# Ecological site F105XY017WI
# Shallow Dry Upland

Last updated: 2/23/2024
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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): 105X–Upper Mississippi River Bedrock Controlled Uplands and Valleys

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

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

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

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

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

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

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

## Classification relationships

Relationship to Established Framework and Classification Systems:

Habitat Types of S. Wisconsin (Kotar, 1996): The sites in this ES keyed out to 3 different habitat types. The most likely dominant habitat type is *Acer rubrum*/Desmodium-Vaccinium [ArDe-V] with Acer saccharum-Tilia/Desmodium(Prunus) [ATiDe(Pr)] and Acer saccharum-Tilia/Sanguinaria-Desmodium [ATiSa-De] occurring as secondaries.

Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Northern Hardwoods Forest, North-Central Interior Maple-Basswood Forest, North-Central Interior Dry-Mesic Oak Forest and Woodland, Paleozoic Plateau Bluff and Talus Woodland, Eastern Cool Temperate Pasture and Hayland, and Eastern Cool Temperate Row Crop

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

USFS Subregions: Menominee Eroded Pre-Wisconsin Till (222La), Melrose Oak Forest and Savannah (222Lb)

Wisconsin DNR Ecological Landscapes: Western Coulee and Ridges

## Ecological site concept

The Shallow Dry Upland ecological site occupies approximately 191,000 acres across MLRA 105, or about 2.8% of total land area. It is the sixth-most extensive site in MLRA 105. It is found in upland positions on diverse landforms throughout the MLRA. It is common to the sandstone hills in the northern portion of MLRA 105, especially the Trempealeau Sandstone Hills and Eau Claire Sandstone Hills. 89% of the acreage of this site is found north of the LaCrosse River.

This site is characterized by somewhat excessively to excessively drained, sandy soils where contact with sandstone bedrock is found within one meter of the soil surface. The bedrock acts as a root restricting layer and can limit root growth and perch water. These sites may be vulnerable to tree trips.

## Associated sites

| | |
|---|---|
| F105XY012WI | **Shallow Loamy-Silty Upland**<br>These sites form in loamy to silty materials, often silty loess and residuum. They have bedrock contact within 3 feet (one meter)of the soil surface. They are moderately well to well drained. They are often found adjacent to Shallow Dry Upland. |
| F105XY019WI | **Dry Upland**<br>These sites form in sandy materials deposited by wind, water, gravity, or weathered from sandstone bedrock. They are well drained to excessively drained. They are sometimes found adjacent to Shallow Dry Upland. |
| F105XY002WI | **Wet Sandy Floodplain**<br>These sites form in deep, sandy alluvium and outwash deposits in floodplains, especially those along 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 found in floodplains adjacent to Shallow Dry Upland. |

## Similar sites

| | |
|---|---|
| F105XY019WI | **Dry Upland**<br>These sites form in sandy materials deposited by wind, water, gravity, or weathered from sandstone bedrock. They are well drained to excessively drained. They are similar to Shallow Dry Upland but they lack bedrock contact within 3 feet (one meter) of the soil surface. |
| R105XY018WI | **Dry Mollic or Umbric Upland**<br>These sites form in sandy materials deposited by wind, water, or weathered from sandstone bedrock. They have deep, dark surfaces. They are moderately well to excessively drained. Like Shallow Dry Upland, they sometimes have bedrock contact within 3 feet (one meter) of the soil surface but they have deeper surfaces (mollic or umbric rather than ochric epipedons). |
| F105XY012WI | **Shallow Loamy-Silty Upland**<br>These sites form in loamy to silty materials, often silty loess and residuum. They have bedrock contact within 3 feet (one meter)of the soil surface. They are moderately well to well drained. They are similar to Shallow Dry Upland but they have finer soil textures. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Quercus alba*<br>(2) *Acer rubrum* |
| Shrub | (1) *Vaccinium* |
| Herbaceous | (1) *Pteridium aquilinum* |

## Physiographic features

These sites are found on ridges, hills, terraces, outwash plains, sand sheets, and valley trains in the summit, shoulder, or backslope positions. Slop shape is convex to linear. Slopes range from 0 to 65 percent. Elevation of the landform ranges from 705 to 902 feet (215 to 275 meters) above sea level.

