USDA Natural Resources
Conservation Service

Ecological site F088XY001MN
Floodplain Peatland

Last updated: 8/12/2024
Accessed: 05/21/2025

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): 088X–Northern Minnesota Glacial Lake Basins

MLRA 88 consists of the lake beds of glacial Lakes Agassiz, Upham, and Aitkin. These vast glacial lake beds were formed by meltwaters associated with the last glaciation of the Wisconsin age. The large, flat, wet landscapes are filled with lacustrine lake sediments, wave-washed glacial till, and vast expanses of organic soils. This area is entirely in Minnesota and makes up about 11,590 square miles (30,019 square kilometers).

The western boundary of MLRA 88 with MLRA 56B is gradual. MLRA 56B is a portion of the Red River Valley that was formed by glacial Lake Agassiz and is dominantly prairie. The southern boundary of MLRA 88 with MLRA 57 consists of distinct moraines that formed from the glacial drift sediments of Late Wisconsin age. The eastern and southeastern boundaries are with portions of MLRAs 90A and 93A. These MLRAs are in a distinct glaciated region of sediments of the Rainy and Superior Lobes, and much of MLRA 93A is bedrock controlled (USDA-Ag Handbook 296, 2022).

Classification relationships

MLRA 88- Northern Minnesota Glacial Lake Basins(USDA Agricultural Handbook 296, 2022)

USFS / MN DNR Sub-regions: 212Mb Agassiz Lowlands, 212Ma Littlefork Vermillion, 212nd Tamarack Lowlands , and 212Nb St Luis Moraines (Cleland et al, 2007)

Ecological site concept

The Floodplain Peatland ecological site is a conifer-dominated swamp on very poorly drained peat soils. Soils are saturated, very deep, very poorly drained and flooding occurs rarely to frequently . No ponding occurs on this site. Typical site settings include margin of streams and river channels plus lake basins and margins of large peatlands. The canopy is often dominated by northern white cedar, black spruce, and balsam fir. The understory includes ericaceous shrubs, multiple species of sedge, and sphagnum. The plant community structure and composition will vary depending on microtopography and the depth and frequency of flooding.

Associated sites

F088XY003MN	**Open Peatland** Open Peatland occurs on level to gently sloping surfaces. Soils have greater than 16” of organic material and soil pH values are greater than 4.5. This site has a high water table that remain near the surface throughout the growing season, preventing the establishment of significant tree cover.
F088XY002MN	**Marsh** Marsh occurs on level or slightly concave landscape positions in closed depressions, shallow wetland basins, drainage ways, and adjacent to open water. They are very poorly drained soils and are frequently inundated with water for long durations. Soil surface textures are typically muck or mucky-modified surface layers over variable parent materials.
F088XY004MN	**Acid Peatland** Acid Peatland occurs in shallow wetland basins, closed depressions, and along drainage ways. Soils and water content have lower pH than the open peatland sites, lending to different vegetation. Soils are occasionally ponded with standing water in spring but tend to recede by late summer. Soil surface layers are typically muck 8 to 16” thick over variable parent materials.

Similar sites

F088XY002MN	**Marsh** Marsh occurs on level or slightly concave landscape positions in closed depressions, shallow wetland basins, drainage ways, and adjacent to open water. They are very poorly drained soils and are frequently inundated with water for long durations. Soil surface textures are typically muck or mucky-modified surface layers over variable parent materials.
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F088XY003MN	**Open Peatland** Open Peatland occurs on level to gently sloping surfaces. Soils have greater than 16” of organic material and soil pH values are greater than 4.5. This site has a high water table that remain near the surface throughout the growing season, preventing the establishment of significant tree cover.

Table 1. Dominant plant species

Tree	(1) *Thuja occidentalis* (2) *Picea mariana*
Shrub	(1) *Ledum groenlandicum* (2) *Alnus incana ssp. rugosa*
Herbaceous	(1) *Carex* (2) *Sphagnum*

Physiographic features

This peatland site is characterized by rare to frequent flooding, and occurs in flood plains, depressions, bogs, and flats.

