

Ecological site F091XY012WI

Loamy Upland

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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): 091X–Wisconsin and Minnesota Sandy Outwash

The Wisconsin and Minnesota Sandy Outwash MLRA is the most extensive glacial outwash system in the northern half of Wisconsin. The total land area of the Wisconsin portion is just under 1.4 million acres (2,170 sq miles). The northern half is a former spillway for Glacial Lake Duluth. The flowing meltwater from the draining lake has left behind thick deposits of drift and carved a terraced river valley now occupied by the St. Croix and Bois Brule Rivers. The northeastern section – the Bayfield hills – is a collapsed outwash plain where drift deposits are thick. Lacustrine materials from Glacial Lake Duluth line the northeastern tip. Moving southwest, the landscape transitions into a large pitted outwash plain. This is an area of extensive kettle holes, and, where the underlying till is less permeable, kettle lakes with some interspersed morainic hills and ridges. The glacial drift deposits are thinner in the southwestern section, although there is still no documented surface bedrock within this MLRA. The St. Croix and Bois Brule rivers share a channel that lines much of the northwestern border of this MLRA. In some places, the underlying reddish-brown sandy loam till of the Copper Falls Formation is exposed along cut riverbanks, though most of it is covered by a mantle of outwash. Glacial lakes deposited pockets of fine-textured lacustrine materials, most of which were washed away or buried by glacial outwash and meltwater flowing through the channel. East of the channel, some of the silty and clayey lakebed deposits are found near the surface, where they impede drainage and contribute to the formation of extensive wetlands. Historically, the area supported extensive jack pine (*Pinus banksiana*), scrub, and oak forests and barrens. The northern portion also supported stands of red pine (*Pinus resinosa*) and eastern white pine (*Pinus strobus*) as well. Marsh and sedge meadow, wet prairies, and lowland shrubs dominated the extensive wetland complexes in the southern tip of this MLRA (Finley, R., 1976).

Classification relationships

Relationship to Established Framework and Classification Systems: Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Northern Hardwoods Forest, Boreal Aspen-Birch Forest, and Eastern Cool Temperate Row Crop Habitat Types of N. Wisconsin (Kotar, 2002): The sites of this ES keyed out to two habitat types: *Pinus strobus*-*Acer rubrum*/*Vaccinium*-*Amphicarpa* (PARVAm); *Acer saccharum*/*Athyrium* (AAt) WDNR Natural Communities (WDNR, 2015): This ES is most similar to the Northern Mesic Forest community. Hierarchical Framework Relationships: Major Land Resource Area (MLRA): Wisconsin and Minnesota Sandy Outwash (91X) USFS Subregions: Mille Lacs Uplands (212Kb) Small sections occur in the Bayfield Sand Plains (212Ka) subregion Wisconsin DNR Ecological Landscapes: Northwest Lowlands, Northwest Sands

Ecological site concept

The Loamy Uplands ecological site is found most commonly on the northwest border of MLRA 91X near the St. Croix River on outwash, lake, and till plains, moraines, stream terraces, hillslopes, and river valleys. These sites are characterized by moderately deep to very deep, moderately well to well drained soils formed in loamy deposits. Some sites have a sandy mantle or are underlain by sandy outwash. Precipitation and runoff are the primary sources of water. Soils range from very strongly acid to slightly alkaline. Historically, this Ecological Site was occupied by forest communities dominated by various mixtures of pine and oak species. Specific mixtures were largely dependent on frequency and severity of disturbances, particularly fire and subsequent seed-bed conditions and availability of seed sources. White pine (*Pinus strobus*) was the most persistent species in forest communities due to its biological and ecological characteristics of great longevity, resistance of old trees to fire damage and moderate tolerance to shade by seedlings and saplings. Red oak (*Quercus rubra*) and white oak (*Q. alba*) were often present as associate species. Virtually all stands on this Ecological Site were harvested during the late 19th and early 20th centuries and post-logging fires were almost universal. Today's forests are dominated by any mixture of, aspen, red oak, white oak, red maple (*Acer rubrum*) and white pine. Red pine (*Pinus resinosa*) plantations also are common. In some stands there is sporadic occurrence of species typical of mesic communities, such as ironwood (*Ostrya virginiana*), basswood (*Tilia americana*), ashes (*Fraxinus* spp.) and sugar maple (*Acer saccharum*), indicating that this ES represents a transition on the soil moisture/nutrient gradient from Dry to Dry-Mesic Forest Habitat Types. Loamy Uplands differ from sandy and clayey uplands

