

Ecological site R105XY007WI Moist Mollic Loamy-Clayey Lowland

Last updated: 2/23/2024
Accessed: 05/04/2024

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 area 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): This ES likely correlates to the habitat types *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, Eastern Cool Temperate Row Crop, and Eastern Cool Temperate Pasture and Hayland

WDNR Natural Communities (WDNR, 2015): This ES is most closely described as a Wet-Mesic Prairie as described by the Wisconsin DNR.

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 Mollic Loamy-Clayey Lowland site occupies approximately 54,000 acres in MLRA 105, or about 0.8% of the total land area. It can be found on loess hills, ridges, pediments, and valley sides in lower landscape positions throughout the MLRA.

This site is characterized by somewhat poorly drained, loamy to clayey soils. They have deep, dark surfaces (mollic epipedons) resulting from long-term additions of organic materials, especially from fine, fibrous roots of grassy vegetation. Historically, these sites were prairies, though modern fire suppression has resulted in the encroachment by woody species. Today, many sites are forested.

Associated sites

F105XY003WI	Wet Loamy-Clayey Floodplain These sites form in deep, loamy alluvium deposits along floodplains, especially those along smaller tributaries to the Chippewa, Black, and Wisconsin rivers. They support vegetation tolerant of seasonal flooding. They are sometimes saturated enough for hydric conditions to occur. They are sometimes found on floodplain landscapes adjacent to Moist Mollic Loamy-Clayey Lowland.
F105XY008WI	Moist Loamy-Clayey Lowland These sites form in loamy and clayey materials. They are somewhat poorly drained. They are sometimes found in similar landscape positions adjacent to Moist Mollic Loamy-Clayey Lowland.
R105XY011WI	Mollic Loamy-Silty Upland These sites form in loamy to silty materials, often silty loess and residuum. They have deep, dark surfaces. They are moderately well to somewhat excessively drained. They are often found adjacent to Moist Mollic Loamy-Clayey Lowland 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 are sometimes found adjacent to Moist Mollic Loamy-Clayey Lowland in higher landscape positions.
-------------	--

Similar sites

F105XY008WI	Moist Loamy-Clayey Lowland These sites form in loamy and clayey materials. They are somewhat poorly drained. They are very similar to Moist Mollic Loamy-Clayey Lowland but have shallower surface horizons of dark, organic-enriched soil (ochric rather than mollic 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 Mollic Loamy-Clayey Lowland but have coarser textures and a lower nutrient status.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Andropogon gerardii</i> (2) <i>Calamagrostis canadensis</i>

Physiographic features

These sites are found on loess hills, ridges, pediments, and valley sides, generally in the footslope position. Slope shape may be concave to linear. Slopes range from 0 to 6 percent. Elevation of the landform ranges from 705 to 1148 feet (215 to 350 meters) above sea level.

Some sites may be subject to rare flooding. These sites are not subject to ponding. The seasonally high water table may be found between 18 to 36 inches (46 and 92 cm) below to soil surface. Runoff potential is low to high.

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope
Slope shape across	(1) Concave
Slope shape up-down	(1) Linear
Landforms	(1) Loess hill (2) Ridge (3) Pediment (4) Valley side
Runoff class	Low to high
Flooding duration	Very brief (4 to 48 hours) to long (7 to 30 days)
Flooding frequency	None to rare
Ponding frequency	None
Elevation	705–1,148 ft
Slope	0–6%
Water table depth	18–36 in
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 MRA 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 40 inches. The annual average maximum and minimum temperatures are 57°F and 35°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	115-122 days
Freeze-free period (characteristic range)	136-150 days
Precipitation total (characteristic range)	34-37 in
Frost-free period (actual range)	107-123 days
Freeze-free period (actual range)	126-158 days
Precipitation total (actual range)	33-38 in
Frost-free period (average)	117 days
Freeze-free period (average)	144 days
Precipitation total (average)	35 in

