USDA Natural Resources
Conservation Service

Ecological site F091XY004WI
Terrace

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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, Laurentian-Acadian Northern Oak Forest, Laurentian-Acadian Northern Pine Forest, Laurentian Pine Barrens, and Laurentian Oak Barrens,

Habitat Types of N. Wisconsin (Kotar, 2002): The sites of this ES keyed out to three habitat types: Acer saccharum/Vaccinium-Clintonia (AVCl); *Pinus strobus*-*Acer rubrum*/Vaccinium-Amphicarpa (PArVAm); *Pinus strobus*-Quercus/Gaultheria-Ceanothus (PQGCe)

WDNR Natural Communities (WDNR, 2015): This ES is most similar to the Norther Dry-Mesic Forest described by the WDNR

Hierarchical Framework Relationships:

Major Land Resource Area (MLRA): Wisconsin and Minnesota Sandy Outwash (91X)

USFS Subregions: Bayfield Sand Plains (212Ka)
Small sections occur in the Mille Lacs Uplands (212Kb) subregion

Wisconsin DNR Ecological Landscapes: Northwest Sands, Northwest Lowlands

Ecological site concept

The Terrace ecological site is located throughout MLRA 91X on stream terraces and strath terraces primarily along the Saint Croix and Namekagon river valleys. These sites are characterized by shallow to very deep, poorly to excessively drained soils that formed primarily in loamy alluvium or sandy outwash. Some soils formed in lacustrine deposits, or have underlying bedrock, residuum, or till. Sites are subject to occasional ponding or flooding. Few sites with lithic contact remain saturated long enough to meet hydric soil requirements. Soils range from very strongly acid to neutral.

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*) has been 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 was often present as an 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 (*Populus tremuloides* and P grandidentata) and several species of oak, e.g.: red (*Quercus rubra*), bur (*Q. macrocarpa*) and swamp white (*Q. bicolor*). White pine is not yet well represented in most communities, but where seed source is present, it often occurs in the seedling and sapling layers. Red maple is well represented on some sites, and is absent on others. It appears that once established, it is capable of remaining a permanent component of communities in absence of fire. Also, on less well drained sites there often is a significant presence of paper birch, balsam fir or white spruce.

The Terrace ecological site differs from others by occurring only on stream and strath terraces—landforms found along river valleys that used to flood frequently when the water levels were higher during and after Wisconsin's most recent glacial advance. The Floodplains ecological site is most similar but occurs on lower landscape positions closer to the river on active floodplains. Vegetation sensitive to frequent and prolonged flooding can be supported by Terraces.

Associated sites

F091XY003WI	**Floodplain** These sites occur in depressions and flats on floodplains. They form in sandy to silty alluvium and are somewhat poorly to very poorly drained. They are subject to flooding. They are found adjacent to Terraces on lower, more frequently flooded landscape positions that are closer to the river.

Similar sites

F091XY010WI	**Acidic Sandy Upland** These soils formed primarily sandy outwash, but some sites formed in loamy alluvium over sandy outwash, and other sites are sandy outwash underlain by lacustrine deposits. Soils are very deep and are moderately well to somewhat excessively drained. These soils are characterized by the presence of a spodic horizon. Their vegetative communities are dry to dry-mesic with poor to medium nutrient requirements, similar to those found on Terraces.
F091XY011WI	**Sandy Upland** 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. Soils are very deep and are moderately well or somewhat excessively drained. They are neutral to extremely acid. They can be differentiated from Acidic Sandy Uplands by their lack of a spodic horizon. Their vegetative communities are dry to dry-mesic, similar to those found on Terraces, but they may be slightly more tolerant to lower nutrient status.

F091XY014WI	**Acidic Dry Upland** These soils formed in sandy and gravelly outwash. Soils are very deep and are excessively drained. They are characterized by the presence of a spodic horizon. Their vegetative communities are dry to dry-mesic with poor to medium nutrient requirements, similar to those found on Terraces.

Table 1. Dominant plant species

Tree	(1) *Pinus strobus* (2) *Quercus rubra*
Shrub	(1) *Corylus*
Herbaceous	(1) *Pteridium aquilinum*

Physiographic features

These sites occur on stream and strath terraces on outwash plains, lake plains, disintegrating moraines, and river valleys. Slopes range from 0 to 45 percent. Sites are on summit, shoulder, and backslope positions.

