USDA Natural Resources Conservation Service

Ecological site F088XY002MN
Marsh

Last updated: 8/12/2024
Accessed: 09/27/2024

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

Relationship to Other Established Classifications:
MN DNR Native Plant Community (MN DNR, 2003); the reference community of this Provisional Ecological Site is most similar to:
MRn83 Northern Mixed Cattail Marsh
MRn93 Northern Bulrush-Spikerush Marsh
Cowardin: Palustrine, Emergent Wetland Persistent (PEMC)
United States Army Corps of Engineers (USACE) Wetland Plant Community: G; Shallow Marshes
Hydrogeomorphic System (USDA, 2008): DEPRESSION (discharge)

Ecological site concept

Marsh sites typically occurs on slightly concave landscape positions in closed depressions and drainage ways; and adjacent to open water along lakeshore, ponds, and near streams. Soil surface textures are typically peat, muck, or mucky-modified surface layers over variable parent materials. Soils are typically saturated on all horizons, frequently ponded, and inundated with water for very long duration, at least 7 out of 12 months.

Associated sites

F088XY007MN	**Wet Depressional Forest** Wet Depressional Forest occurs in shallow wetland basins, closed depressions, and generally in narrow transition zones between mineral uplands and peatlands. Soil surface layers are typically mucky-modified surface textures or muck less than 8” thick over variable parent materials.

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.

Similar 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.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Typha latifolia* (2) *Calamagrostis canadensis*

Physiographic features

This site occurs in depressions adjacent to open water along lakeshore, ponds, and near streams. These sites are subject to frequent ponding throughout the year. The ponding duration is long with possible depths over 150 cm above the surface. These sites have a stable water level and do not change seasonally, but the water table may drop during dry conditions or changes in drainage conditions. Runoff is negligible.

Table 2. Representative physiographic features

Slope shape across	(1) Linear
Slope shape up-down	(1) Linear
Landforms	(1) Depression (2) Lake plain > Drainageway (3) Lake plain > Depression
Runoff class	Negligible
Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	Frequent
Elevation	180–619 m
Slope	0–1%
Ponding depth	10–30 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).
The mean frost free period ranges from 84 to 110 days, with the mean freeze-free period ranging from 117 to 135 days.

Table 3. Representative climatic features

Frost-free period (characteristic range)	84-110 days
Freeze-free period (characteristic range)	117-135 days
Precipitation total (characteristic range)	635-711 mm
Frost-free period (actual range)	75-112 days
Freeze-free period (actual range)	114-141 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