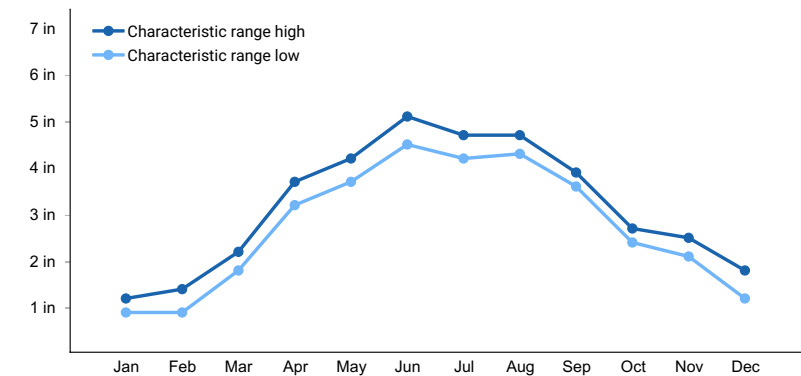


Figure 1. Monthly precipitation range

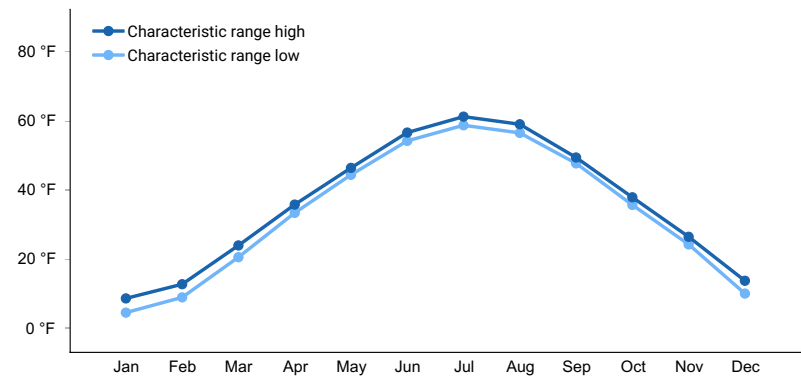


Figure 2. Monthly minimum temperature range

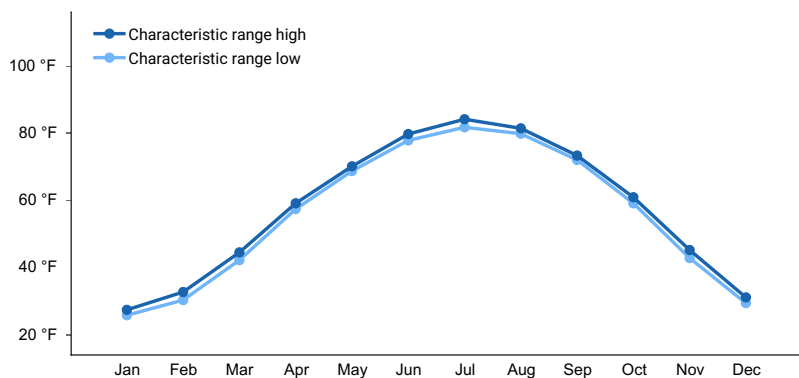


Figure 3. Monthly maximum temperature range

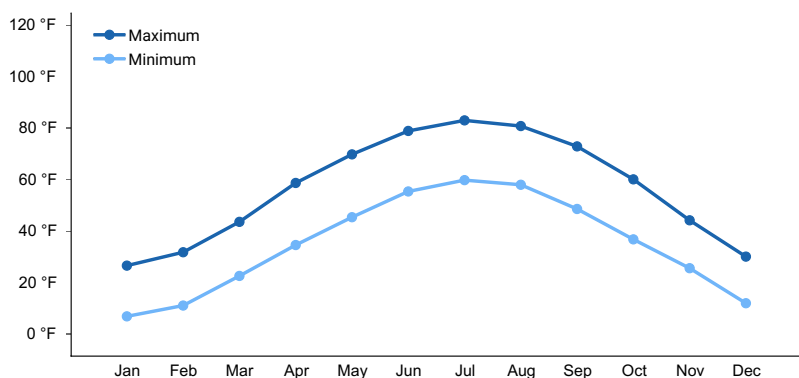


Figure 4. Monthly average minimum and maximum temperature

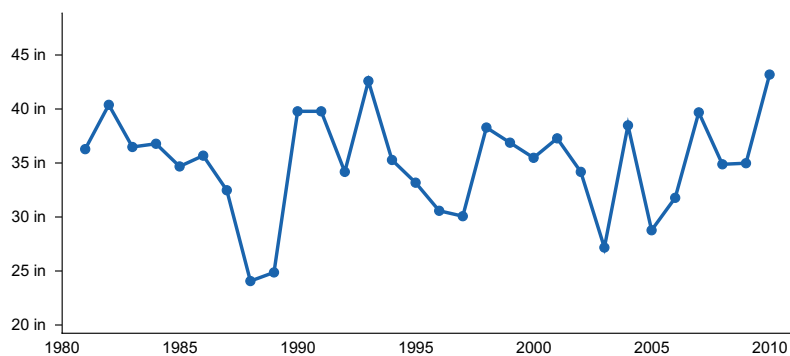


Figure 5. Annual precipitation pattern

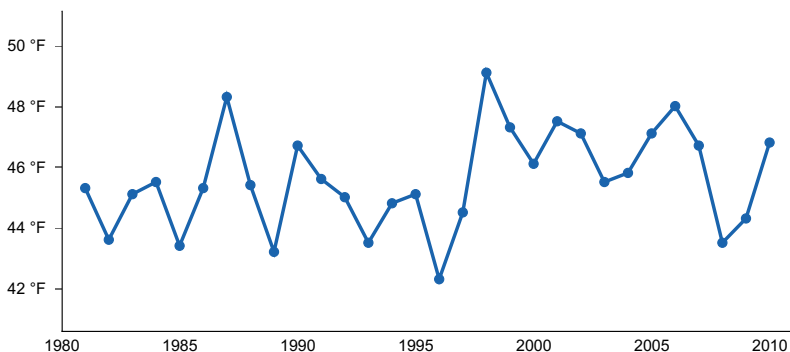


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MONDOVI [USC00475563], Mondovi, WI
- (2) MENOMONIE [USC00475335], Menomonie, WI
- (3) PLATTEVILLE [USC00476646], Platteville, WI

- (4) DODGEVILLE [USC00472173], Dodgeville, WI
- (5) ARGYLE [USC00470287], Argyle, WI
- (6) DARLINGTON [USC00472001], Darlington, WI
- (7) SPARTA [USC00477997], Sparta, WI
- (8) DURAND [USC00472279], Durand, WI
- (9) RICHLAND CTR [USC00477158], Richland Center, WI
- (10) BLAIR [USC00470882], Blair, WI
- (11) DODGE [USC00472165], Arcadia, WI
- (12) 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 moderately slow. The hydrologic groups for this site are C, A/D, and B/D.

Wetland description

Not Applicable.

Soil features

This site is represented by the Bearpen, Hoop, Hoopeston, Lawson, Muscatine, and Rowley soil series, and by variants of the Schapville and Dakota soil series. About half of the acreage of this site is made up of Aquic Argjudolls. Aquic Cumulic Hapludolls and Aquic Hapludolls make up the remaining half.