Table 2. Representative physiographic features

Slope shape across	(1) Linear
Slope shape up-down	(1) Concave
Landforms	(1) Flood plain (2) Depression (3) Flat (4) Bog
Runoff class	Very low
Flooding duration	Long (7 to 30 days) to very long (more than 30 days)
Flooding frequency	Occasional to very frequent
Ponding duration	Very brief (4 to 48 hours) to very long (more than 30 days)
Ponding frequency	None to frequent
Elevation	213–488 m
Slope	0–2%
Ponding depth	0–30 cm
Water table depth	0 cm
Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation is 24 to 28 inches (610 to 711 millimeters). Most of the rainfall comes from convective thunderstorms during the growing season. Snowfall generally occurs from October through April. The average annual temperature is 43 to 46 degrees F (6 to 8 degrees C).

Table 3. Representative climatic features

Frost-free period (characteristic range)	85-110 days
Freeze-free period (characteristic range)	116-134 days
Precipitation total (characteristic range)	635-711 mm
Frost-free period (actual range)	75-112 days
Freeze-free period (actual range)	113-139 days
Precipitation total (actual range)	610-711 mm
Frost-free period (average)	97 days
Freeze-free period (average)	128 days
Precipitation total (average)	660 mm

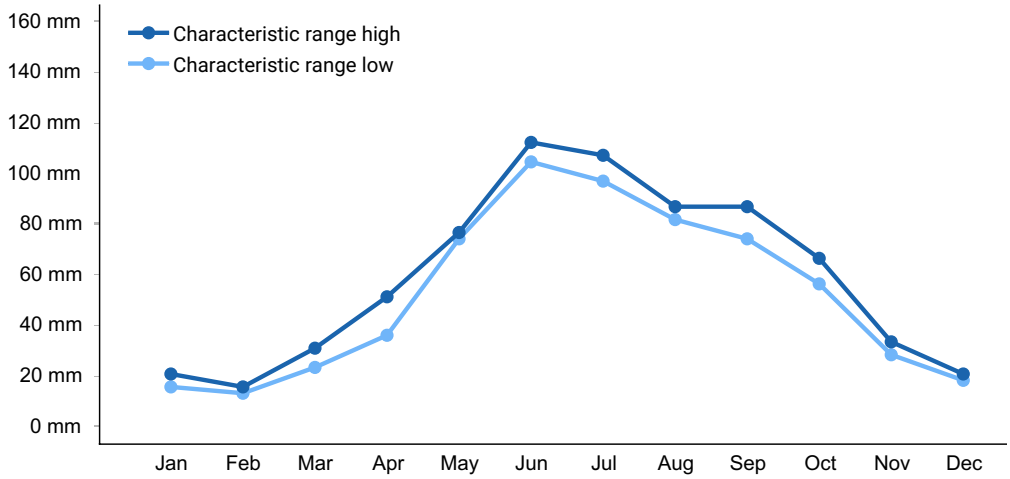


Figure 1. Monthly precipitation range

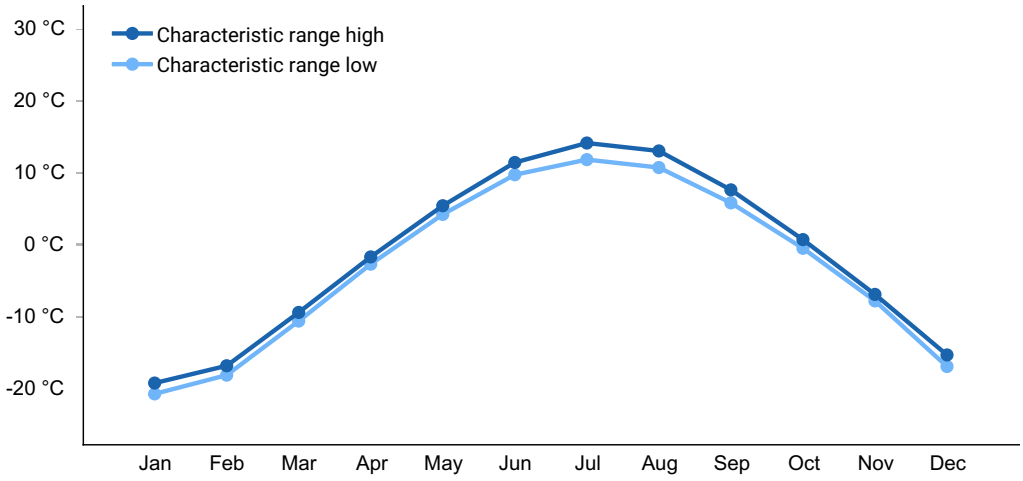


Figure 2. Monthly minimum temperature range

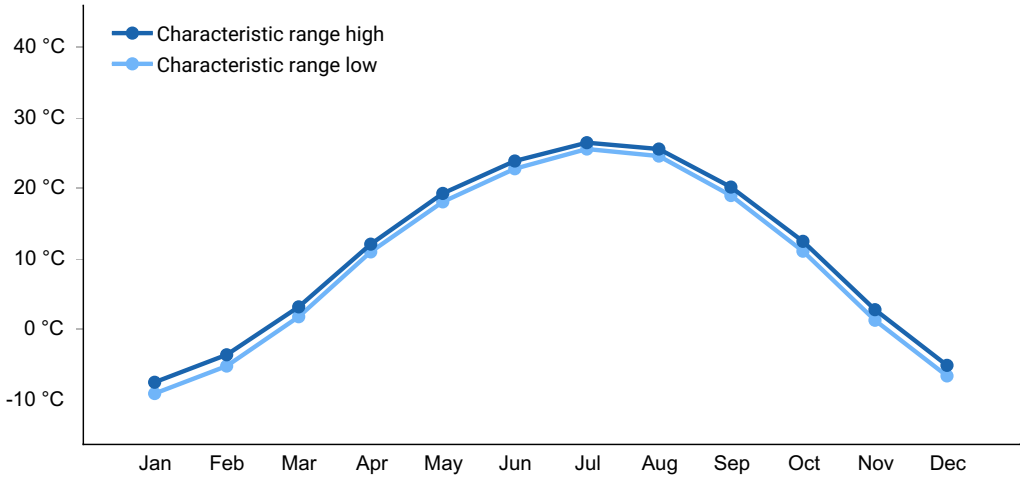


Figure 3. Monthly maximum temperature range

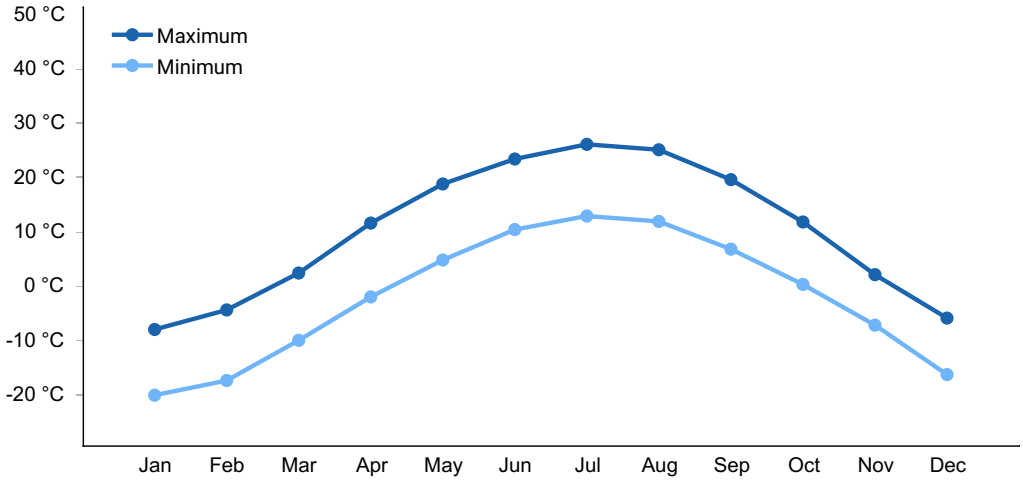


Figure 4. Monthly average minimum and maximum temperature

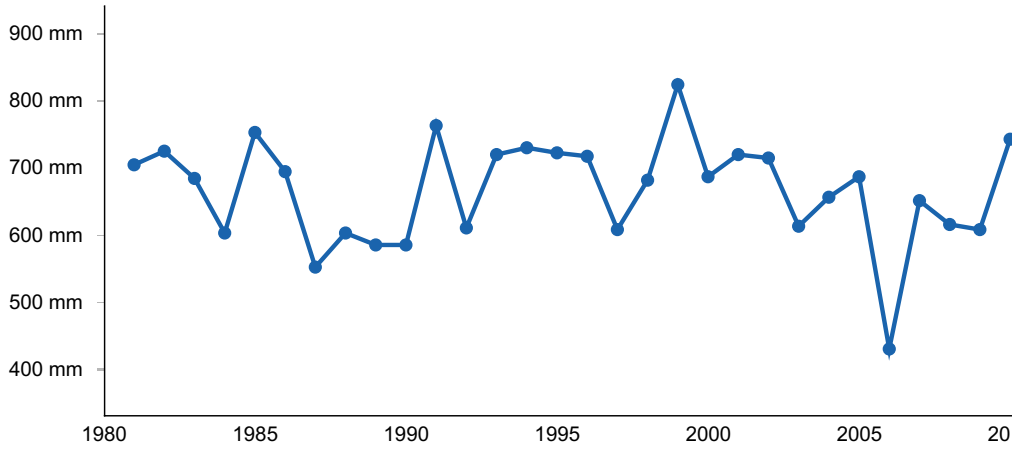


Figure 5. Annual precipitation pattern

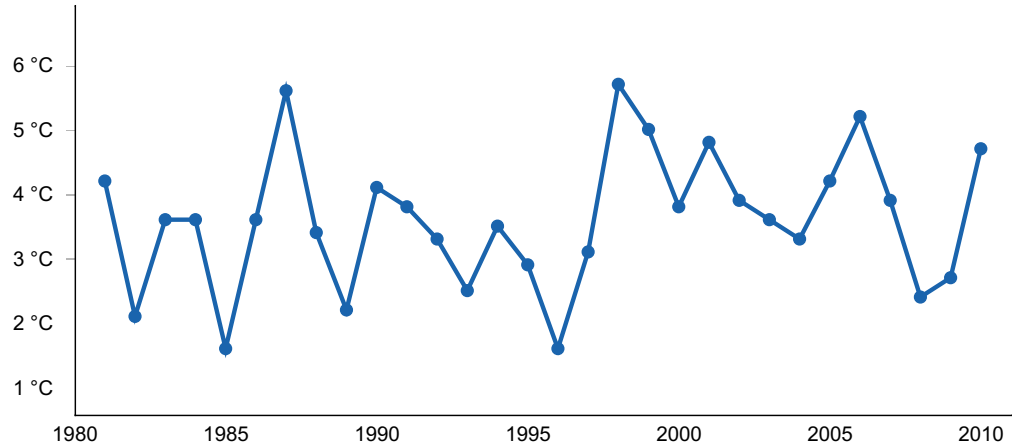


Figure 6. Annual average temperature pattern

Climate stations used

- (1) SANDY LAKE DAM LIBBY [USC00217460], McGregor, MN
- (2) FLOODWOOD 3 NE [USC00212842], Floodwood, MN
- (3) HIBBING CHISHOLM HIBBING AP [USW00094931], Hibbing, MN
- (4) EVELETH WWTP [USC00212645], Eveleth, MN
- (5) LEECH LAKE [USC00214652], Bena, MN
- (6) BIG FALLS [USC00210746], Big Falls, MN
- (7) RED LAKE INDIAN AGCY [USC00216795], Ponemah, MN
- (8) WASKISH 4NE [USC00218700], Big Falls, MN
- (9) CAMP NORRIS DNR [USC00211250], Beltrami Isl State for, MN
- (10) WARROAD [USC00218679], Warroad, MN
- (11) BAUDETTE INTL AP [USW00094961], Baudette, MN

Influencing water features

This site receives water through precipitation, runoff from uplands, and subsurface flow including direct flooding from riparian features. Flooding occurs rarely to frequently and variations in flooding regimes will directly affect the plant community composition.