based on its loamy textures. Loamy textures have a higher pH and available water capacity than sandy materials, but lower than clay materials. The moderately well and well drainage differs Loamy Uplands from other loamy sites.

Associated sites

<p>F091XY005WI</p>	<p>Wet Sandy and Loamy Lowland</p> <p>These sites occur on depressions and drainageways on outwash plains and lake plains. They primarily form in sandy outwash are subject to some flooding. Soils are very deep and poorly or very poorly drained. They are saturated for much of the year. They are much wetter and occur lower on the drainage sequence than Lamy Uplands.</p>
<p>F091XY007WI</p>	<p>Moist Sandy and Loamy Lowland</p> <p>These soils formed in sandy outwash, sandy lacustrine deposits, sandy eolian deposits, or loess that is sometimes underlain by sandy or loamy till. Soils are very deep and somewhat poorly drained. They are wetter and occur lower on the drainage sequence than Loamy Uplands.</p>

Similar sites

<p>F091XY004WI</p>	<p>Terrace</p> <p>These sites occur on stream and strath terraces. They are defined by their landforms, not by particle size class or drainage class. These sites were once floodplains but are no longer subject to frequent flooding. Terrace sites with loamy particle size classes and good drainage will support vegetative communities similar to those of Loamy Uplands.</p>
<p>F091XY011WI</p>	<p>Sandy Upland</p> <p>These soils formed primarily in sandy outwash or sandy eolian deposits, but some sites formed in sandy lacustrine or loamy alluvium underlain by sandy outwash. They occupy similar landscape positions as Loamy Uplands and are also moderately well to somewhat excessively drained. Sandy Uplands have coarser particle size classes. This difference is reflected in the vegetative communities, with Loamy Uplands supporting communities with higher nutrient requirements.</p>
<p>F091XY013WI</p>	<p>Clayey Upland</p> <p>These sites form in clayey lacustrine deposits, often with a sandy or loamy mantle. They occupy similar landscape positions as Loamy Uplands and are also moderately well to somewhat excessively drained. Clayey Uplands have finer particle size classes. The two sites can support similar vegetative communities.</p>

Table 1. Dominant plant species

<p>Tree</p>	<p>(1) <i>Quercus rubra</i> (2) <i>Acer rubrum</i></p>
<p>Shrub</p>	<p>(1) <i>Corylus</i></p>
<p>Herbaceous</p>	<p>(1) <i>Eurybia macrophylla</i> (2) <i>Amphicarpaea bracteata</i></p>

Physiographic features

These sites formed on outwash, lake, and till plains, moraines, and stream terraces. Slopes range from 0 to 45 percent. Sites are on summit, shoulder, and backslope positions.