These soils formed in loamy and silty deposits of loess, alluvium, and outwash. They’re sometimes underlain by sandy alluvium, sandy outwash, or clayey residuum weathered from shale. In some sites south of the Wisconsin River, contact with shale bedrock may be found as high as 40 inches (102 cm) from the soil surface. Soils may have subsurface fragments composed of rocks deposited by flowing water or of weathered bedrock fragments. These soils are somewhat poorly drained and do not meet hydric soil requirements.

These soils contain dark surface horizons rich in base-forming cations (mollic epipedon). About half of the sites have a subsurface horizon of accumulated clay (argillic horizon). They are strongly acid to slightly alkaline. Some have secondary carbonates as high as 30 inches (76 cm) from the surface, especially in south of the Wisconsin River where dolomitic bedrock is common.



Figure 7. Lawson soil series sampled on 08/05/2020 in Iowa County, WI.

Table 4. Representative soil features

Parent material	(1) Alluvium (2) Loess (3) Residuum
Surface texture	(1) Loam (2) Silt loam (3) Sandy loam
Drainage class	Somewhat poorly drained
Permeability class	Moderately slow
Soil depth	40–79 in
Surface fragment cover <=3"	0–3%
Surface fragment cover >3"	0–3%
Available water capacity (0-59.1in)	2.15–4.89 in
Calcium carbonate equivalent (0-39.4in)	0–8%
Soil reaction (1:1 water) (0-39.4in)	5.3–7.5
Subsurface fragment volume <=3" (0-39.4in)	0–10%
Subsurface fragment volume >3" (0-39.4in)	0–3%