Most sites are not subject to ponding or flooding. A few sites are subject to ponding with occasional frequency. Ponding duration is brief (2 to 7 days), at depths of 0 to 12 inches above the soil surface. Few sites are subject to flooding with occasional frequency and brief (2 to 7 days) duration. Most sites have an apparent seasonally high water table (endosaturation) with depth of 0 to 30 inches below the surface. Some sites have a perched water table (episaturation) with depths of 0 to 12 inches. The water table can drop to greater than 60 inches during dry conditions.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Shoulder (3) Backslope
Slope shape across	(1) Convex
Slope shape up-down	(1) Linear
Landforms	(1) Strath terrace (2) Stream terrace
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to occasional
Ponding duration	Long (7 to 30 days)
Ponding frequency	None to occasional
Elevation	590–2,130 ft
Slope	0–45%
Ponding depth	0–12 in
Water table depth	0–30 in
Aspect	Aspect is not a significant factor

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.

Table 3. Representative climatic features

Frost-free period (characteristic range)	85-104 days
Freeze-free period (characteristic range)	120-134 days
Precipitation total (characteristic range)	30-31 in
Frost-free period (actual range)	75-109 days
Freeze-free period (actual range)	112-136 days
Precipitation total (actual range)	29-32 in
Frost-free period (average)	94 days
Freeze-free period (average)	126 days
Precipitation total (average)	30 in