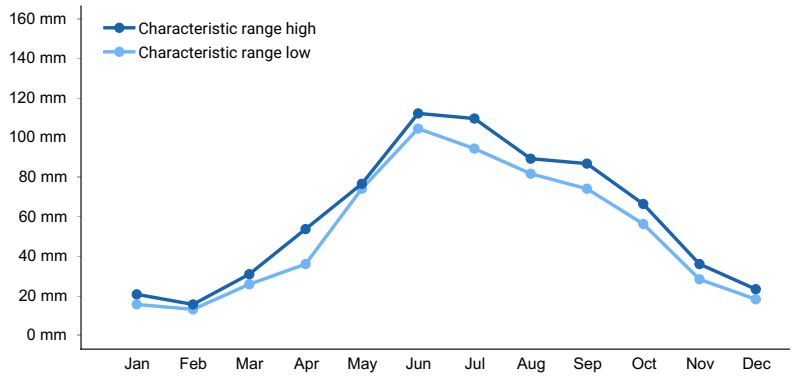


Figure 1. Monthly precipitation range

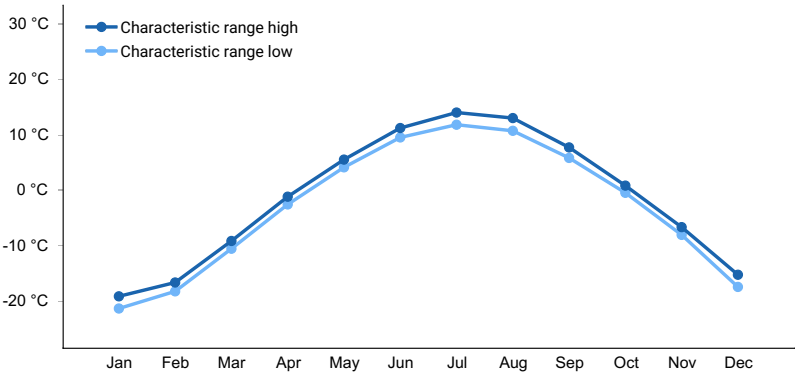


Figure 2. Monthly minimum temperature range

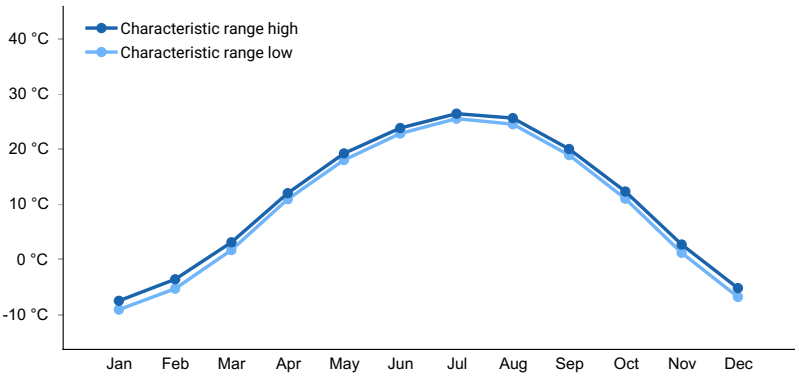


Figure 3. Monthly maximum temperature range

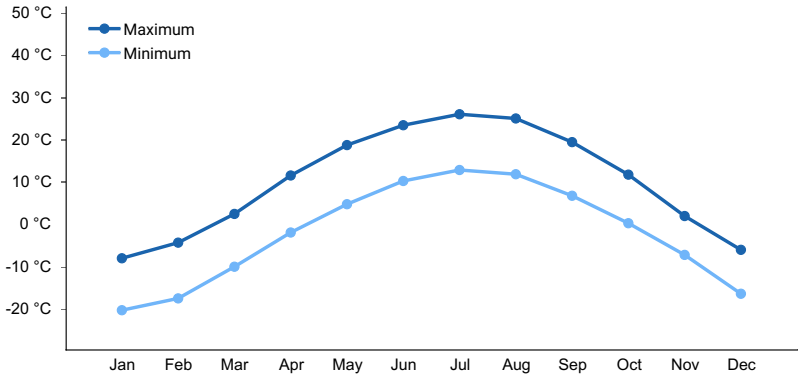


Figure 4. Monthly average minimum and maximum temperature

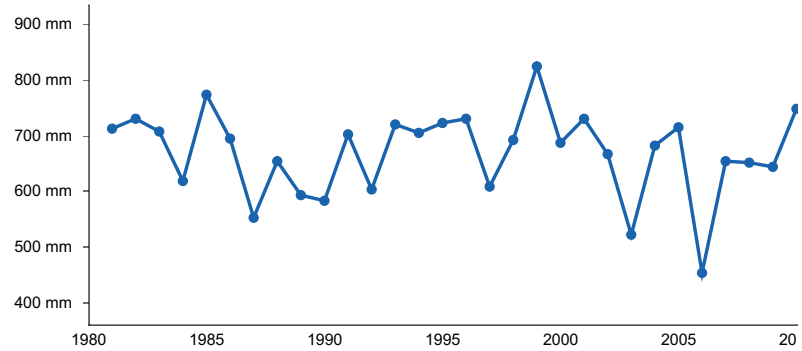


Figure 5. Annual precipitation pattern

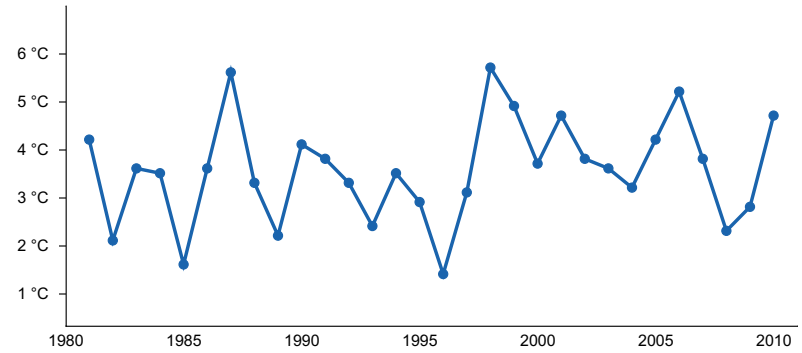


Figure 6. Annual average temperature pattern

Climate stations used

- (1) WARROAD [USC00218679], Warroad, MN
- (2) BAUDETTE INTL AP [USW00094961], Baudette, MN
- (3) CAMP NORRIS DNR [USC00211250], Beltrami Isl State for, MN
- (4) WASKISH 4NE [USC00218700], Big Falls, MN
- (5) RED LAKE INDIAN AGCY [USC00216795], Ponemah, MN
- (6) BIG FALLS [USC00210746], Big Falls, MN
- (7) LITTLEFORK 10 SW [USC00214809], Big Falls, MN
- (8) INTL FALLS INTL AP [USW00014918], International Falls, MN
- (9) LEECH LAKE [USC00214652], Bena, MN
- (10) POKEGAMA DAM [USC00216612], Cohasset, MN
- (11) GRAND RPDS FOREST LAB [USC00213303], Grand Rapids, MN
- (12) SANDY LAKE DAM LIBBY [USC00217460], McGregor, MN
- (13) FLOODWOOD 3 NE [USC00212842], Floodwood, MN
- (14) HIBBING CHISHOLM HIBBING AP [USW00094931], Hibbing, MN
- (15) EVELETH WWTP [USC00212645], Eveleth, MN

Influencing water features

Water is received through precipitation, runoff from adjacent uplands, and groundwater. Water levels are greatly influenced by ground water, precipitation rates and runoff from upland sites. Water leaves the site primarily through evapotranspiration and groundwater recharge. These sites are wetlands. The hydrology of Marsh sites significantly impacts their ecological development.