Ecological dynamics

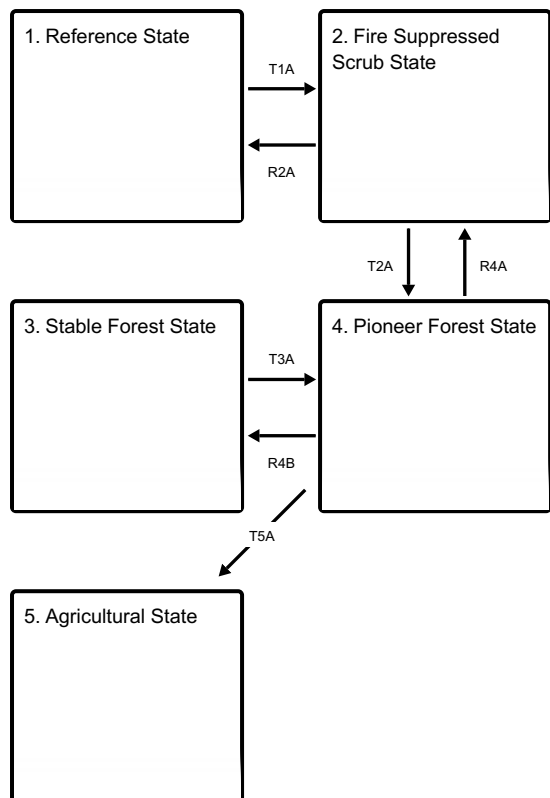
In pre-European settlement time wildfire was the main controlling factor of range and forest community dynamics. Some areas had been persistent in grasslands, but had the capacity to support both grassland and forest depending on the frequency and intensity of fire and the presence of large grazers. Shorter fire return intervals led to grasslands, intermediate fire return intervals to scrub, and long fire return intervals to forest. Any scrub or forest community was dependent on the presence of adjacent seed source. Many of the previous grasslands have been converted to agriculture or have reverted to forest following fire suppression.

Forest communities can be described thusly, 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.

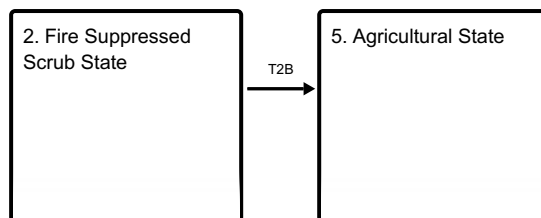
Current stands on this Ecological Site represent the entire array of potential successional stages from pure aspen, or aspen-white birch, stands to sugar maple dominated stands. Succession to sugar maple dominance is evident everywhere that seed sources are present. In the absence of sugar maple seed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

State and transition model

Ecosystem states



States 2 and 5 (additional transitions)



T1A - Suppression of fire

R2A - Return of fire and/or large grazers to the landscape.

T2A - Continued fire suppression for over 20 years

T2B - Removal of forest/shrub cover and tilling for agricultural crop production.

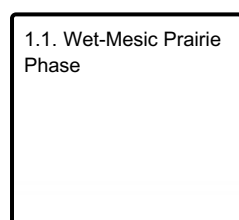
T3A - Cutting, fire, or blowdown removing existing tree canopy.

R4A - Low intensity moderate return interval fire removing fire intolerant species and regeneration

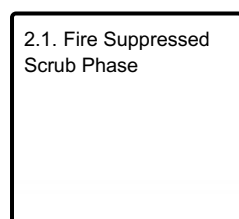
R4B - Deciduous forest community is slowly invaded by conifers.

T5A - Removal of forest/shrub cover and tilling for agricultural crop production.

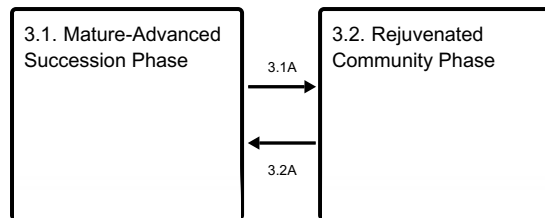
State 1 submodel, plant communities



State 2 submodel, plant communities



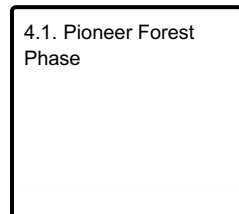
State 3 submodel, plant communities



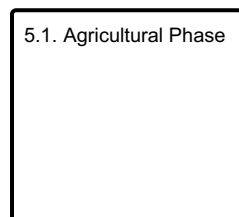
3.1A - Light to moderate intensity fires, blow-downs, ice storms.