These sites are not subject to inundation by water. They generally lack evidence of a seasonally high water table. Runoff potential is very low to high.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Hillslope profile | (1) Summit<br>(2) Shoulder<br>(3) Backslope |
| Slope shape across | (1) Convex |
| Slope shape up-down | (1) Linear |
| Landforms | (1) Ridge<br>(2) Hill<br>(3) Terrace<br>(4) Outwash plain<br>(5) Sand sheet<br>(6) Valley train |
| Runoff class | Very low to high |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 215–275 m |
| Slope | 0–65% |
| Water table depth | 99 cm |
| Aspect | Aspect is not a significant factor |

## Climatic features

The climate of the Upper Mississippi River Bedrock Controlled Uplands and Valleys MLRA is typical of southern

Wisconsin, with warmer winters, warmer summers, and higher precipitation rates than MLRA in northern Wisconsin. The 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 43 inches. The annual average maximum and minimum temperatures are 56°F and 34°F, respectively.

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (characteristic range) | 109-123 days |
| Freeze-free period (characteristic range) | 130-150 days |
| Precipitation total (characteristic range) | 864-914 mm |
| Frost-free period (actual range) | 107-124 days |
| Freeze-free period (actual range) | 125-151 days |
| Precipitation total (actual range) | 813-965 mm |
| Frost-free period (average) | 116 days |
| Freeze-free period (average) | 140 days |
| Precipitation total (average) | 889 mm |