Wetland description

Under the Cowardin System of Wetland Classification, or National Wetlands Inventory (NWI), the wetlands can be classified as:
1) Palustrine, emergent, persistent, saturated or

Under the Hydrogeomorphic Classification System (HGM), the wetlands can be classified as:
1) Depressional, forested/organic, or

Permeability of the soil is very slow.
Hydrologic Group: A/D, B/D, C/D
Hydrogeomorphic Wetland Classification: Depressional, forested/organic, or
Cowardin Wetland Classification: PEM1B

Soil features

The Marsh ecological site typically occurs in a basin or closed depression, and receives water directly from precipitation and groundwater discharge. Soils are very poorly drained and formed in organic material. Permeability is very slow and the site will be ponded most of the year. The central concept soil series are Rifle, Greenwood, Lupton, and Cathro. Ponded water conditions and very slow permeability strongly influences the soil-water-plant relationship.

Table 4. Representative soil features

Parent material	(1) Organic material (2) Glaciolacustrine deposits (3) Till
Surface texture	(1) Peat (2) Mucky peat (3) Muck
Drainage class	Very poorly drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	0 cm
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	44.96–57.4 cm
Subsurface fragment volume <=3" (0-101.6cm)	0%
Subsurface fragment volume >3" (0-101.6cm)	0%