3.2A - Disturbance-free period for 30+ years.

State 4 submodel, plant communities



State 5 submodel, plant communities



State 1 Reference State

The Reference State is a grassland state dominated by tall grasses including big bluestem, Canada blue joint, and sedges with a mixture of forbs including goldenrods. The reference state for this ES is very rare today and was maintained by frequent fire removing the encroachment of tree and shrub species.

Community 1.1 Wet-Mesic Prairie Phase



The Wet-Mesic Prairie Phase is a grassland state dominated by tall grasses including big bluestem, Canada blue joint, Sedges and others with a mixture of forbs including goldenrods. This phase is very rare today.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass

- bluejoint (*Calamagrostis canadensis*), grass
- sedge (*Carex*), grass
- goldenrod (*Solidago*), other herbaceous

State 2

Fire Suppressed Scrub State

A mostly open grassland with sporadic shrubs and trees. As soon as fire is suppressed tree and shrub species invade this ES and various tree and shrub species may take hold resulting in a grassland with sparse and sporadic tree and shrub cover.

Community 2.1

Fire Suppressed Scrub Phase

Fire Suppressed Scrub is a tree and shrub invaded grassland. The grassland species are similar to the reference state with the addition of various species of tree or shrub beginning to create a sparse canopy.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- red maple (*Acer rubrum*), tree
- oak (*Quercus*), tree
- pine (*Pinus*), tree
- big bluestem (*Andropogon gerardii*), grass
- bluejoint (*Calamagrostis canadensis*), grass
- sedge (*Carex*), grass

State 3

Stable Forest State

Stable Forest state 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: a mature phase and a rejuvenated phase.

Community 3.1

Mature-Advanced Succession Phase

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
- basswood (*Tilia*), tree
- gooseberry currant (*Ribes montigenum*), shrub
- black cherry (*Prunus serotina*), shrub
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous
- enchanter's nightshade (*Circaea*), other herbaceous
- geranium (*Geranium*), other herbaceous

Community 3.2

Rejuvenated Community Phase

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

- sugar maple (*Acer saccharum*), tree
- American basswood (*Tilia americana*), tree
- gooseberry currant (*Ribes montigenum*), shrub
- black cherry (*Prunus serotina*), shrub
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous
- enchanter's nightshade (*Circaea*), other herbaceous
- geranium (*Geranium*), other herbaceous

Pathway 3.1A

Community 3.1 to 3.2

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 3.2A

Community 3.2 to 3.1

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 4

Pioneer Forest 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 4.1

Pioneer Forest Phase

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
- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), shrub
- black cherry (*Prunus serotina*), shrub

- ash (*Fraxinus*), shrub
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

State 5

Agricultural State

Indefinite period of applying agricultural practices varying from crops to pasture or hay.

Community 5.1

Agricultural Phase



Indefinite period of applying agricultural practices. Crops likely include alfalfa, corn, soybeans, and hay or pasture. It is possible that some areas have been abandoned, but persist in a domesticated grassland condition having been previously pasture or hay ground.

Transition T1A

State 1 to 2

Suppression of fire leading to the encroachment of wood species. Continued suppression for 10+ years required for the establishment of woody species.

Restoration pathway R2A

State 2 to 1

Reintroduction of fire causing the mortality of encroaching trees and shrubs. This fire must then return at relatively short intervals to continue to suppress the growth of woody vegetation.

Transition T2A

State 2 to 4

Continued fire suppression for several decades will lead to a dominant woody cover on the site.

Transition T2B

State 2 to 5

Removal of forest cover and tilling for agricultural crop production

Transition T3A

State 3 to 4

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.

Restoration pathway R4A

State 4 to 2

Reintroduction of low intensity fire that kills fire intolerant species and most regeneration.

Restoration pathway R4B

State 4 to 3

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.

Transition T5A

State 4 to 5

Removal of forest/shrub cover and tilling for agricultural crop production.

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, Relevé Method, NASIS pedon description, NRCS SOI 036, photographs, and Kotar Habitat Types.

Other references

Cleland, D.T.; Avers, P.E.; McNab, W.H.; Jensen, M.E.; Bailey, R.G., King, T.; Russell, W.E. 1997. National Hierarchical Framework of Ecological Units. Published in, Boyce, M. S.; Haney, A., ed. 1997. Ecosystem Management Applications for Sustainable Forest and Wildlife Resources. Yale University Press, New Haven, CT. pp. 181-200.

