USDA Natural Resources
Conservation Service

Ecological site R102DY038SD
Calcareous Fen

Last updated: 4/22/2025
Accessed: 12/19/2025

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): 102D–Prairie Coteau

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This area makes up about 7,867 square miles (20,375 square kilometers), consisting mostly of nearly level to undulating till plains with potholes and moraines. Elevation ranges from 1,150 to 2,130 feet (350 to 650 meters). The average annual precipitation is 22 to 29 inches (559 to 734 millimeters). The average annual temperature is 42 to 45 degrees F (6 to 7 degrees C). The dominant soil order in this MLRA is Mollisols. The soils in this area dominantly have a frigid temperature regime, and an aquic or udic moisture regime. They are generally very deep and loamy. Soils range from well drained to very poorly drained. Parent materials are dominantly fine-loamy till to clayey material, with smaller amounts of outwash, glaciofluvial deposits, eolian deposits, alluvium, and, to a lesser extent, loess and organic materials.

Classification relationships

Fenneman (1916) Physiographic Regions
Division - Interior Plains
East:
Province - Central Lowland
Section - Western Lake / Dissected Till Plains (12b/12e)

USFS (2007) Ecoregions
Domain - Humid Temperate
Division - Prairie

Province - Prairie Parkland (Temperate)
Section - North-Central Glaciated Plains (251B)

EPA Ecoregions (Omernik 1997)
I - Great Plains (9)
II - Temperate Prairies (9.2)
III - Aspen Parkland/Northern Glaciated Plains (9.2.1)

Ecological site concept

The Calcareous Fen ecological site represents a highly calcareous organic soil area which can be located on hillsides, lake/pond shorelines, and mounds on glacial outwash channels. Calcareous fens develop under very localized and uncommon hydrogeologic conditions where there are upwellings or lateral flows of mineral rich groundwater. Unlike many terrestrial ecological sites, calcareous fens do not have a single, uniform plant community. Instead, they are a wetland complex typically comprised of different structural parts each with its own plant community or vegetation zone.

Associated sites

R102DY002SD	**Linear Meadow** These sites occur in drainageways or along the edges of closed depressions. Soils are poorly and very poorly drained which have a water table within 0 to 2 feet of the soil surface that persists longer than the wettest part of the growing season typically until the month of August. The central concept soil series are Vallers and Colvin, but other series are included.
R102DY006SD	**Limy Subirrigated** These sites occur along the edges of drainageways. Soils are somewhat poorly drained which have a water table within 2 to 5 feet of the soil surface that persists longer than the wettest part of the growing season typically until the month of August. Soils will effervesce with acid at or near the surface. The central concept soil series is Cubden, Hamerly, McKranz, but other series are included.
R102DY010SD	**Loamy** These sites occur on upland areas. The soils are well drained and have less than 40 percent clay in the surface and subsoil. The central concept soil series is Barnes, Forman, and Poinsett, but other series are included.
R102DY012SD	**Thin Upland** These sites occur on uplands. Soils are well drained and will effervesce with acid at or near the surface. The central concept soil series is Buse, Hattie, Langhei, and Zell, but other series are included.

Table 1. Dominant plant species

Tree	Not specified

Shrub	Not specified
Herbaceous	(1) *Carex prairea* (2) *Schoenoplectus pungens*

Physiographic features

The Calcareous Fen ecological site is located in depressions and fens on moraines and lake plains. These sites have 0-2 percent slope.

Table 2. Representative physiographic features

Landforms	(1) Ground moraine
Runoff class	Very low
Ponding duration	Very long (more than 30 days)
Ponding frequency	Frequent
Elevation	262–649 m
Slope	1–25%
Ponding depth	15 cm
Water table depth	Not specified
Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation is 22 to 28 inches. Half or more of the precipitation falls during the growing season. Rainfall typically occurs during high-intensity, convective thunderstorms in summer. In the western part of the MLRA, rainfall is less abundant and not always adequate for full maturation of crops. Precipitation in winter is typically snow. The average annual temperature is 42 to 45 degrees F. The freeze-free period averages 142 days and ranges from 131 to 150 days.

Table 3. Representative climatic features

Frost-free period (characteristic range)	113-130 days
Freeze-free period (characteristic range)	135-151 days
Precipitation total (characteristic range)	610-686 mm
Frost-free period (actual range)	104-131 days
Freeze-free period (actual range)	130-152 days
Precipitation total (actual range)	559-711 mm
Frost-free period (average)	121 days