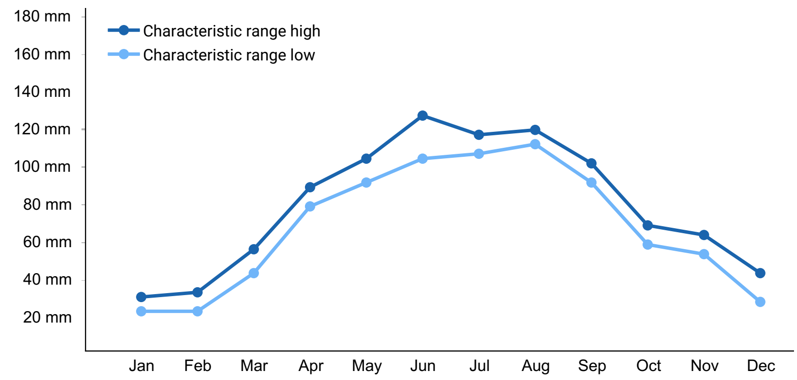



**Figure 1. Monthly precipitation range**

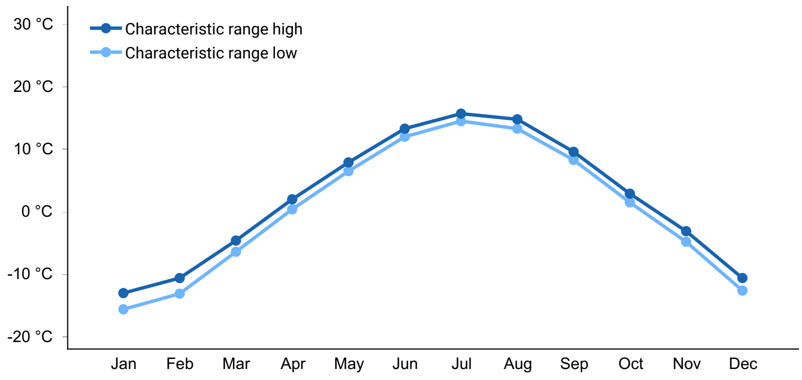



**Figure 2. Monthly minimum temperature range**

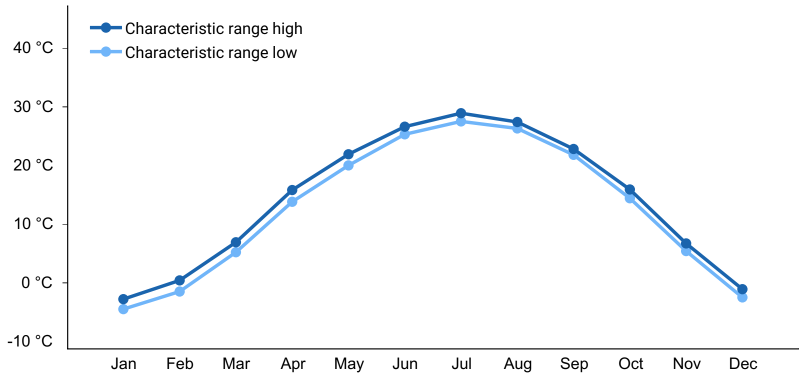



**Figure 3. Monthly maximum temperature range**

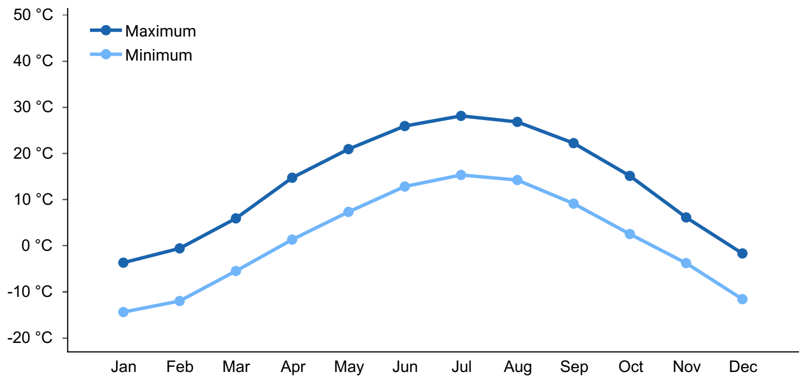



**Figure 4. Monthly average minimum and maximum temperature**

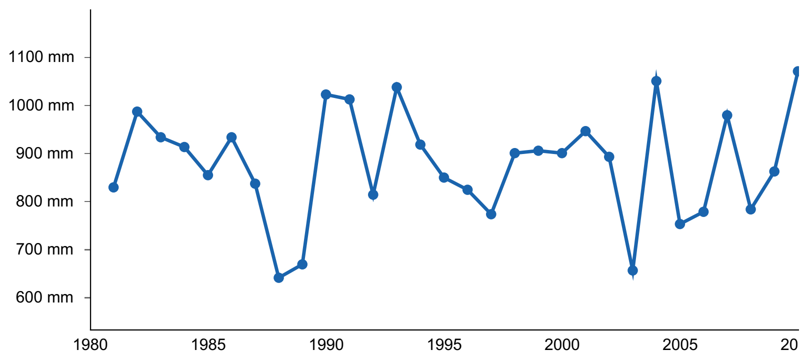



**Figure 5. Annual precipitation pattern**

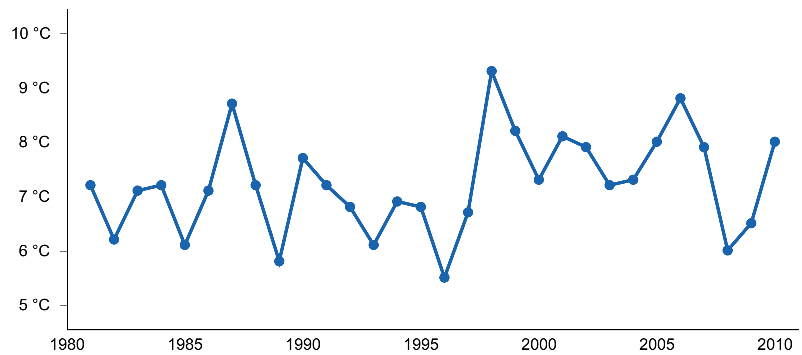



**Figure 6. Annual average temperature pattern**

## Climate stations used

- (1) RIDGELAND 1 NNE [USC00477174], Dallas, WI
- (2) MONDOVI [USC00475563], Mondovi, WI
- (3) EAU CLAIRE RGNL AP [USW00014991], Eau Claire, WI

- (4) DODGEVILLE [USC00472173], Dodgeville, WI
- (5) SPARTA [USC00477997], Sparta, WI
- (6) REEDSBURG [USC00477052], Reedsburg, WI
- (7) BLAIR [USC00470882], Blair, WI
- (8) DODGE [USC00472165], Arcadia, WI

## Influencing water features

Water is received through precipitation and runoff from adjacent uplands. Water is lost from the site primarily through runoff, evapotranspiration, and groundwater recharge.
Permeability of the soils is impermeable to rapid.

The hydrologic soil groups for these sites are A and B.

## Wetland description

Not Applicable.

## Soil features

This site is represented by the Boone, Boplain, Elevasil, Keyesville, Plainbo, Twinmound, and Urne soil series. Typic Quartzipsamments make up 87% of the acreage of this site. The remaining acreage is made up of Typic Udipsamments, Ultic Hapludalfs, Dystric Eutrudepts, and Typic Dystrudepts.

These soils formed in sandy and loamy outwash deposits, sandy and loamy colluvium and slope alluvium deposits, wind-blown sand deposits, and sandy to loamy residuum weathered from sandstone bedrock. Bedrock contact will be found within 39 inches (100 cm) of the soil surface. Subsurface fragments smaller than 3 inches in diameter (gravel) may occupy up to 10% soil volume. Larger fragments may occupy up to 25% soil volume. These fragments may be mixed rocks deposited by flowing water, unconsolidated rocks deposited on slopes by gravity, or fragments of weathered sandstone bedrock. Soils are somewhat excessively to excessively drained. They do not meet hydric soil requirements.