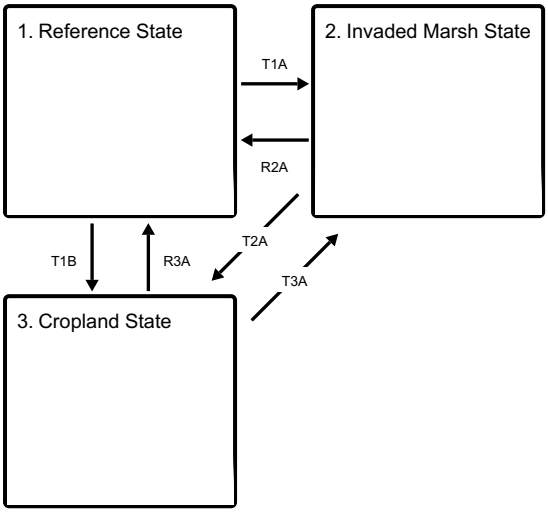
Ecological dynamics

Marsh sites typically occurs on level or slightly concave landscape positions in closed depressions, shallow wetland basins, drainage ways; and adjacent to open water along lakeshore, ponds, and near streams. Soils are typically endosaturated, frequently ponded, and inundated with water for very long duration, at least 7 out of 12 months.

Vegetation can be found rooting on floating mats (MNDNR 2003). Water sources include precipitation, surface flow, lateral flow, and groundwater discharge. The fluctuation of water levels on site are fairly stable (due to groundwater influences) and do not change seasonally, but can vary with drought or changes to drainage across the watershed.

State and transition model

Ecosystem states



T1A - Altered hydrology/invasion of exotic species

T1B - Tile drainage, tillage, herbicide use, and seeding.

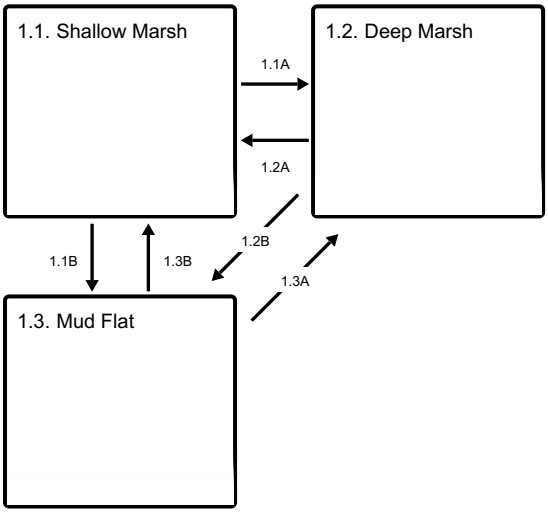
R2A - Complete hydrologic restoration of wetland basin, invasive species management, seeding, muskrat re-establishment.

T2A - Tile drainage, tilling, seeding, herbicides.

R3A - Complete hydrologic restoration of wetland basin, invasive species management, seeting, muskrat re-establishment.

T3A - Partial or complete hydrologic restoration of wetland basin; agricultural abandonment.

State 1 submodel, plant communities



1.1A - Increased water depth and duration/excessive precipitation years.

1.1B - Little or no spring ponding/drought.

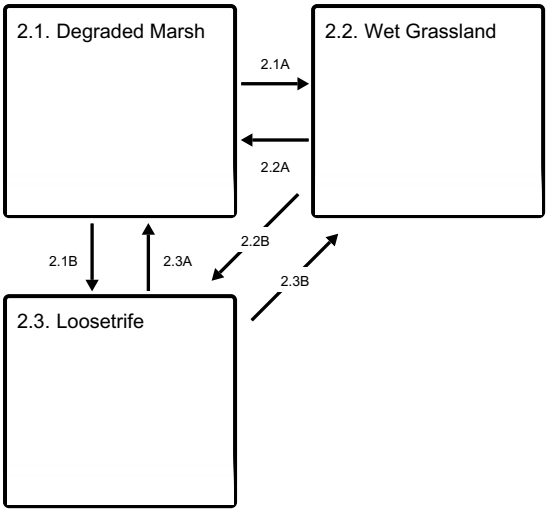
1.2A - Decreased water depth and duration, cattail dominance.

1.2B - Decreased water depth and duration; Little or no spring ponding/drought.

1.3B - Increased water depth and duration/excessive precipitation years.

1.3A - Increased water depth and duration/excessive precipitation years.

State 2 submodel, plant communities



2.1A - Draw-down or partial drainage.

2.1B - Invasion of exotic purple loosestrife

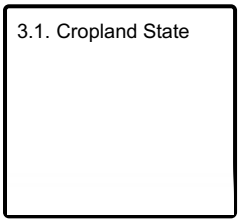
2.2A - Increased water depth and duration/excessive precipitation years.