Freeze-free period (average)	143 days
Precipitation total (average)	660 mm

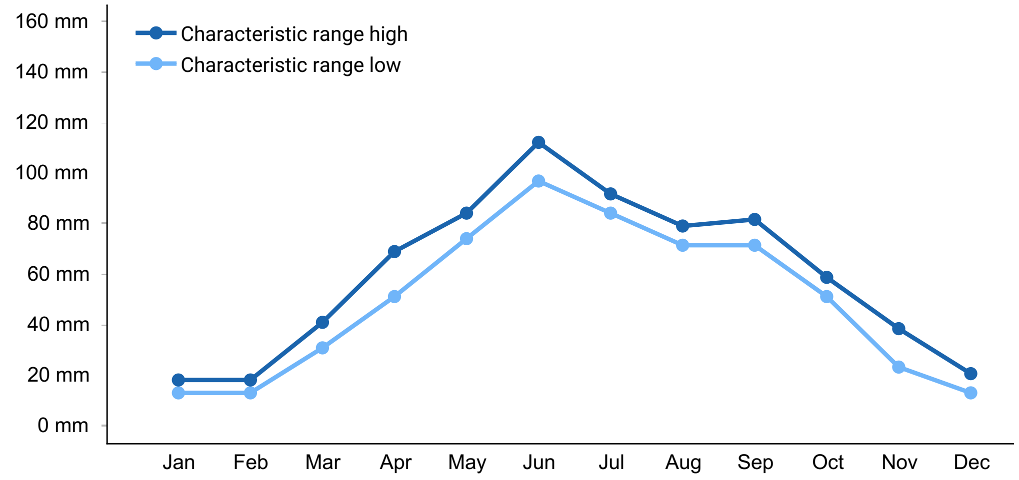


Figure 1. Monthly precipitation range

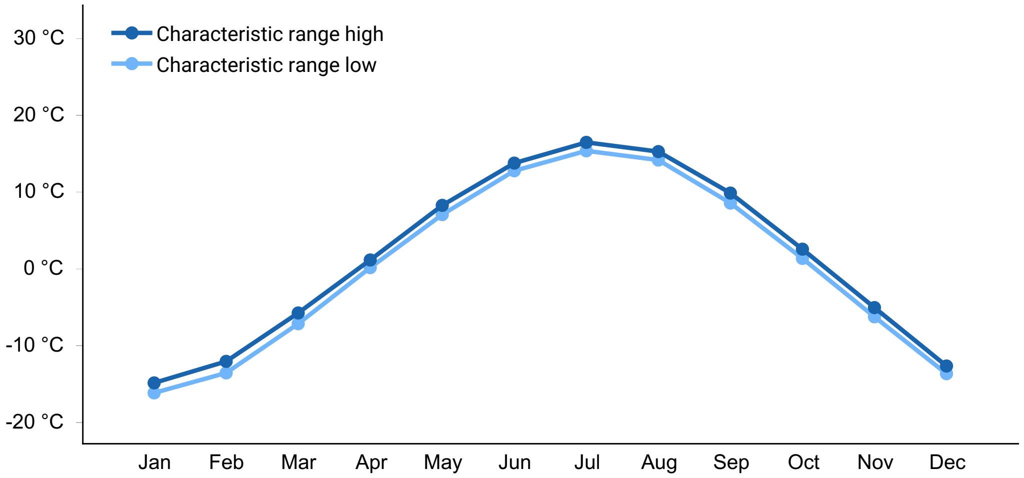


Figure 2. Monthly minimum temperature range

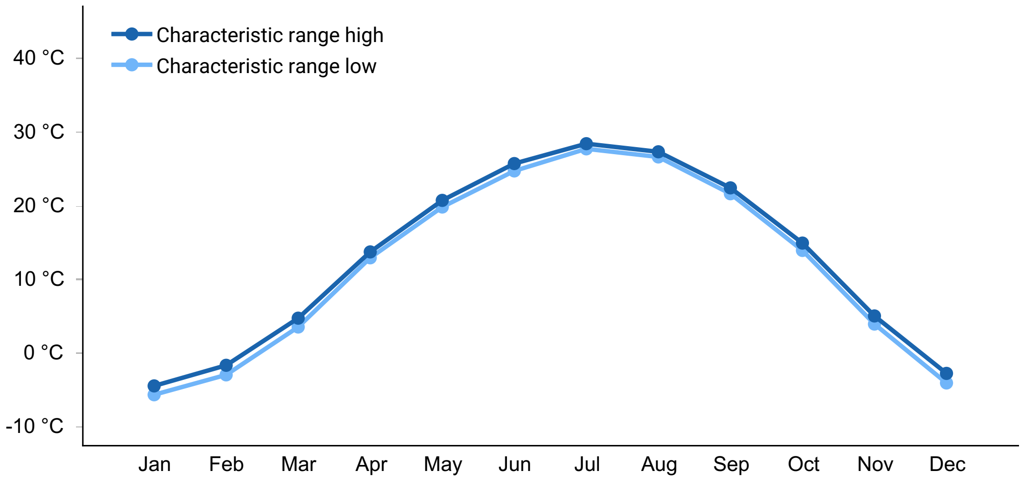