These sites are not subject to ponding or flooding. Some sites have a perched seasonally high water table (episaturation), while the others have an apparent water table (endosaturation). The depth to seasonally high water tables for these sites ranges from 24 to 42 inches but the water table can drop to greater than 60 inches during dry conditions. Runoff ranges from negligible to high.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Shoulder (3) Shoulder
Slope shape up-down	(1) Convex
Slope shape across	(1) Linear
Landforms	(1) Outwash plain (2) Lake plain (3) Till plain (4) Moraine (5) Stream terrace
Runoff class	Negligible to high
Flooding frequency	None
Ponding frequency	None
Elevation	200 – 610 m
Slope	0 – 50 %
Water table depth	60 – 110 cm

Climatic features

The continental climate of the Wisconsin and Minnesota Sandy Outwash MLRA is typical of northern Wisconsin – colder winters and warmer summers. In general, the northern latitudes have cooler summers, colder winters, lower precipitation, and shorter growing seasons than the south; however, neither average annual precipitation nor average annual minimum and maximum temperatures vary greatly within this MLRA. The climate of the northernmost tip is somewhat affected by Lake Superior and receives higher annual precipitation in the form of lake effect snow.

The average annual precipitation for this site is 31 inches. The average annual snowfall is 51 inches. The average annual maximum and

minimum temperatures are 53°F and 32°F, respectively.

Table 3 Representative climatic features

Frost-free period (characteristic range)	90-110 days
Freeze-free period (characteristic range)	120-140 days
Precipitation total (characteristic range)	740-810 mm
Frost-free period (actual range)	80-120 days
Freeze-free period (actual range)	110-140 days
Precipitation total (actual range)	740-810 mm
Frost-free period (average)	100 days
Freeze-free period (average)	130 days
Precipitation total (average)	790 mm

- (1) DANBURY [USC00471978], Danbury, WI
- (2) MINONG 5 WSW [USC00475525], Minong, WI
- (3) GORDON [USC00473186], Gordon, WI
- (4) GRANTSBURG [USW00014995], Grantsburg, WI

Influencing water features

Water is received primarily through precipitation, runoff from adjacent uplands, and groundwater discharge. Water is discharged from the site primarily through runoff, evapotranspiration, and groundwater recharge.

Permeability of these sites is impermeable to moderately slow.
Hydrologic group is A, B, or C.

Wetland description

Hydrogeomorphic Wetland Classification: None
Cowardin Wetland Classification: None

Soil features

These sites are represented by the Aftad, Amery, Braham, Branstad, Chetek, Crystal Lake, Cutaway, Haugen, Haustrup, Lundeen, Milaca, Padus, Pierz, Pomroy, Rosholt, and Scott Lake soil series. Aftad, Branstad, Crystal Lake, Milaca, and Scott Lake series are all classified as Oxyaquic Glossudalfs; Amery and Rosholt are Haplic Glossudalfs; Braham is an Arenic Hapludalf; Chetek is an Inceptic Hapludalf; Cutaway is an Oxyaquic Hapludalf; Haugen is an Oxyaquic Paludalf; Haustrup is a Humic Lithic Dystrudept; Lundeen is a Humic Dystrudept; Padus is an Alfic Haplorthod; Pierz is a Typic Argiudoll; and Pomroy is an Arenic Oxyaquic Hapludalf.

These soils formed in loamy lacustrine, loamy alluvium, loamy till, sandy outwash, sandy eolian, or loess deposits. Some sites have

underlying lacustrine deposits, till, or basalt bedrock. Soil depth ranges from 16 to over 80 inches. Drainage class is moderately well to well drained. Soils do not meet hydric soil requirements.

Surface textures of these sites are primarily loamy sand, sandy loam, and silt loams. Some have fine and very fine modifiers. Subsurface textures include loam, sandy loam, silt loam, clay loam, sandy clay loam, and loamy sand. Some have fine or gravelly modifiers. Soil pH ranges from very extremely acid to slightly alkaline with values of 4.4 to 7.6. Carbonates are mostly absent, but can be present up to 1 percent beginning at 35 inches.

Figure 7. Pomroy Soil Series sampled on 07/23/2019 in Burnett County, WI.