2.2B - Invasion of exotic purple loosestrife.

2.3A - Chemical, mechanical removal of purple loosestrife, and use of biocontrol.

2.3B - Chemical, mechanical removal of purple loosestrife, and use of biocontrol.

State 3 submodel, plant communities



State 1
Reference State

This state identifies the condition of Marsh prior to European settlement. Community phases within the Reference State are dependent upon ponding during the spring months. During drier times of the year, this site would burn regularly with the prairie fires that were common in the region. Woody species and upland grasses were kept from proliferating mainly by saturated conditions. The plants that dominate these community phases are adapted to long periods of inundation, having stems, leaves, and roots that diffuse oxygen from the air and store it in specialized cells (aerenchyma) (MN DNR 2003). Dominant species in this state include broadleaf cattail, river bulrush, softstem bulrush, giant bur-reed and water knotweed (Cowardin 2013). While extensive acres of Marsh may still be found in MLRA 88, of those that still exist, it is likely that the hydrology has at least been slightly modified due to road development, tile drainage, ditching, and channelization elsewhere in the watershed(s), and invasion by exotic species is common (see State 2).

Dominant plant species

- river bulrush (*Bolboschoenus fluviatilis*), grass
- softstem bulrush (*Schoenoplectus tabernaemontani*), grass
- bluejoint (*Calamagrostis canadensis*), grass
- broadleaf cattail (*Typha latifolia*), grass
- water knotweed (*Polygonum amphibium*), other herbaceous
- broadfruit bur-reed (*Sparganium eurycarpum*), other herbaceous

Community 1.1
Shallow Marsh

Cattails, bulrushes, and arrowheads establish in rising water levels, utilizing rhizomes, aerenchyma, and taller vegetation structures to remain established on-site as water levels rise. If water levels remain stable for a long period of time, this phase can lose diversity and may become comprised of only one or two species, usually cattail.

Dominant plant species

- bulrush (*Scirpus*), grass
- bulrush (*Schoenoplectus*), grass
- bulrush (*Bolboschoenus*), grass
- cattail (*Typha*), other herbaceous
- broadleaf arrowhead (*Sagittaria latifolia*), other herbaceous

Community 1.2
Deep Marsh

As water levels rise and remain persistently high, floating species such as duckweeds and common white water lily become more frequent, as well as submerged species such as bladderworts, common coontail, and Canadian elodea (MN DNR 2003). In areas with more wave action, such as along stream beds or lakeshores, spikerushes, pondweeds, and watermilfoils may be more common (MN DNR 2003). Graminoids typically are found in patches, and can have variable cover across the site, interspersed by open water, and can include softstem bulrush, hard stem bulrush, river bulrush, slender bulrush, and Small's spikerush (MN DNR 2003).

Dominant plant species

- softstem bulrush (*Schoenoplectus tabernaemontani*), grass
- hardstem bulrush (*Schoenoplectus acutus*), grass
- river bulrush (*Bolboschoenus fluviatilis*), grass
- slender bulrush (*Schoenoplectus heterochaetus*), grass
- dwarf spikerush (*Eleocharis parvula*), grass
- common duckweed (*Lemna minor*), other herbaceous
- common duckmeat (*Spirodela polyrrhiza*), other herbaceous
- Columbian watermeal (*Wolffia columbiana*), other herbaceous
- American white waterlily (*Nymphaea odorata*), other herbaceous
- coon's tail (*Ceratophyllum demersum*), other herbaceous

Community 1.3
Mud Flat

Water level drawdowns occur due to drought or diversion of water off-site due to beaver activity. Beggarticks and smartweeds germinate rapidly and prolifically on freshly exposed substrates and may find refuge on floating mats once water levels rise. Most of the submerged and floating species present in 1.2 are not resistant to desiccation and will disappear in this phase.

Dominant plant species

- beggarticks (*Bidens*), other herbaceous
- knotweed (*Polygonum*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

Increased water depth and duration/excessive precipitation years which cause higher energy water and wave action.