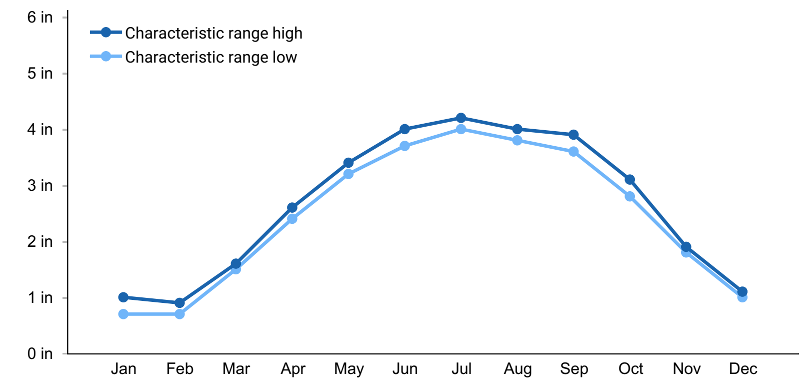


Figure 1. Monthly precipitation range

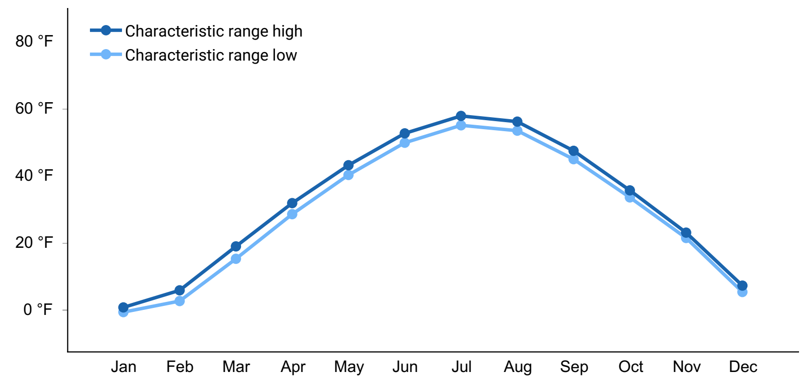


Figure 2. Monthly minimum temperature range

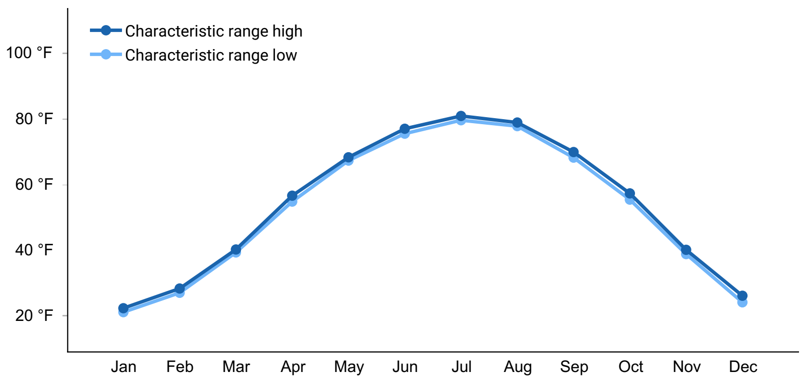


Figure 3. Monthly maximum temperature range

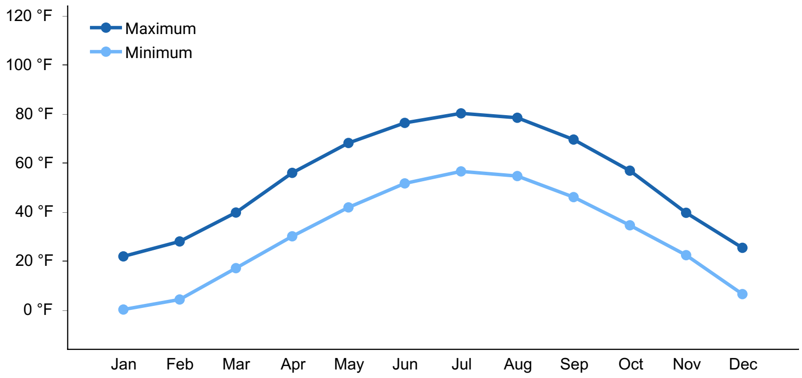


Figure 4. Monthly average minimum and maximum temperature

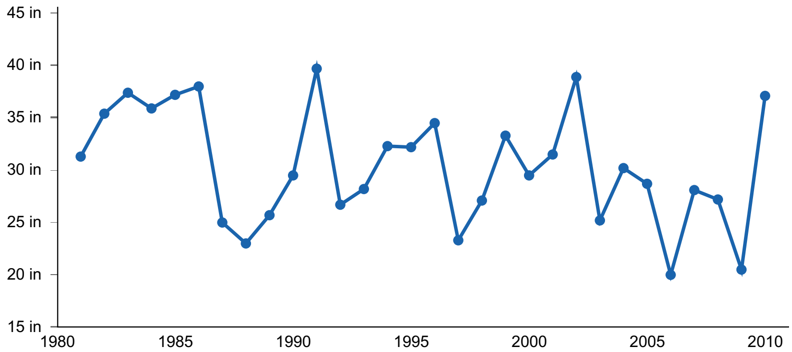


Figure 5. Annual precipitation pattern

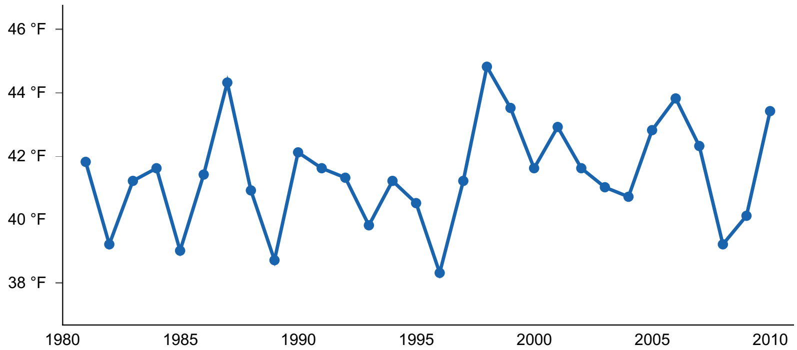


Figure 6. Annual average temperature pattern

Climate stations used

- (1) DANBURY [USC00471978], Danbury, WI
- (2) HAYWARD MUNI AP [USW00094973], Hayward, WI
- (3) HAYWARD RS [USC00473511], Hayward, WI
- (4) MINONG 5 WSW [USC00475525], Minong, WI
- (5) SPOONER AG RES STN [USC00478027], Spooner, WI

Influencing water features

Water is received primarily through precipitation, runoff from adjacent uplands, groundwater discharge, and sometime stream inflow. Water is lost from the site primarily through runoff, evapotranspiration, groundwater recharge, and stream outflow.

Permeability of these sites is very slow to rapid depending on parent material and soil textures. The soils with finer materials have lower permeability. Hydrologic group is A, B, A/D, B/D or C/D.