County Soil Surveys from St. Croix, Polk, Barron, Rusk, Chippewa, Clark, Marathon, Taylor, Price, Sawyer, Burnett, Washburn, Douglas, Bayfield, Ashland, Lincoln, Oneida, Langlade, Shawano, Menominee, Forest, Florence, Marinette, and Pierce Counties.

Curtis, J.T. 1959. Vegetation of Wisconsin: an ordination of plant communities. University of Wisconsin Press, Madison. 657 pp.

Davis, R.B. 2016. Bogs and Fens, A Guide to the Peatland Plants of Northeastern United States and Adjacent Canada. University Press of New England, Hanover and London. 296 pp.

Finley, R. 1976. Original vegetation of Wisconsin. Map compiled from U.S. General Land Office notes. U.S. Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Hvizdak, David. Personal knowledge and field experience.

Jahnke, J. and Giencke, A. 2002. MLRA 92 Clay Till Field Investigations. Summary of field day investigations by Region 10 Soil Data Quality Specialists.

Kotar, J. 1986. Soil – Habitat Type relationships in Michigan and Wisconsin. J. For. and Water Cons. 41(5): 348-350.

Kotar, J., J.A. Kovach and G. Brand. 1999. Analysis of the 1996 Wisconsin Forest Statistics by Habitat Type. U.S.D.A. For. Serv. N.C. Res. Stn. Gen. Tech. Rept. NC-207.

Kotar, J. and T. L. Burger. 1996. A Guide to Forest Communities and Habitat Types of Central and Southern

Wisconsin. University of Wisconsin-Madison, Department of Forest Ecology and Management, Madison.

Kotar, J., and T. L. Burger. 2017. Wetland Forest Habitat Type Classification System for Northern Wisconsin: A Guide for Land Managers and landowners. Wisconsin Department of Natural Resources, PUB-FR-627 2017, Madison.

Martin, L. 1965. The physical geography of Wisconsin. Third edition. The University of Wisconsin Press, Madison.

McNab, W.H. and P.W. Avers. 1994. Ecological Subregions of the United States: Section Descriptions. USDA For. Serv. Pub. WO-WSA-5, Washington, D.C.

NatureServe. 2018. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 28 August 2018.

Radeloff, V.C., D.J. Mladenoff, H.S. He and M.S. Boyce. 1999. Forest landscape change in Northwestern Wisconsin Pine Barrens from pre-European settlement to the present. Can. J. For. Res. 29: 1649-1659.

Schulte, L.A., and D.J. Mladenoff. 2001. The original U.S. public land survey records: their use and limitations in reconstructing pre-European settlement vegetation. Journal of Forestry 99:5–10.

Schulte, L.A., and D.J. Mladenoff. 2005. Severe wind and fire regimes in northern forests: historical variability at the regional scale. Ecology 86(2):431–445.

Soil Survey Staff. Input based on personal experience. Tim Miland, Scott Eversoll, Ryan Bevernitz, and Jason Nemecek.

Stearns, F. W. 1949. Ninety years change in a northern hardwood forest in Wisconsin. Ecology, 30: 350-58.

United States Department of Agriculture, Forest Service. 1989. Proceedings – Land Classification Based on Vegetation: Applications for Management. Gen. Tech. Report INT-527.

United States Department of Agriculture, Forest Service. 1990. Silvics of North America, Vol. 1, Hardwoods. Agricultural Handbook 654, Washington, D.C.

United States Department of Agriculture, Forest Service. 1990. Silvics of North America, Vol. 2, Conifers. Agricultural Handbook 654, Washington, D.C.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

United States Department of Agriculture, Natural Resources Conservation Service. 2008. Hydrogeomorphic Wetland Classification System: An Overview and Modification to Better Meet the Needs of the Natural Resources Conservation Service. Technical Note No. 190-8-76. Washington D.C.

Wilde, S.A. 1933. The relation of soil and forest vegetation of the Lake States Region. Ecology 14: 94-105.

Wilde, S.A. 1976. Woodlands of Wisconsin. University of Wisconsin Cooperative Extension, Pub. G2780, 150 pp.

Wisconsin Department of Natural Resources. 2015. The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management. Wisconsin Department of Natural Resources, PUB-SS-1131 2015, Madison.

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	05/04/2024
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:**
-