Pathway 1.1B
Community 1.1 to 1.3

Little or no spring ponding/drought. One example of where this can occur is on the dry side of beaver dam construction.

Pathway 1.2A
Community 1.2 to 1.1

Decreased water depth and duration, cattail dominance which causes Lower energy water and wave action.

Pathway 1.2B
Community 1.2 to 1.3

Decreased water depth and duration; Little or no spring ponding/drought. One example of where this can occur is on the dry side of beaver dam construction. Also, potentially severe drought could create mudflats if the marsh is primarily fed by runoff/precipitation with limited groundwater inputs.

Pathway 1.3B
Community 1.3 to 1.1

Increased water depth that may potentially fluctuate in duration. It may occur with excessive precipitation years. This increased depth leads to an increase in cattails, bulrushes, and arrowheads. If the depth increases further this plant community will transition to a deep marsh plant community.

Pathway 1.3A
Community 1.3 to 1.2

Water levels rise and remain persistently high. Rapid increased water depth and duration/excessive precipitation years. This leads to cattails, bulrushes, and arrowheads having no chance to establish or they only may establish in patches. Floating species become more frequent, as well as submerged species (MN DNR 2003).

State 2
Invaded Marsh State

Sites in this state may be in set-aside conservation easements. Areas not in a conservation program are assumed to be jurisdictional wetlands, making it very unlikely they will be transitioned to the Cropland State due to various wetland programs and laws, including the Swampbuster provision of the Food Security Act of 1985 (P.L. 99-198, as amended by P.L. 115-25) and the Minnesota Wetland Conservation Act (WCA) of 1991 (M.R. 8420.0100, as amended in 2009).

Dominant plant species

- reed canarygrass (*Phalaris arundinacea*), grass
- common reed (*Phragmites australis*), grass
- hybrid cattail (*Typha ×glauca*), grass
- narrowleaf cattail (*Typha angustifolia*), grass
- broadleaf cattail (*Typha latifolia*), grass
- purple loosestrife (*Lythrum salicaria*), other herbaceous
- broadfruit bur-reed (*Sparganium eurycarpum*), other herbaceous

Community 2.1
Degraded Marsh

Common reed is considered an invasive species, even though it has been present in North American wetlands for over 3,000 years, because its aggressive expansion, usually attributed to disturbances, has greatly increased over the last 50 years (Mitsch, 2015). The presence of invasive cattails or common reed is usually an indicator of altered hydrology and increases in salinity and nutrients. Burning and herbicide application are used for control. There are some desirable varieties of common reed, so managers need to be aware of the distinctions in haplotypes and how to identify them (Mitsch, 2015). Hybrid cattail and common reed have been more problematic in this region, in that they both have expanded more aggressively by replacing bulrushes and giant bur-reed as dominants (Eggers, 1997). narrow-leaved cattail tolerates more mixosaline and calcareous waters than broadleaf cattail. Narrow-leaved cattail tolerates higher levels of nutrient inputs, usually from agricultural runoff. Broad-leaved and narrow-leaved

cattail freely hybridize to form the hybrid, Typha x glauca Gordon (Eggers, 1997).

Dominant plant species

- common reed (*Phragmites australis*), grass
- narrowleaf cattail (*Typha angustifolia*), other herbaceous
- broadleaf cattail (*Typha latifolia*), other herbaceous
- hybrid cattail (*Typha ×glauca*), other herbaceous

Community 2.2
Wet Grassland

Disturbances such as artificial drainage, plowing, mechanized land-clearing, road construction, excessive sediment and/or nutrient inputs, allow reed canary grass to outcompete native plants and form monocultures, reducing diversity and ecosystem function. Shrubs can also invade in this phase of lowered water levels and altered hydrology.

Dominant plant species

- common buckthorn (*Rhamnus cathartica*), shrub
- reed canarygrass (*Phalaris arundinacea*), grass

Community 2.3
Loosetrife

Purple loosestrife has spread across much of North American marshes in the late 20th century, displacing literally every other native plant on-site, including Typha sp. (Mitsch 2015). It is often associated with wetlands that have been disturbed by agricultural use, drainage, pasturing, siltation, or water level fluctuations (Eggers, 1997). This is of great concern to managers, who care about the functions of the site for water quality and wildlife habitat, which is dependent upon a diversity of plant species present on-site.