Wetland description

Under the Cowardin System of Wetland Classification, or National Wetlands Inventory (NWI), the wetlands can be classified as:
1) Palustrine, forested, needle-leaved evergreen, saturated, or
2) Palustrine, scrub-shrub, broad-leaved deciduous, saturated, or
3) Palustrine, scrub-shrub, broad-leaved evergreen, saturated, or
4) Palustrine, emergent, persistent, saturated
Under the Hydrogeomorphic Classification System (HGM), these sites could be classified as: Depressional, forested/organic or Depressional, scrub-shrub/organic.

Soil features

All soils in the Floodplain Peatland ecological site are Histosols. Soils for this site can be further described as Typic Borosaprists, Fluvaquentic Haplosaprists, and Typic Haplosaprists. The soil series included in the Floodplain Peatland ecological site include Borosaprists, Bowstring, and Seelyeville.

Floodplain Peatland soils developed as organic materials over alluvium. They are very poorly drained, deep, and have relatively high available water capacity (13.4 to 17.7).

Table 4. Representative soil features

Parent material	(1) Organic material (2) Alluvium
Surface texture	(1) Muck
Drainage class	Very poorly drained
Permeability class	Moderately rapid
Depth to restrictive layer	0 cm
Soil depth	152–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	34.04–44.96 cm
Subsurface fragment volume <=3" (0-101.6cm)	0%
Subsurface fragment volume >3" (0-101.6cm)	0%

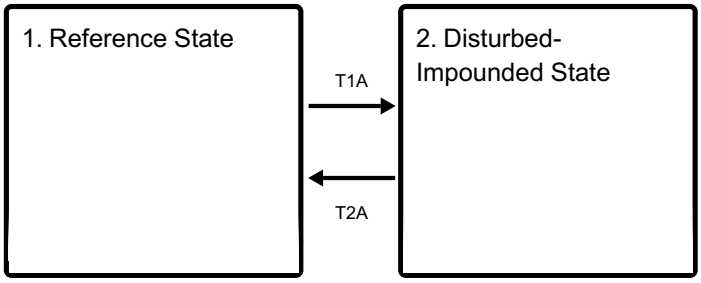
Ecological dynamics

This site is a wooded swamp on saturated, organic substrate of muck or mucky peat. This site is influenced by periodic flooding. Flooding intensity and frequency will result in variability in the plant community composition.

Historically, catastrophic disturbances were quite rare within this community. Stand replacing catastrophic storms occurred every 575 to 600 years. Catastrophic fires rarely occur, with an estimated occurrence every 920 years approximately (Minnesota Department of Natural Resources, 2005). Due to the saturated soils and shallow tree rooting systems, windthrow did cause smaller canopy-opening disturbances to occur at a shorter time interval. Hence, downed trees, displaced stumps, and sphagnum hummocks are characteristic for this site.

State and transition model

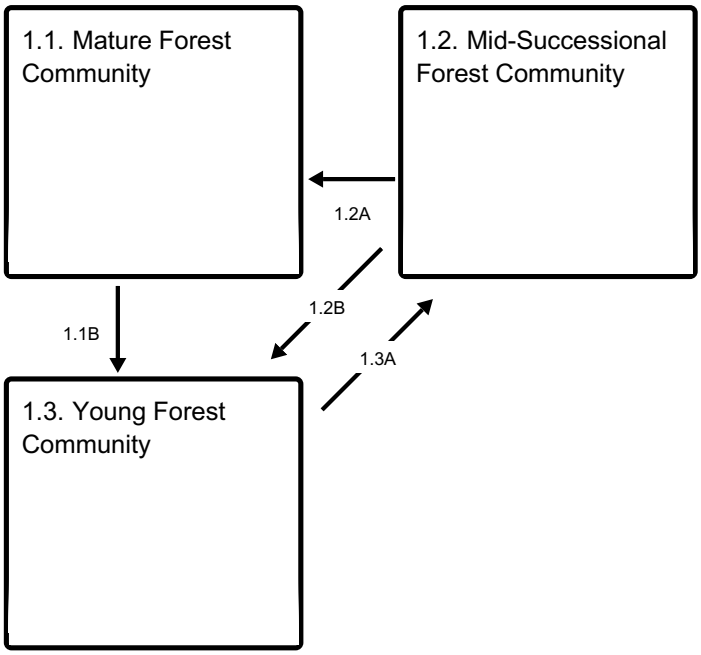
Ecosystem states



T1A - Disturbances that impound water, both natural and human made.

T2A - Restoration of natural hydrology

State 1 submodel, plant communities

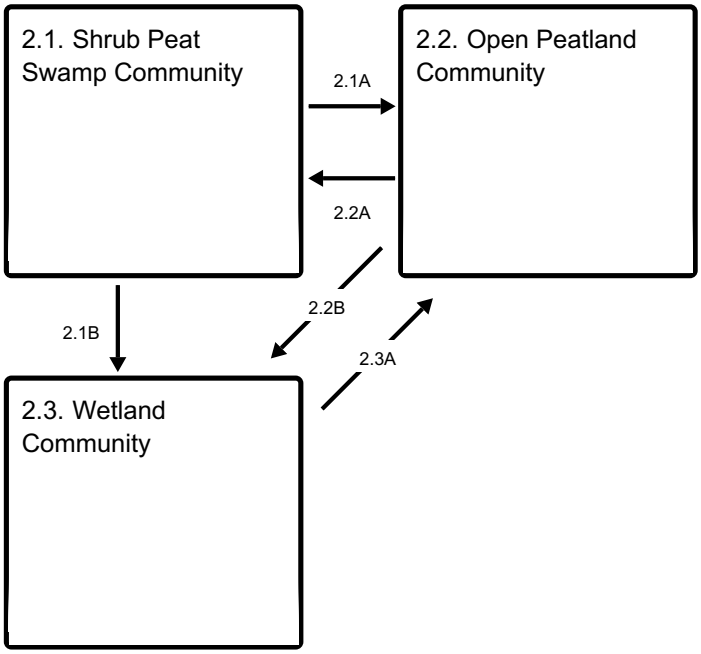


1.1B - Stand-replacing disturbance; canopy removal

1.2A - No severe site disturbances 70+ years

1.2B - Large-scale disturbance
1.3A - No major disturbance (35-75 years)

State 2 submodel, plant communities



2.1A - Increase in flooding/ponding length
2.1B - Beaver dam off-site restricts water flow or contributes to ponding on-site.
2.2A - Reduced flooding/ponding length.
2.2B - Increase in long-term flooding/ponding.
2.3A - Reduction of flooding/ponding occurrence and length.

State 1
Reference State

This state is a conifer-dominated swamp forest on very poorly drained peat soils. Species variability will occur depending on the depth, seasonality, and frequency of flooding/ponding. Catastrophic events are rare with fires occurring approximately every 920 years, stand-regenerating windthrow approximately every 600 years, and windthrow of small patches of canopy trees approximately every 380 years (Minnesota Department of Natural Resources. 2005.).

Dominant plant species

- balsam fir (*Abies balsamea*), tree
- arborvitae (*Thuja occidentalis*), tree
- black spruce (*Picea mariana*), tree
- paper birch (*Betula papyrifera*), tree
- tamarack (*Larix laricina*), tree
- black ash (*Fraxinus nigra*), tree
- gray alder (*Alnus incana*), shrub

- bog Labrador tea (*Ledum groenlandicum*), shrub
- alderleaf buckthorn (*Rhamnus alnifolia*), shrub
- softleaf sedge (*Carex disperma*), grass
- bristlystalked sedge (*Carex leptalea*), grass
- threeleaf goldthread (*Coptis trifolia*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous

Community 1.1
Mature Forest Community

This community is a mature, wet forest with a canopy cover generally between 50-80 percent. Trees on site include white cedar, black spruce, balsam fir, tamarack, birch, and black ash. Locally arborvitae (*Thuja occidentalis*) is commonly known as white cedar. Differences in flooding frequency and duration will influence the plant community. Understory plant diversity is often robust with numerous unique species such as showy lady's slipper (Cypripedium, reginae), small northern bog orchid (*Platanthera obtusata*), and tall northern bog orchid (*Platanthera hyperborea*).

Dominant plant species

- black spruce (*Picea mariana*), tree
- arborvitae (*Thuja occidentalis*), tree
- balsam fir (*Abies balsamea*), tree
- paper birch (*Betula papyrifera*), tree
- tamarack (*Larix laricina*), tree
- black ash (*Fraxinus nigra*), tree
- speckled alder (*Alnus incana ssp. rugosa*), shrub
- alderleaf buckthorn (*Rhamnus alnifolia*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- softleaf sedge (*Carex disperma*), grass
- bristlystalked sedge (*Carex leptalea*), grass
- threeleaf goldthread (*Coptis trifolia*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous

Community 1.2
Mid-Successional Forest Community

A transition period marked with an increase in canopy cover of *Thuja occidentalis* and intermediate patches of *Picea mariana*/*Abies balsamea*. The increase in canopy shading will benefit shade-tolerant ground layer species (*Rubus pubescens* and *Cornus canadensis*) and eventually reduce shrub density such as *Cornus sericea*.

Dominant plant species

- arborvitae (*Thuja occidentalis*), tree
- balsam fir (*Abies balsamea*), tree

- paper birch (*Betula papyrifera*), tree
- black spruce (*Picea mariana*), tree
- alder (*Alnus*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- sedge (*Carex*), grass
- dwarf red blackberry (*Rubus pubescens*), other herbaceous
- bunchberry dogwood (*Cornus canadensis*), other herbaceous

Community 1.3
Young Forest Community

A severe canopy-level disturbance such as fire or wind-throw alters the plant community in multiple ways. Sunlight to the forest floor increases dramatically and benefits plant species that prefer a higher level of light. Shrub density increases. Existing seed sources will determine the dominant tree seedlings and saplings initially on site.

Dominant plant species

- balsam fir (*Abies balsamea*), tree
- arborvitae (*Thuja occidentalis*), tree
- dogwood (*Cornus*), shrub
- blackberry (*Rubus*), shrub
- alder (*Alnus*), shrub
- sedge (*Carex*), grass
- bluejoint (*Calamagrostis canadensis*), grass
- fowl mannagrass (*Glyceria striata*), grass
- sphagnum (*Sphagnum*), other herbaceous

Pathway 1.1B
Community 1.1 to 1.3

Stand-replacing disturbance. Canopy layer removed.

Pathway 1.2A
Community 1.2 to 1.1

The successional community transition through time (70 + years) to a mature forest community.

Pathway 1.2B
Community 1.2 to 1.3

A large-scale disturbance can transition the community back to an earlier successional state.

Pathway 1.3A
Community 1.3 to 1.2

No major disturbances for multiple decades will allow for the increase in forest stand density and canopy cover.

State 2
Disturbed-Impounded State

This state is characterized by a long-term pattern of flooding/ponding extending beyond the spring season. This alteration can be caused by anthropogenic (road construction) activities, or natural impoundments can be caused by beaver dams. Tree mortality occurs when flooding/ponding depth and duration increase. Water impoundment of varying depths and extended durations results in substantial variations in plant community composition. Due to increased flooding/ponding duration a reduction in tree species diversity occurs and an increased wetland plant composition takes hold.

Dominant plant species

- arborvitae (*Thuja occidentalis*), tree
- black spruce (*Picea mariana*), tree
- balsam fir (*Abies balsamea*), tree
- speckled alder (*Alnus incana ssp. rugosa*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- currant (*Ribes*), shrub
- willow (*Salix*), shrub
- sedge (*Carex*), grass
- bluejoint (*Calamagrostis canadensis*), grass

Community 2.1
Shrub Peat Swamp Community

This community is characterized by a dominant shrub layer that includes speckled alder, redosier dogwood, and willows. Sedges and other graminoids tend to dominant the ground layer. Sun tolerant wetland forb species are common. Trees may be scattered but do not constitute a significant canopy cover.

Dominant plant species

- arborvitae (*Thuja occidentalis*), tree
- black spruce (*Picea mariana*), tree
- balsam fir (*Abies balsamea*), tree
- speckled alder (*Alnus incana ssp. rugosa*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- willow (*Salix*), shrub
- currant (*Ribes*), shrub

- bluejoint (*Calamagrostis canadensis*), grass
- softleaf sedge (*Carex disperma*), grass
- bristlystalked sedge (*Carex leptalea*), grass
- hairy sedge (*Carex lacustris*), grass
- marsh marigold (*Caltha*), other herbaceous
- eastern marsh fern (*Thelypteris palustris*), other herbaceous

Community 2.2
Open Peatland Community

This site is characterized by a variable shrub layer and an increase in graminoid cover. Tree cover is sparse or absent.

Dominant plant species

- bog birch (*Betula pumila*), tree
- arborvitae (*Thuja occidentalis*), tree
- speckled alder (*Alnus incana ssp. rugosa*), shrub
- willow (*Salix*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- hairy sedge (*Carex lacustris*), grass

Community 2.3
Wetland Community

The wetland community is characterized by long term flooding/ponding. Depending on depth of water, there will be areas with emergent and submergent aquatic vegetation, as well as scattered remnants of downed trees such as black spruce (*Picea mariana*) or arborvitae (*Thuja occidentalis*).

Dominant plant species

- hairy sedge (*Carex lacustris*), grass
- cattail (*Typha*), grass
- softstem bulrush (*Schoenoplectus tabernaemontani*), grass
- hardstem bulrush (*Schoenoplectus acutus*), grass
- shortspike watermilfoil (*Myriophyllum sibiricum*), other herbaceous
- broadleaf cattail (*Typha latifolia*), other herbaceous
- narrowleaf cattail (*Typha angustifolia*), other herbaceous
- northern wildrice (*Zizania palustris*), other herbaceous

Pathway 2.1A
Community 2.1 to 2.2

An increase in ponding/flooding length on the site continuing throughout much of the year will transition the plant community. Human activities, such as road building, or natural

blockages, such as beaver dam construction, may be the causal mechanism.

Pathway 2.1B
Community 2.1 to 2.3

An increase in ponding/flooding duration to most of the year or year-round on the site will transition the plant community towards aquatic plant species. Human activities or natural blockages, such as beaver dams, substantially increases ponding depth on the site longer than the open community.

Pathway 2.2A
Community 2.2 to 2.1

Reduction of flooding/ponding length on site outside of the spring season. Due to hydrological changes such as a failing beaver dams, mechanically changing drainageways, or changes to roadways.

Pathway 2.2B
Community 2.2 to 2.3

Flooding/ponding occurrence increases throughout the year due to natural or human caused activities.

Pathway 2.3A
Community 2.3 to 2.2

Reduction of flooding/ponding occurrence and length. Due to hydrological changes such as a failing beaver dams, mechanically changing drainageways, or changes to roadways.

Transition T1A
State 1 to 2

State 2 describes the alteration of natural hydrology causing water impoundment. Multiple causal factors can impound water and result in altered plant communities. Road construction and beaver dams are a common causal mechanism in addition to stream bank degradation.

Transition T2A
State 2 to 1

Restoration of natural hydrology through mechanical removal of beaver dams and hydrology altering roadways. Stream bank and channel restoration to a more natural state.

Additional community tables

Inventory data references

This is a provisional ecological site, and as such no field plots were inventoried for this project. A review of the scientific literature and expert opinion was used to develop the plant communities and ecological dynamics contained within the state and transition model. Future field verification is needed to refine the plant communities and ecological dynamics described in this ecological site description.

References

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Approval

Suzanne Mayne-Kinney, 8/12/2024

Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	08/12/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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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:**