Table 4. Representative soil features

Parent material	(1) Outwash (2) Eolian sands (3) Loess (4) Lacustrine deposits (5) Alluvium (6) Glaciofluvial deposits (7) Basalt
Surface texture	(1) Loamy sand (2) Sandy loam (3) Silt loam
Drainage class	Moderately well drained to well drained
Permeability class	Very slow to moderately slow
Soil depth	40 – 200 cm
Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	Not specified
Available water capacity (0-152.4cm)	3.43 – 12.27 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified

Soil reaction (1:1 water) (0-101.6cm)	4.4 – 7.6
Subsurface fragment volume <=3" (0-101.6cm)	0 – 30 %
Subsurface fragment volume >3" (0-101.6cm)	0 – 10 %

Ecological dynamics

Perhaps the most important ecological characteristic of this Ecological Site, in terms of influence on forest community dynamics, is its limited capacity to support the high to moderate soil moisture and nutrient requiring species such as sugar maple (*Acer saccharum*), basswood (*Tilia americana*) and white ash (*Fraxinus Americana*). These are the shade-tolerant species, commonly known as the northern hardwoods, that typically dominate the more productive sites throughout northern Wisconsin. Although some of these species do occur sporadically on this Ecological Site, their regeneration capacity and growth rates are sub-optimal, thus limiting their attainment of canopy dominance.

In pre-European settlement time wild fire was the main controlling factor of forest community dynamics. Following a severe, stand-replacing fire, any of the naturally occurring species could become established, depending on the seed source and specific conditions of post-fire seedbed. The newly established young stands of any species were easily eliminated by recurring fires, but differences in fire-resisting properties among the species began to play a role in a given species' survival success. White pine is best adapted for long-term success on this Ecological Site. Although vulnerable to damage or elimination by fire in early growth stages, it eventually develops thick fire-resistant bark which helps to extend its longevity, in some cases for up to four centuries or more. These survival properties assure the species' relatively continuous seed source in the region as a whole. White pine is also moderately shade-tolerant in early life which means that it can become established in some pioneer communities, such as aspen – white birch stands, or in poorly stocked oak and red maple dominated communities. Red pine had in the past been a common associate of white pine stands. It shares some of the fire-resisting properties of white pine, but it lacks shade-tolerance and does not become established in the understory. For this reason, it has not maintained its presence in current stands and its seed source has been greatly reduced throughout its natural range following the onset of fire suppression. Red and white oak (*Quercus rubra* and *Q. alba*) have been common members of white pine-dominated stands and upon removal of white pine during early logging era, became the dominant tree component in most stands. Red oak's shade tolerance is only moderate, about equal to that of white pine and both species typically regenerate in large canopy openings. White oak is somewhat more tolerant and regenerates more readily in stands with full stocking. The oaks also have an advantage with the ability to sprout from stumps and damaged seedlings and saplings, while pines do not reproduce vegetatively.

In his reconstruction of pre-European settlement vegetation of Wisconsin, Finley (1976) did not identify red maple (*Acer rubrum*) as a prominent component of pine forests, but the species is a common member of current communities. Absence of fire since the end of the original logging era is probably the main reason. Red maple is extremely sensitive to fire, but is a prolific and early seed producer. Stems of 2-4 inches in diameter can produce large amounts of seed (USDA Forest Service, 1990). It is sufficiently shade-tolerant to become established in the understories of most communities on sandy soils. On this Ecological Site it behaves similarly to white pine, but because of its much smaller stature at maturity, it does not compete with white pine in the upper canopy.

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 (%)
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Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 7. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 8. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 9. Community 2.3 plant community composition

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

Plot and other supporting inventory data for site identification and community phases is located on a NRCS North Central Region shared and one drive folder. University Wisconsin-Stevens Point described soils, took photographs, and inventoried vegetation data at community phases within the reference state. The data sources include WI ESD Plot Data Collection Form - Tier 2, Releve Method, NASIS pedon description, NRCS SOI 036, photographs, and Kotar Habitat Types.

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Contributors

Approval

Suzanne Mayne-Kinney, 9/27/2023

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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	09/27/2023
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:
