Ecological site F089XY005WI
Wet Sandy Bedrock 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): 089X–Wisconsin Central Sands

The Wisconsin Central Sands (MLRA 89) corresponds closely to Central Sand Plains Ecological Landscape published by the Wisconsin Department of Natural Resources (WDNR, 2015). Much of the following brief overview of this MLRA is borrowed from that publication. The Wisconsin Central Sands MLRA is entirely in Wisconsin. The total land area is 2,187,100 acres (3,420 square miles, 8858 square kilometers). It is bordered to the east by Johnstown-Hancock end moraines, which were pushed to their extent by the west side of the Green Bay Lobe (Clayton & Attig, 1999). It is bordered to the southwest by highly eroded, unglaciated valleys and ridges. The dominant feature of this MLRA is the remarkably flat, sandy plain, composed of lacustrine deposits and outwash sand, that was once the main basin of Glacial Lake Wisconsin. It also features extensive pine and oak barrens and wetland complexes. Glacial Lake Wisconsin was fed primarily by glacial meltwater from the north and east. The lake deposited silt overlain by tens of meters of sand (Clayton & Attig, 1989). The silty layers are closer to the surface in some areas, where they impede drainage and contribute to the formation of extensive wetland complexes. It is believed that Glacial Lake Wisconsin drained within several days after a breach in the ice dam that supported it. The catastrophic flood that followed flowed to the south and carved the scattered buttes and mesas protruding from the sandy plain in the southern portion of this MLRA. Before vegetation established after glacial recession, strong winds formed aeolian sand dunes that now support xeric pine and oak stands within the Wisconsin Central Sands. The surface of the northwestern portion is mostly undulating. The sandy surface sediment was mostly deposited by meltwater during the Wisconsin glaciation. Gentle hills are a result of underlying bedrock topography. Valleys and floodplains are formed by stream action. The underlying bedrock controls the water table elevation and contributes to the formation of numerous wetlands. Historically, the Wisconsin Central Sands were dominated by large wetland complexes, sand prairies, and oak forests, savannas, and barrens. Some pine and hemlock forests were found in the northwest portion. The Wisconsin Central Sands was subject to frequent fires, leading to today’s need for prescribed burns to maintain the area.

Classification relationships

Major Land Resource Area (MLRA): Wisconsin Central Sands (89) USFS Subregions: Neillsville Sandstone Plateau (222Rb) and Central Wisconsin Sand Plain (222Ra) Relationship to Established Framework and Classification Systems: Habitat Types of S. Wisconsin (Kotar, 1996): The sites of this ES keyed out to two habitat types: Pinus/Vaccinium-Rubus hispidus (PVRh); Pinus/Vaccinium-Gaultheria (PVG) Biophysical Settings (Landfire, 2014): This ES is largely mapped as North-Central Interior Maple-Basswood Forest, Laurentian-Acadian Northern Hardwoods Forest, and Laurentian-Acadian Northern Pine Forest. WDNR Natural Communities (WDNR, 2015): This ES is most similar to the White Pine-Red Maple Swamp and the Northern Wet-mesic Forest communities.

Ecological site concept

The Wet Sandy Bedrock Lowlands ecological site is characterized by moderately deep to deep, poorly drained soils formed in sandy alluvium overlying a thin layer of loamy residuum over interbedded sandstone and shale. This site is found along rivers and outwash channels in the northern portion of the MLRA, where the bedrock is shallow. They are subject to brief flooding in the spring and fall. Water is primarily received from precipitation and runoff from adjacent uplands, but groundwater discharge also contributes as a water source. Soils range from extremely acid to strongly acid. Sites are saturated for most of the growing season and meet hydric requirements. Some sites may be wetlands. Main limiting factors on this site are low available nutrient status and impeded water uptake by poorly oxygenated root systems. Historically, this Ecological Site was dominated by a variety of plant communities, apparently reflecting differences in fire regime. Pine Barrens, Oak Barrens, Oak Savanna and mixed Pine - Oak forests were all represented (Finley,1976). Following European settlement most of the area was cleared of forest vegetation and converted to farming, although scattered woodlots remained. Current woodlots typically consist of mixed oak, primarily white oak (Q. alba) and Red oak (Q. rubra), white pine (Pinus strobus) and red maple (Acer rubrum).. There are also considerable areas of planted red pine (P. resinosa). Even though this Ecological Site is classified as Poorly Drained, this condition is not uniform across the landscape. Species reflecting relatively high soil moisture, such as winterberry (Ilex verticillata), swamp dewberry (Rubus hispidus) and cinnamon fern (Osmunda cinamomea), occur only sporadically. Some locations,

however, are considerably more poorly drained and are evident by the presence of such species as sphagnum moss (Sphagnum spp.), speckled alder (Alnus crispa) and tamarack (Larix laricina). Current vegetation is represented by woodlands typically consisting of mixed oak, primarily red oak (Quercus rubra) and white oak (Q. alba), white pine (Pinus strobus) and red maple (Acer rubrum). There are also areas of planted red pine (P. resinosa). Wet Sandy Bedrock Lowlands is differentiated from other ecological sites by drainage class and depth to bedrock. The depth to bedrock sets this site apart from Wet Sandy Outwash Lowlands and Wet Siliceous Sand Lowlands, which lack bedrock contact within 78.7 inches (200 cm) of the surface. The bedrock both perches the water table and restricts root growth, which can cause trees to tip. The poor drainage sets this ecological site apart from other sandy sites.