Wetland description

Hydrologic Group: A, B, A/D, B/D, C/D
Hydrogeomorphic Wetland Classification: None
Cowardin Wetland Classification: None

Soil features

These sites are represented by the Alban, Annalake, Beartree, Bigisland, Caryville, Cress, Drylanding, Elderon, Emmert, Mahtomedi, Plainbo, Rockmarsh, and Tourtillotte soil series. Alban is classified as a Typic Glossudalf; Annalake is an Alfic Oxyaquic Haplorthod; Beartree is a Lithic Endoaquoll; Bigisland is a Typic Hapludalf; Caryville is a Fluventic Hapludoll; Cress is Humic Dystrudept; Drylanding is a Lithic Hapludoll; Elderon is a Typic Dystrudept; Emmert is a Typic Udorthent; Mahtomedi and Plainbo are Typic Udipsamments; Rockmarsh an Aquollic Hapludoll; and Tourtillotte is an Oxyaquic Udipsamment.

These soils formed primarily in sandy outwash or loamy alluvium. Some are underlain by dense till, clayey lacustrine, or residuum and bedrock. Some sites formed in loamy lacustrine deposits. Soils are mostly very deep, but some sites have bedrock contact beginning at 12 inches. Soils are primarily somewhat excessively drained, but few sites are poorly or very poorly drained. Soils do not remain saturated and most do not meet hydric soil requirements. Only sites with Beartree soil series meet hydric soil requirements.

The surfaces of these soils are primarily loamy sands and sandy loams, but many sites have a high volume of surface fragments or are composed of organic material. Subsurface textures range from sands to clay loams with many coarse fragment modifiers. Soil pH ranges from very strongly acid to neutral with values of 4.7 to 7.3. Carbonates are typically absent, but few sites have them present up to 8 percent beginning at 6 inches.

Figure 7. Mahtomedi Soil Series sample taken on 06/24/2019 in Sawyer County, WI. Courtesy of UWSP

Table 4. Representative soil features

Parent material	(1) Outwash (2) Alluvium (3) Lacustrine deposits (4) Residuum
Surface texture	(1) Mucky peat (2) Muck (3) Loamy sand (4) Sand (5) Loam (6) Silt loam (7) Sandy loam
Drainage class	Poorly drained to excessively drained
Permeability class	Very slow to rapid
Soil depth	12–80 in

Surface fragment cover <=3"	0–7%
Surface fragment cover >3"	0–2%
Available water capacity (0-60in)	1.38–8.78 in
Calcium carbonate equivalent (0-40in)	0–8%
Soil reaction (1:1 water) (0-40in)	4.7–7.3
Subsurface fragment volume <=3" (0-40in)	0–55%
Subsurface fragment volume >3" (0-40in)	0–35%

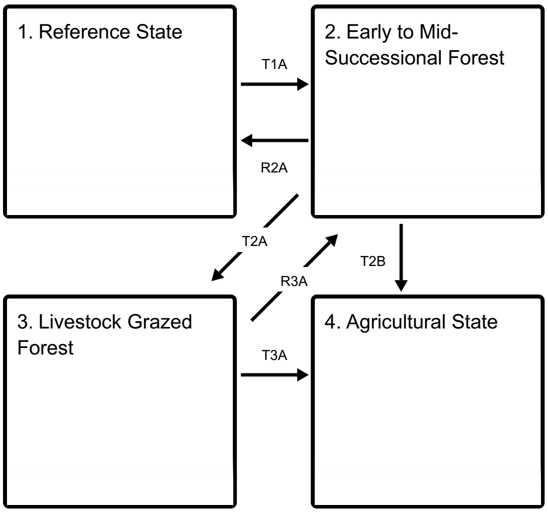
Ecological dynamics

The low soil moisture and nutrient availability on this Ecological Site limits the composition of forest communities to mixtures of aspen, pines and oaks. Historically, red and white pine (Pinus. resinosa, *P. strobus*) and four oaks species, red-, bur-, white-, swamp white - (Quercus rubra, *Q. macrocarpa*, *Q. alba*, *Q. bicolor*) have played a role in community 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 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 occupancy 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, on best sites, for up to four centuries or more. These survival properties assure the species' relatively continuous seed source in a 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 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. Red maple (*Acer rubrum*) has not been an important component of pre-settlment forests on this ES (Finley, 1976), but is well represented in many stands today. 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 natural, much smaller stature at maturity, it does not compete with white pine in the upper canopy.