Soils are slightly to strongly acid. They generally lack accumulations of secondary carbonates.


**Figure 7. Boone(variant) soil series sampled on 07/21/2020 in LaCrosse County, WI.**

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Eolian sands<br>(2) Outwash<br>(3) Residuum<br>(4) Alluvium<br>(5) Colluvium<br>(6) Drift |
| Surface texture | (1) Sand<br>(2) Loamy sand<br>(3) Sandy loam |
| Drainage class | Somewhat excessively drained to excessively drained |
| Permeability class | Rapid |
| Soil depth | 56–99 cm |
| Surface fragment cover <=3" | 0–3% |
| Surface fragment cover >3" | 0–10% |
| Available water capacity (0-150.1cm) | 1.52–4.19 cm |
| Soil reaction (1:1 water) (0-100.1cm) | 5.1–6.5 |
| Subsurface fragment volume <=3" (0-100.1cm) | 4–10% |
| Subsurface fragment volume >3" (0-100.1cm) | 0–25% |

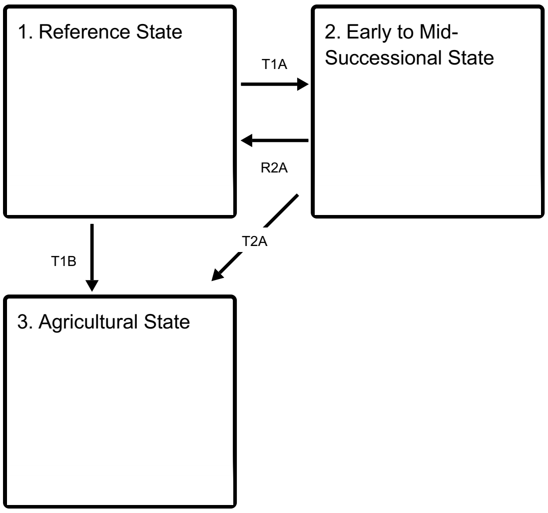
## Ecological dynamics

Historically, this site was dominated by mesic hardwoods in a landscape adapted to fire disturbance that allowed for a strong presence of oaks. In pre-European settlement time wildfire 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. Many pine and oak species were dominant in the region because of their fire-resistant properties and successful regeneration post-fire. With clear cutting and continued fire suppression, many of these species adapted to fire and intolerant of shade are replaced by other species. Species such as white pine and red oak are still common on the landscape based on their tolerance to some shade; these species to establish under a canopy, and in time, may become a component of the canopy. Mesic hardwoods are sensitive to fire, but in its absence, the have the ability to dominate sites based on their shade tolerance and prolific seed production.

Today, these forests most commonly include stands of white oak, red maple, and other mesic hardwoods. Some sites have a strong presence of red oak. These sites have the conditions to support shade tolerant mesic hardwoods, but these sites have a dry soil moisture regime. Red oak can compete on these sites based on its ability to grow in drier soils, but does not often dominate. Instead, White oak and red maple with white pine are most likely to dominate these sites. Historically, these sites had significant wind throw and fire disturbance that allowed for a strong presence of oak species.

## State and transition model

**Ecosystem states**



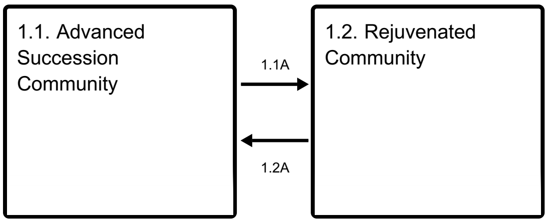

**T1A** - Clear cutting or stand-replacing fire.

**T1B** - Removal of forest vegetation and tilling.

**R2A** - Disturbance-free period 70+ years.

**T2A** - Removal of forest vegetation and tilling.

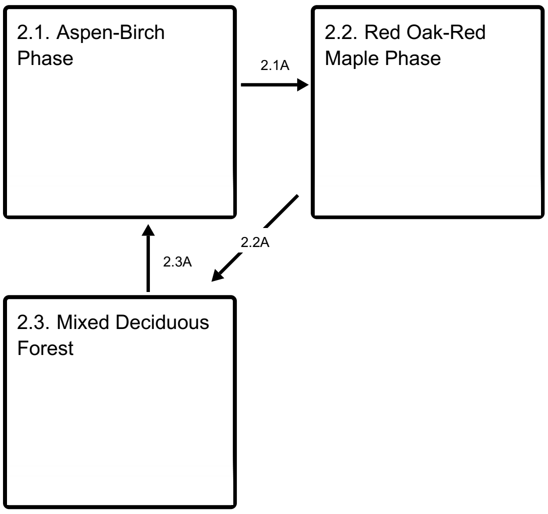
**State 1 submodel, plant communities**




**1.1A** - Natural mortality in the oldest age classes, sporadic small-scale blow-downs and ice storms, create openings for entry of mid-tolerant species, such as red oak and red maple.