Associated sites

F089XY001WI	**Organic Poor Fen** Acidic Poor Fens consist of shallow to deep, highly decomposed herbaceous organic material. These sites are very poorly drained and remain saturated throughout the year. They are very strongly to extremely acidic. These sites are wetlands. These sites are found exclusively in the northwest portion of the Wisconsin Central Sands MLRA where the depth to bedrock is shallow. They occur lower on the drainage sequence and stay saturated for longer than Wet Sandy Bedrock Lowlands.
F089XY010WI	**Moist Sandy Bedrock Upland Forest** Moist Sandy Bedrock Uplands consist of sandy deposits derived from a mixture of outwash, alluvium, and lacustrine sources. They have contact with sandstone bedrock within 40 inches (102 cm) of the surface. These soils are somewhat poorly drained. These sites are found to the west of the Wisconsin River, mostly in Clark and Jackson counties where the depth of bedrock is shallow. They occur higher in the drainage sequence than Wet Sandy Bedrock Lowlands.
F089XY016WI	**Sandy Nutrient Limited Bedrock Upland Forest** Sandy Bedrock Uplands sites form in sandy deposits derived from a mixture of outwash, alluvium, and residuum. Contact with interbedded sandstone and shale bedrock occurs within 39.3 inches (100 cm) of the surface. These soils are moderately well to excessively drained. The occur much higher in the drainage sequence than Wet Sandy Bedrock Lowlands

Similar sites

F089XY003WI	**Sandy Floodplain Forest** Sandy Floodplains sites are found exclusively on floodplains in sandy alluvium. Most sites are somewhat poorly to poorly drained and are subject to flooding. These sites occur primarily along the Wisconsin, Lemonweir, Yellow, and Black Rivers and some of their tributaries. These sites have similar textures and drainage and host similar vegetative communities.
F089XY006WI	**Wet Sandy Lowland Forest** Wet Sandy Outwash Lowlands consist of deep sandy deposits derived from a mixture of outwash, alluvium, and lacustrine sources. They are very poorly to poorly drained, remain saturated for much of the growing season, and are subject to frequent ponding. These sites are primarily found in the eastern half of the Wisconsin Central Sands MLRA. Their vegetative communities are very similar to those of Wet Sandy Bedrock Lowlands.
F089XY007WI	**Wet Sandy Nutrient Limited Lowland Forest** Wet Siliceous Sand Lowlands consist of deep sandy deposits sourced primarily from the weathering of sandstone high in silica. The weathered sand was deposited by rivers or glacial lakes. They are very poorly to poorly drained and remain saturated from much of the growing season. Some are subject to ponding. These sites are primarily found in the western half of the Wisconsin Central Sands

Table 1. Dominant plant species

Tree	(1) *Pinus strobus* (2) *Quercus alba*
Shrub	(1) *Acer rubrum*
Herbaceous	(1) *Vaccinium* (2) *Pteridium aquilinum*

Physiographic features

This site occurs in depressions on rock pediments in river valleys. Slopes range from 0 to 2 percent. Elevation ranges from 210 to 370 meters above sea level.

These sites are subject to frequent ponding in the spring and fall. The ponding duration is brief (2 to 7 days), with depths up to 11.8 inches (30 cm) above the soil surface. These sites do not flood. The soil has an apparent seasonally high water table (endosaturation) at a depth of 0 inches (0 cm), but the water table may drop to 37.4 inches (95 cm) during dry conditions. Runoff is negligible to very low.

Figure 1. Distribution of Wet Sandy Bedrock Lowlands sites in the Wisconsin Central Sands MLRA (89)

Table 2. Representative physiographic features

Slope shape across	(1) Linear
Slope shape up-down	(1) Concave
Hillslope profile	(1) Toeslope
Landforms	(1) River valley > Depression > Toe
Runoff class	Negligible to very low
Flooding frequency	None
Ponding duration	Brief (2 to 7 days)
Ponding frequency	Frequent
Elevation	210 – 370 m
Slope	0 %

Ponding depth	0 – 30 cm
Water table depth	0 cm
Aspect	Aspect is not a significant factor

Climatic features

The continental climate of the Wisconsin Central Sands is typical of the southern half of the state – cold winters and warm summers. Precipitation is well-distributed throughout the year with a slight peak in the summer months. Snowfall covers the ground from late fall to early spring. The soil moisture regime of MLRA 89 is udic (humid climate). The soil temperature regime is mostly frigid, with a small portion of mesic in the southern tip. Neither precipitation nor temperature vary greatly across this MLRA. More so than latitude, local topography seems to be an important predictor of growing season length, with fewer growing degree days in lower-lying areas.