Aspen is the prevalent forest cover type today. Both, trembling aspen (*Populus tremuloides*) and bigtooth aspen (*P. grandidentata*) occur. Often present in aspen stands, or as dominant cover type, are the oaks. The main survival advantage of oak species is the ability of old, as well as young, specimens to sprout from stumps, following harvesting or natural disturbance such as wind-throw, fire, or animal browsing of seedlings and saplings.

State and transition model

Ecosystem states



T1A - Stand replacing disturbance e.g., blow-down and fire, or clear-cutting followed by fire. Regeneration by natural seeding or planting.

R2A - Fire control, time, natural succession.

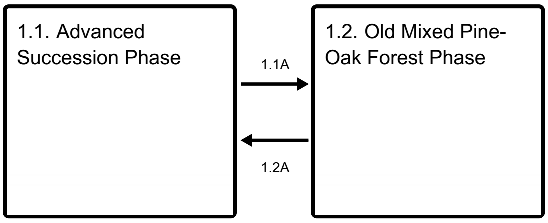
T2A - Grazing by livestock. Disruption of tree regeneration and ground vegetation.

T2B - Removal of natural vegetation, plowing, fertilizing, irrigating, planting agricultural crops.

R3A - Removal of livestock from stands.

T3A - Removal of natural vegetation, plowing, fertilizing, irrigating, planting agricultural crops.

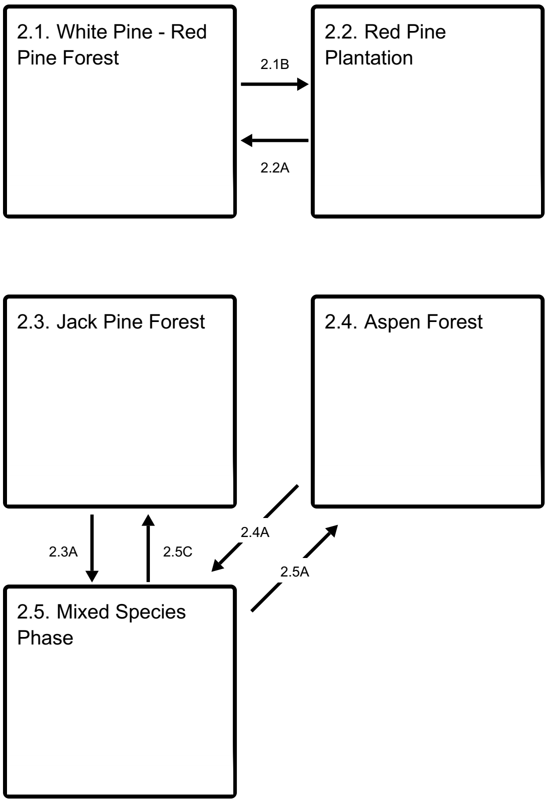
State 1 submodel, plant communities



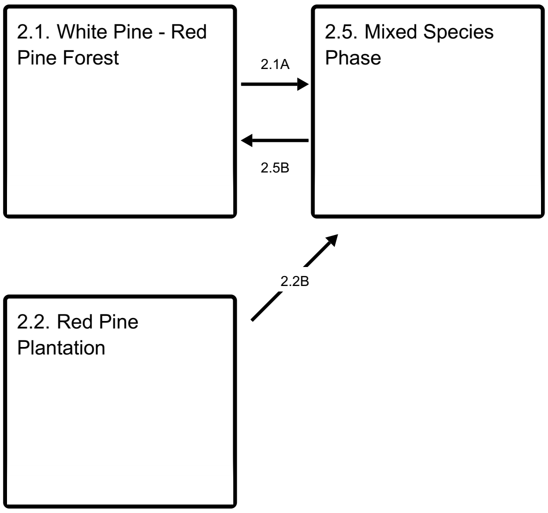
1.1A - Light to moderate intensity fires, reducing or eliminating advance tree regeneration.

1.2A - White pine and red oak regeneration re-establishes.

