Ecological site F090AY007WI
Wet Clayey Lowlands

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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: Bayfield Sand Plains (212Ka), Rib Mountain Rolling Ridges (212Qd) Small sections occur in St. Croix Moraine (212Qa) and Mille Lacs Uplands (212Kb) Wisconsin DNR Ecological Landscapes: Northwest Sands, Forest Transition, Northwest Lowlands, North Central Forest

Ecological site concept

The Wet Clayey Lowlands ecological site is uncommon in MLRA 90A, located in depressions and drainageways on lake plains and moraines. These sites are characterized by very deep, very poorly or poorly drained soils that formed primarily in clayey lacustrine, till, and residuum. Sites are subject to frequent ponding during the spring and fall. Soils remain saturated for long periods during the growing season and meet hydric soil requirements. Precipitation, runoff from adjacent uplands, and groundwater discharge are the primary sources of water. Soils range from very strongly acid to moderately alkaline. Wet Clayey Lowlands is differentiated from other ecological sites by its deep clayey deposits and very poorly or poorly drained soils. Other very poorly or poorly drained sites have sandy or loamy deposits. Clays often have higher pH and available water capacity than sandy and loamy sites, which can promote vegetative growth.

Associated sites

F090AY012WI	**Moist Clayey Lowland** Moist Clayey Lowland consist of deep clayey lacustrine deposits. The finer textures perch the water table. These soils remain moist - but not saturated - throughout much of the growing season. They are drier and occur higher on the drainage sequence than Wet Clayey Lowland.
F090AY017WI	**Clayey Upland** Loamy 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 Wet Clayey Lowland.

Similar sites

F090AY006WI	**Wet Loamy Lowland** Wet Loamy Lowland consist primarily of deep loamy deposits derived from a mixture of outwash, alluvium, loess, and lacustrine sources. Some sites may have bedrock contact within two meters of the surface. These sites are seasonally ponded depressions that remain saturated for sustained periods, allowing hydric conditions to occur. They occur in similar landscape positions and have similar drainage as Wet Clayey Lowland, though with coarser particle sizes. The vegetative communities they support are similar to those found on Wet Clayey Lowland.

Table 1. Dominant plant species

Tree	(1) *Fraxinus nigra* (2) *Quercus bicolor*
Shrub	(1) *Fraxinus pennsylvanica*
Herbaceous	(1) *Oligoneuron* (2) *Carex*

Physiographic features

This site occurs in depressions and drainageways on lake plains and moraines. Slopes range from 0 to 2 percent.

Some sites are subject to occasional ponding throughout the year. The ponding duration ranges from brief (2 to 7 days) to long (7 to 30 days), with depths up to 6 inches above the soil surface. These sites do not flood. The soils have an apparent seasonally high water table (endosaturation) at the surface, but the water table may drop to 35 inches during dry conditions. Some sites have a perched seasonally high water table (episaturation). Runoff is negligible to very high.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope (2) Footslope
Slope shape across	(1) Concave
Slope shape up-down	(1) Linear
Landforms	(1) Depression (2) Drainageway (3) Lake plain (4) Moraine
Runoff class	Negligible to very high
Flooding frequency	None
Ponding duration	Brief (2 to 7 days) to long (7 to 30 days)
Ponding frequency	None to occasional
Elevation	180 – 340 m
Slope	0 %
Ponding depth	0 – 20 cm
Water table depth	0 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 29 inches. The annual average maximum and minimum temperatures are 53°F and 34°F, respectively.

Table 3 Representative climatic features

Frost-free period (characteristic range)	70-120 days
Freeze-free period (characteristic range)	100-140 days
Precipitation total (characteristic range)	810-890 mm
Frost-free period (actual range)	40-120 days
Freeze-free period (actual range)	90-140 days
Precipitation total (actual range)	810-940 mm
Frost-free period (average)	90 days
Freeze-free period (average)	120 days
Precipitation total (average)	860 mm

- (1) LUCK [USC00474894], Luck, WI
- (2) AMERY [USC00470175], Amery, WI
- (3) COUDERAY 7 W [USC00471847], Stone Lake, 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 leaves the site primarily through evapotranspiration and groundwater recharge. These sites are wetlands.