**1.2A** - Time and natural succession.

**State 2 submodel, plant communities**




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

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

**2.3A** - Clear cutting or stand-replacing fire.

**State 3 submodel, plant communities**

3.1. Planted Crops

## State 1
## Reference State

Reference state is a forest community dominated by White oak ( *Quercus alba*) and red maple (*Acer rubrum*). Depending on history of disturbance, two community phases can be distinguished largely by differences in dominance of tree species and community age structure.

## Community 1.1
## Advanced Succession Community

In the absence of any major disturbance, specifically fire, this community is dominated by white oak ( *Quercus alba*) and red maple (*Acer rubrum*). Common associates include other White pine (*Pinus strobus*) and red oak (*Quercus rubra*). Red oak requires some disturbance to create gaps for regeneration; with the absence of disturbance, they are less common in the canopy. The shrub layer is often dominated by Hazelnuts and Gooseberry. The ground layer is dominated by blueberries (Vaccinium spp.) and bracken fern (*Pteridium aquilinum*).

**Dominant plant species**

- white oak (*Quercus alba*), tree
- red maple (*Acer rubrum*), tree
- blueberry (*Vaccinium*), shrub
- western brackenfern (*Pteridium aquilinum*), other herbaceous

## Community 1.2
## Rejuvenated Community

This community is often dominated by sugar maple and red oak. The shrub and ground layers are similar to the advanced succession phase, but may include the establishment of new seedlings.

**Dominant plant species**

- sugar maple (*Acer saccharum*), tree
- northern red oak (*Quercus rubra*), tree
- blueberry (*Vaccinium*), shrub
- western brackenfern (*Pteridium aquilinum*), other herbaceous

## Pathway 1.1A
## Community 1.1 to 1.2

Light intensity fires, crown breakage from ice and snow, and small scale blow-downs create canopy openings, releasing advance regeneration and stimulating new seedling establishment. Some additional less shade tolerant species such as red oak may be able to enter the community.

## Pathway 1.2A
## Community 1.2 to 1.1

A long period without major canopy disturbance allows gradual replacement of oldest canopy trees by younger cohorts. Lacking a major disturbance, the canopy will likely be replaced with sugar maple, but red oak can compete to maintain its place in the canopy. Small scale disturbances may still occur periodically, but once second or third canopies are established there is minimal new regeneration taking place and the forest gradually returns to mature state.

### State 2
### Early to Mid-Successional State

Following disturbances described in Transition T1A a wide range of forest community phases may come into temporary existence, the three most common ones are described here in phases 2.1, 2.2 and 2.3.

### Community 2.1
### Aspen-Birch Phase

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

#### Dominant plant species

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

### Community 2.2
### Red Oak-Red Maple Phase

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

#### Dominant plant species

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

### Community 2.3
### Mixed Deciduous Forest

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

**Dominant plant species**

- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- red maple (*Acer rubrum*), tree
- eastern white pine (*Pinus strobus*), tree
- hazelnut (*Corylus*), shrub
- gooseberry currant (*Ribes montigenum*), shrub
- western brackenfern (*Pteridium aquilinum*), other herbaceous

### Pathway 2.1A
### Community 2.1 to 2.2

Immigration and establishment of red oak and red maple.

### Pathway 2.2A
### Community 2.2 to 2.3

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

### Pathway 2.3A
### Community 2.3 to 2.1

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

### State 3
### Agricultural State

Indefinite period of applying agricultural practices. Primary crops include row crops, hay, and pasture.

### Community 3.1
### Planted Crops

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

### Transition T1A
### State 1 to 2

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

### Transition T1B
### State 1 to 3

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

### Restoration pathway R2A
### State 2 to 1

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

### Transition T2A
### State 2 to 3

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

## Additional community tables

## Inventory data references

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

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## Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

| | |
|---|---|
| Author(s)/participant(s) | |
| Contact for lead author | |
| Date | 05/18/2024 |
| Approved by | Suzanne Mayne-Kinney |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

## Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

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

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

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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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:**

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