State 2 submodel, plant communities



Communities 1, 5 and 2 (additional pathways)



2.1B - Removal of White Pine

2.1A - White pine regeneration in mixed stand of white, red, and sometimes Jack pine.

2.2A - White pine seeding in from natural seed source or under-planted.

2.2B - White pine seeding in from natural seed source or under-planted.

2.3A - White pine seeding in from natural seed source or under-planted.

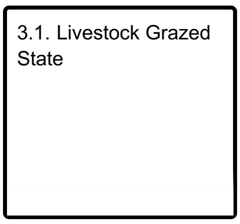
2.4A - White pine seeding in from natural seed source or under-planted.

2.5B - Time without disturbance, natural succession

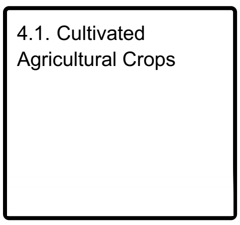
2.5C - This pathway occurs with fire when Jack pine seed sources is available or when planted.

2.5A - Repetitive clearcutting and burning of earlier stands

State 3 submodel, plant communities



State 4 submodel, plant communities



State 1
Reference State

In the long-term absence of stand replacing disturbance, tree species composition of forest communities on this ecological site fluctuates among white pine (*Pinus strobus*), red pine (P. Resinosa), red oak (*Quercus rubra*) and red maple (*Acer rubrum*). This fluctuation is due to many factors. There is a differential response to a range of common, but not stand-replacing disturbances, such as light fire, snow and ice brakeage and natural mortality in the canopy. There are differences in regeneration requirements among the species and in seedling tolerance of understory conditions. While the resulting community species composition and structure can be viewed as a continuum, two distinct community phases can be described as representing the opposite ends of a continuum.

Dominant plant species

- eastern white pine (*Pinus strobus*), tree
- red pine (*Pinus resinosa*), tree
- northern red oak (*Quercus rubra*), tree

Community 1.1
Advanced Succession Phase

White pine, with varying admixtures of red pine and red oak, constitutes the dominant overstory. The shrub layer typically is well-developed and is dominated by beaked- and american hazel, (*Corylus cornuta* and *C. americana*)). Other important species are juneberry (Amalenchier spp.) and blueberry, (Vaccinium angustifolum). Herbaceous layer typically is dominated by high cover of bracken fern (*Pteridium aquilinum*) and large-leaf aster (*Eurybia macrophylla*). Other well represented species include wild lily of-the valley (*Maianthemum canadense*), wood anemone (*Anemone quinquefolia*) and starflower (*Trientalis borealis*).

Community 1.2
Old Mixed Pine-Oak Forest Phase

Pathway 1.1A
Community 1.1 to 1.2

Periodic moderate intensity fires, eliminating or reducing advance regeneration, but leaving at least the oldest and fire-resistant pines and oaks.

Pathway 1.2A
Community 1.2 to 1.1

Canopy species re-establish regeneration layer.

State 2
Early to Mid-Successional Forest

Community 2.1
White Pine - Red Pine Forest

Even-aged, naturally regenerated, mixed pine forest, some times with admixture of red oak of sprout origin. These stands often contain considerable amount of white pine regeneration, but with only sporadic presence of young red pine in locations with large canopy openings and absence of other competing vegetation.

Dominant plant species

- eastern white pine (*Pinus strobus*), tree
- red pine (*Pinus resinosa*), tree

Community 2.2
Red Pine Plantation

Planted red pine with varying spacing. Plantations with close spacing e.g. less than 8 x 8 feet typically are devoid of significant understory vegetation. However, if thinning is applied the shrub component, dominated by beaked hazelnut (*Corylus cornuta*), increases significantly. Other common shrubs may include blackberries and raspberries (Rubus spp.), juneberry (Amelanchier spp.) and blueberries (Vaccinium spp.). Depending on the proximity of seed sources, white pine regeneration may be common. Herbaceous layer also increases, often dramatically, with bracken fern (*Pteridium aquilinum*) and large-leaf aster (*Eurybia macrophylla*) attaining strong dominance.

Dominant plant species

- red pine (*Pinus resinosa*), tree

Community 2.3
Jack Pine Forest

Unless planted, this community develops only if fire was included in the destruction of preceding community and mature Jack pine trees were present to provide seed source. Young jack pine communities often are very dense. Over time, natural mortality thins the stand and shrub and herb layers develop similarly as described for Community Phase 2.2.