Dominant plant species

- purple loosestrife (*Lythrum salicaria*), grass

Pathway 2.1A
Community 2.1 to 2.2

Drawdown of water levels due to water diversion or use throughout the watershed, partial drainage of the site due to ditching, or other impediments to water flow into the site

Pathway 2.1B
Community 2.1 to 2.3

Invasion of exotic purple loosestrife

Pathway 2.2A
Community 2.2 to 2.1

Increased water flow into site or ponding on site.

Pathway 2.2B
Community 2.2 to 2.3

Invasion of exotic purple loosestrife.

Pathway 2.3A
Community 2.3 to 2.1

Chemical (herbicide approved for use in wetlands), mechanical removal of purple loosestrife, use of biocontrol (loosestrife beetles).

Pathway 2.3B
Community 2.3 to 2.2

Chemical (herbicide approved for use in wetlands), mechanical removal of purple loosestrife, use of biocontrol (loosestrife beetles).

State 3
Cropland State

In the Cropland State, most ecological functions have been destroyed, converted, or otherwise removed from the system. In farmed conditions, dynamic soil properties such as bulk density, structure, organic carbon content and saturated hydraulic conductivity can change quickly because of various agricultural practices. Many of these sites are and will likely continue to be in corn and soybean production. There are certain management practices that are proven to be destructive, not only to the individual field, but to the watershed.

Dominant plant species

- corn (*Zea mays*), grass
- soybean (*Glycine*), other herbaceous

Community 3.1
Cropland State

Certain practices can mediate the destructive effect of traditional agricultural practices on the soil resource. Conservation tillage that minimizes soil disturbance is more sustainable than traditional methods. Corn and/or soybean plantings with a cover crop rotation can help to build soil structure, improve infiltration rates, reduce runoff and erosion and have a comparatively positive effect on the overall environment.

Dominant plant species

- corn (*Zea mays*), grass
- soybean (*Glycine*), other herbaceous

Transition T1A
State 1 to 2

Hydrologic alterations can, over time, transition the reference depressional marsh community into an invaded marsh state. A variety of invasive woody plants and grasses can become established and spread, shading out native species. Common non-native species that invade this state include narrowleaf cattail, hybrid cattail, reed canarygrass, common reed, purple loosestrife, and various small woody plants.

Transition T1B
State 1 to 3

To transition to the cropland state, subsurface tile drainage of the site must be utilized, as well as tillage, herbicide use, and seeding. Human driven hydrologic alterations can transition the reference depressional marsh state into a crop land state.

Restoration pathway R2A
State 2 to 1

Complete hydrologic restoration of wetland basin, invasive species management, seeding, muskrat re-establishment.

Transition T2A
State 2 to 3

To transition to the cropland state, subsurface tile drainage of the site must be utilized, as well as tillage, herbicide use, and seeding.

Restoration pathway R3A
State 3 to 1

Complete hydrologic restoration of wetland basin, invasive species mangement, seeting, muskrat re-establishment.

Restoration pathway T3A
State 3 to 2

From an abandoned Crop Production state, it may only take several years to transition to this state. This transition involves partial or complete hydrologic restoration of the wetland basin, and agricultural abandonment.

Additional community tables

Inventory data references

Information presented was derived from Minnesota Department of Natural Resources Field Guide to the Native Plant Communities of Minnesota, USDA-NRCS soil survey information, and USDA Plants Database.

Other references

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Contributors

Kade Anderson, Ecological Site Specialist for North Central Region
Patty Burns, Soil Scientist at Bemidji Soil Survey Office
Stacey Clark, Former Regional Ecologist for Regions 10 & 11
Ezra Hoffman, Ecological Site Specialist for North Central Region
Landon Wolter, Rangeland Management Specialist for North Central Region

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:**

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):**

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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:**
