub layer in this community is not well developed due to dense

shade created by the tree canopy. Sugar maple saplings dominate the shrub layer, but other shrubs Gooseberry and Black cherry are likely to be present. The herb layer in this phase varies greatly, but is likely to include Virginia creeper, Geraniums, and Enchanter’s nightshade. Rich site indicator plant Blue cohosh may be present. No herb layer species seems to be particularly dominant.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- American basswood (*Tilia americana*), tree
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous
- geranium (*Geranium*), other herbaceous
- enchanter's nightshade (*Circaea*), other herbaceous

Community 1.2
Rejuvenated Community

Disturbances described in Pathway 1.1A lead to increased species and structural diversity of the forest community. Depending on seed source, red oak, white oak, and red maple regenerate in the canopy openings and in time join sugar maple and Basswood in the dominant canopy. Ashes may also commonly present along with Hickories. The sparse shrub and herb layers also increase during this stage. Species composition remains relatively unchanged, but abundance changes can be significant. 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

- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), tree
- American basswood (*Tilia americana*), tree

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 shade mid-tolerant species such as red oak.

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.

State 2
Early to Mid-Successional State

Post disturbance pioneer community of aspen and paper birch with mixtures of other species from available seed sources. 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. The mid-successional phase of this state can represent and alternate stable state when seed sources for reference state dominant species are missing (particularly sugar maple).

Community 2.1
Aspen-Birch Phase

These two species have a very narrow window of environmental and ecological conditions for successful establishment. Main requirements are exposed mineral soil and elimination, most effectively by fire, of on-site seed sources of potential competing vegetation. In addition, adequate soil moisture must be available for initial seedling development. Once seedlings are firmly established, height growth of both species is relatively rapid and able to outgrow most competitive species. Paper birch seedlings and saplings tolerate partial shade and often become members of mixed species communities. This is not true for aspen which requires continuous full-sun exposure for survival. Aspen stands are initially very dense due to sprouting from extensive lateral roots, but rapid natural thinning ensues as stems compete for available light.

Dominant plant species

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

Community 2.2
Red Oak-Red Maple Phase

This community phase occurs by invading and succeeding a pioneer aspen-birch community.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree

Community 2.3
Mixed Deciduous Forest

Stand structure consists of dominant red oak and white oak in combination with a modest, or strong presence of mature, or decaying, aspen and/or paper birch. A wide variety of tree species may be present with red oak and white oak in the canopy (Sugar maple, Red maple, Black cherry, Ashes). The shrub layer typically reaches its best development in this community phase. Depending on seed source, sugar maple has become established and a young cohort exists in the sub-canopy. If sugar maple seeds are not present the site may persist in this state/phase for a long time. Potential variants of this phase may exist with other species such as black walnut.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- quaking aspen (*Populus tremuloides*), tree
- paper birch (*Betula papyrifera*), tree

Pathway 2.1A
Community 2.1 to 2.2

Immigration and establishment of red oak and red maple.

Pathway 2.2A
Community 2.2 to 2.3

Time and natural succession. Red oak and red maple have succeeded the aspen-birch community. Depending on seed source, sugar maple begins growth and establishment in the understory.

Pathway 2.3A
Community 2.3 to 2.1

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

State 3
Agricultural State

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

Community 3.1
Planted Crops

Indefinite period of applying agricultural practices. Crops likely include alfalfa, corn, soybeans, and hay or pasture.

Transition T1A

State 1 to 2

Major stand-replacing disturbance. In pre-European settlement time, the event was most often a severe blow down, sometimes followed by fires. Such blow downs have been estimated to occur in this part of Wisconsin every 300 to 400 years (Schulte and Mladenoff, 2005). In post settlement virtually every acre has been logged either by clear cutting or successive cuts targeting species marketable at that time. Post logging slash fires also have been a significant factor in most areas. These disturbances created the environment suitable for natural regeneration of many shade-intolerant species and for commercial planting.

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

A period of some 70-100 years without major stand disturbance, especially fire, leads to decreased presence, through natural mortality, of early successional species and the dominance of shade tolerant sugar maple with less tolerant associates of red oak and white ash, returning the community to Reference State.

Transition T2A
State 2 to 3

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

Additional community tables

Inventory data references

Plot and other supporting inventory data for site identification and community phases is located on a NRCS North Central Region shared and one drive folder. University of 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

Jacob Prater, Associate Professor at University of Wisconsin Stevens Point
Bryant Scharenbroch, Assistant Professor at University of Wisconsin Stevens Point
John Kotar, Ecological Specialist Independent Contractor

Approval

Suzanne Mayne-Kinney, 2/23/2024

Acknowledgments

NRCS contracted UWSP to write ecological sites in MLRA 105. 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	05/18/2024
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:**