Dominant plant species

- jack pine (*Pinus banksiana*), tree

Community 2.4
Aspen Forest

Figure 8. Image courtesy of UWSP taken on 6/25/2019 in Sawyer County, WI.

Like the naturally developed jack pine forest, the aspen forest community most often requires fire disturbance for establishment. Once in place it can be perpetuated by clear cutting. Understory communities develop in a similar way as described in communities 2.2 and 2.3, but more quickly, because aspen mortality leads to faster self-thinning of stands and light penetration in aspen canopy is greater that that in conifer stands.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- bigtooth aspen (*Populus grandidentata*), tree

Community 2.5
Mixed Species Phase

Figure 9. Image courtesy of UWSP taken on 06/24/2019 in Sawyer County, WI.

This is a mid-successional community. The oldest tree cohort is made up of remnants of the pioneer communities of either Jack pine, red pine, or aspen. This cohort is in the process of being replaced by more shade tolerant white pine. Red oak is also frequent associate. In absence of major disturbance this community phase transitions into Reference State Community.

Dominant plant species

- jack pine (*Pinus banksiana*), tree
- red pine (*Pinus resinosa*), tree
- quaking aspen (*Populus tremuloides*), tree
- eastern white pine (*Pinus strobus*), tree
- northern red oak (*Quercus rubra*), tree

Pathway 2.1B
Community 2.1 to 2.2

Stand replacing disturbance e.g., blow-down and fire, or logging of white pine followed by fire. Regeneration by natural seeding or planting.

Pathway 2.1A
Community 2.1 to 2.5

White pine regeneration in mixed stand of white, red, and sometimes Jack pine.

Pathway 2.2A

Community 2.2 to 2.1

White pine seeding in from natural seed source or under-planted.

Pathway 2.2B
Community 2.2 to 2.5

White pine seeding in from natural seed source or under-planted.

Pathway 2.3A
Community 2.3 to 2.5

White pine seeding in from natural seed source or under-planted.

Pathway 2.4A
Community 2.4 to 2.5

Aspen Forest

Mixed Species Phase

White pine seeding in from natural seed source or under-planted.

Pathway 2.5B
Community 2.5 to 2.1

Elimination of repetitive clearcutting and burning of stands. Lack of disturbance over time will cause this transition.

Pathway 2.5C
Community 2.5 to 2.3

This pathway occurs with fire when Jack pine seed sources is available or when planted.

Pathway 2.5A
Community 2.5 to 2.4

Mixed Species Phase

Aspen Forest

Aspen becomes established following repetitive clearcutting and burning of early stages of pine and oak. These stands are being perpetuated through clear cutting.

State 3
Livestock Grazed Forest

Livestock grazed forests are more often referred to as woodlands rather than forests because this long-term land use significantly changes some soil characteristics and nature of vegetative community. Species composition is altered by selective browsing and grazing as well as by distribution of seeds and other propagules by grazing animals. In addition, soil compaction differentially affects germination and establishment of plant species, including trees.

Community 3.1

Livestock Grazed State

Site phase consists of various grasses and forbs impacted by livestock grazing.

State 4
Agricultural State

Production of agricultural crops, most often oats or hay. Routine usage of tillage, fertilizer, and other field practices.

Community 4.1
Cultivated Agricultural Crops

Sites phase consists of various crops being grown.

Transition T1A
State 1 to 2

Stand-replacing disturbance, such as blow-down, or ice storm, followed by fire, or clear-cut logging, followed by natural regeneration or site preparation and planting.

Restoration pathway R2A
State 2 to 1

Time (50-100 years) and natural succession by white pine will lead back to the reference state. Minimal disturbance during the successional period.

Transition T2A
State 2 to 3

Prolonged grazing by livestock

Transition T2B
State 2 to 4

Elimination of forest cover and introduction of tilling, fertilizing an/or irrigation.

Restoration pathway R3A
State 3 to 2

Removal of livestock, natural succession. Results may be sped up by planting and initial outcomes will be heavily influenced by seed source and adjacent plant communities.

Transition T3A
State 3 to 4

Elimination of forest cover and introduction of tilling, fertilizing an/or irrigation.

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 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.

Other references

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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	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):**

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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:**