These sites occur on landscape depressions and their local topography is expected to influence growing season length. The freeze-free and frost-free periods may be shorter than what is represented here.

The average annual precipitation for this ecological site is 33 inches. The average annual snowfall is 43 inches. his site is exclusive to the northern portion of the latitudinal gradient of this MLRA. The frost-free period of this site is 21 days shorter than the MLRA average (135 days, base 32°F).

Table 3 Representative climatic features

Frost-free period (characteristic range)	90-120 days
Freeze-free period (characteristic range)	110-140 days
Precipitation total (characteristic range)	810-860 mm
Frost-free period (actual range)	80-120 days
Freeze-free period (actual range)	100-140 days
Precipitation total (actual range)	810-860 mm
Frost-free period (average)	110 days
Freeze-free period (average)	130 days
Precipitation total (average)	840 mm

- (1) HATFIELD [USC00473471], Merrillan, WI
- (2) WISCONSIN RAPIDS [USC00479335], Wisconsin Rapids, WI
- (3) FRIENDSHIP [USC00472973], Adams, WI
- (4) STEVENS POINT [USC00478171], Stevens Point, WI

Influencing water features

Water is received through precipitation, runoff from adjacent uplands, groundwater recharge, and rarely stream inflow. Water levels are greatly influenced by precipitation rates and runoff from upland sites. Water leaves the site primarily through evapotranspiration and groundwater recharge. Subsurface flow may occur because of the perched water on the bedrock. These sites are wetlands.

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, forested, needle-leaved evergreen, saturated, or
3) Palustrine emergent, persistent, saturated

Under the Hydrogeomorphic Classification System (HGM), the wetlands can be classified as:

1) Depressional, acid, forested/organic, or
2) Depressional, acid, scrub-shrub/organic

Permeability of the soil is very slow to impermeable. The hydrologic group of this site is B/D.

Soil features

These sites are represented by the Elmlake soil series, classified as a Humaqueptic Epiaquent.

These soils are formed in siliceous sandy alluvium over loamy residuum from interbedded sandstone and shale. Depth of soil to bedrock ranges from 19.7 to 39.3inches (50 to 100 cm). The sandy mantle ranges from 13.8 to 37.4 inches (35 cm to 95 cm). The bedrock perches the water table. The NRCS writes that the Elmlake series does not fit either definition of episaturation or endosaturation but expanded the definition of episaturation to include soils with a water table perched on top of bedrock, like Elmlake. These soils are poorly drained and remain saturated for much of the growing season. They meet hydric soil requirements.

The surface horizon of these sites is muck—sapric materials that are highly decomposed herbaceous organic matter. Subsurface horizons are mucky sand with sapric materials staining the siliceous sands. Horizons then transition to sand, silty clay loam, and bedrock. Soil pH is extremely acid to very strongly acid in all horizons with a range of 4.2 to 4.8. Surface fragments are absent. Subsurface fragments less than 3 inches can be present up to 3 percent volume, and fragments greater than 3 inches can be present up to 5 percent. Sites are absent of carbonates within 78.7 inches (200 cm).

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Muck
Drainage class	Poorly drained
Permeability class	Very slow
Soil depth	50 – 100 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified

Available water capacity (0-152.4cm)	12.37 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	4.2 – 4.8
Subsurface fragment volume <=3" (0-203.2cm)	Not specified
Subsurface fragment volume >3" (0-203.2cm)	Not specified

Ecological dynamics

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 species present on the landscape could become established, depending on seed source availability 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 any 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 life 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 unset of fire suppression. Several species of oak are common members of forest communities on this ecological site. Northern pin oak (Q. ellipsoidalis) and, to a lesser degree, black oak (Q. velutina), are intolerant of shade and do not reproduce from seed under existing canopies. However, following fire or clear cutting they respond by sprouting from stumps. In the absence of disturbance they are replaced, through succession, by more shade-tolerant white pine, red maple (Acer rubrum), or white oak (Q. alba).

Red maple has not been identified by Finley (1976) as an important component of pre-settlement pine or oak forests, but it is a prominent member in current stands. Absence of fire since the original logging era is probably the main reason. Red maple is extremely sensitive to fire damage, but is a prolific and early seed producer. Stems of 2-4 inches in diameter can produce large amounts of seed (USDA For. Serv. 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 size 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 (%)

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 2.3 plant community composition

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

Table 10. Community 2.4 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.

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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	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:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**