Wetland description

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

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

Permeability of the soils are impermeable to very slow.
Hydrologic Group: D, C/D
Hydrogeomorphic Wetland Classification: Depressional, forested/organic; Depressional, scrub-shrub/organic
Cowardin Wetland Classification: PFO1B, PSS1B, PEM1B

Soil features

These sites are represented by Altdorf, Indus, and Wildwood soil series. Altdorf is classified as an Aeric Glossaqualf, Indus is a Vertic Epiaqualf, and Wildwood is a Histic Humaquept.

These soils formed in various parent materials including silty alluvium, loamy or clayey residuum, loess, loamy or clayey till, and clayey lacustrine. Soils are very deep. Sites are very poorly or poorly drained and remain saturated for much of the growing season. They meet hydric soil requirements.

The surface of these sites is often muck, mucky silt loam, silt loam, or clay loam. Subsurface horizons include clay loam, silt loam, silty clay, and clay textures. Soil pH ranges from very strongly acid to moderately alkaline with values of 4.6 to 7.9. This range occurs because some sites have carbonates present beginning at 25 inches and can have up to 18 percent calcium carbonates. Fragments are typically absent, but subsurface fragments less than 3 inches can be present up to 3 percent in the profile.

Figure 7. Wildwood 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 (2) Till (3) Organic material (4) Eolian deposits (5) Metamorphic rock
Surface texture	(1) Mucky silt loam (2) Mucky clay
Drainage class	Very poorly drained to poorly drained
Permeability class	Very slow
Soil depth	200 – 250 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-154.9cm)	5.92 – 9.98 cm
Calcium carbonate equivalent (0-100.1cm)	0 – 20 %

Soil reaction (1:1 water) (0-100.1cm)	4.6 – 7.9
Subsurface fragment volume <=3" (Depth not specified)	Not specified
Subsurface fragment volume >3" (Depth not specified)	Not specified

Ecological dynamics

Because of the poorly drained soils, the historic fire disturbance has likely been less frequent and less severe than on the better drained sites. These forested wetlands are dominated by black ash (Fraxinus nigra) with other hardwood associates such as swamp white oak (Quercus bicolor) and slippery elm (Ulmus rubra). Trembling aspen (Populus trembuloides) is common on many sites, but cannot compete with other hardwoods that are more tolerant of shade and moisture. This community relies heavily on soil moisture and nutrient regimes. These sites can support more nutrient demanding species, and the plants must tolerate seasonal ponding. During the driest months, standing water drains, but soils remain saturated throughout the growing season. Tree species often rely on the pit-and-mound microtopography to remain above the oversaturated rooting zones to avoid prolonged anaerobic conditions. Pit-and-mound topography is caused by tree species that have shallow roots and tip from windthrow. Seasonal ponding prevents other shade-tolerant species such as sugar maple from becoming competitive on these sites.

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 7. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 8. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 9. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

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. Wetland Forest Habitat Type Classification System for Northern Wisconsin (Kotar and Burger, 2017): The sites of this ES keyed out to two main habitat type (due to MLRA spanning several habitat type regions others are included here as likely in the PESD): Fraxinus nigra-Acer rubrum/Impatiens (FnArI); Fraxinus nigra-Acer rubrum/Impatiens-Ilex variant (FnArI-Ix); Fraxinus nigra/Onoclea (FnOn); Fraxinus nigra-Abies balsamea-Acer rubrum/Onoclea (FnAbArOn); Abies balsamea-Fraxinus nigra-Thuja/Ilex (AbFnThIx); Acer rubrum-Fraxinus nigra/Rubus hispidus (ArFnRh) Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Northern Hardwoods Forest, Eastern Cool Temperate Close Grown Crop, and Eastern Cool Temperate Pasture and Hayland WDNR Natural Communities (WDNR, 2015):

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 Gienccke, 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., J. A. Kovach, and T. L. Burger. 2002. A Guide to Forest Communities and Habitat Types of Northern Wisconsin. Second edition. 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. Pun. WO-WSA-5, Washington, D.C.

NatureServe. 2018. International Ecological Classification Satandard: Terrestrial Ecological Classifications. NautreServe Centreal 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. 2022. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture, 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.

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Approval

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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	08/30/2026
Approved by	
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:**