Figure 3. Monthly maximum temperature range

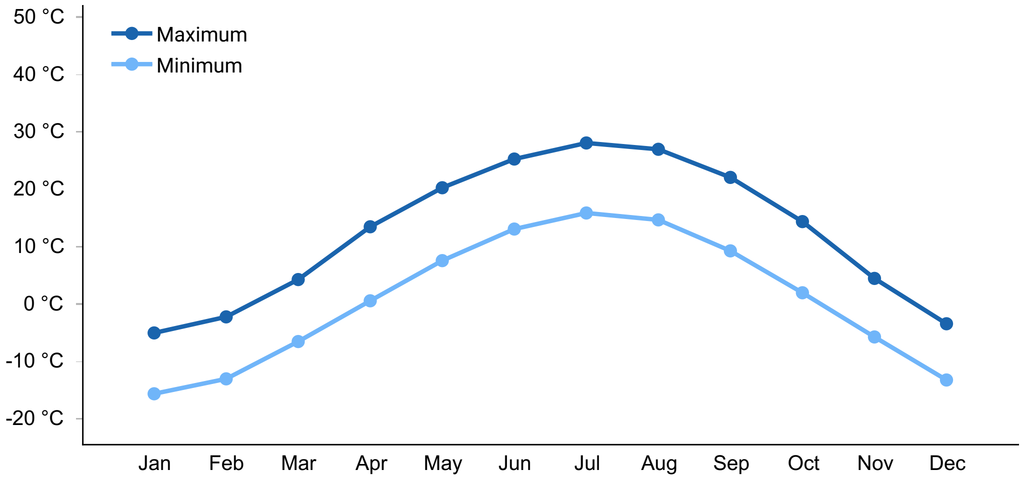


Figure 4. Monthly average minimum and maximum temperature

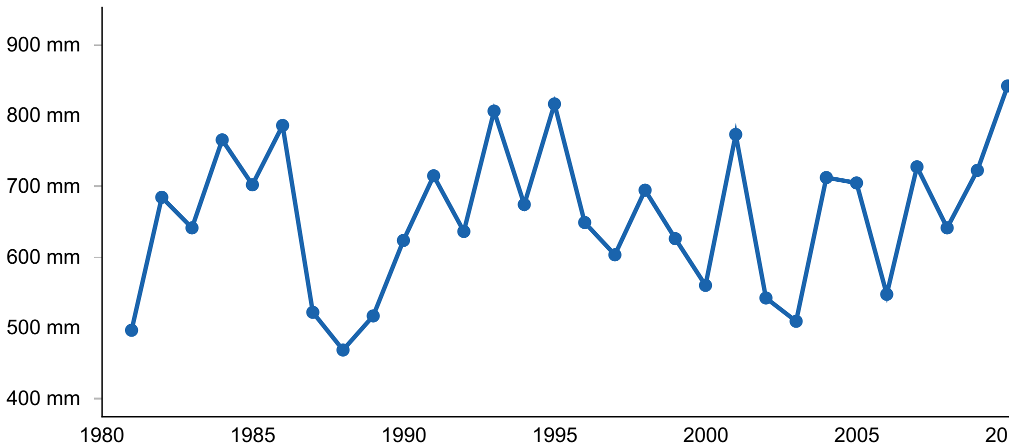


Figure 5. Annual precipitation pattern

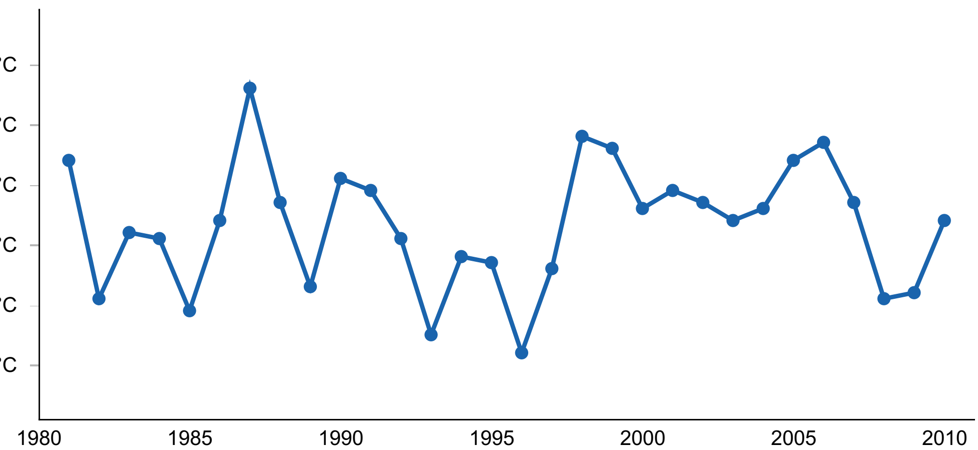


Figure 6. Annual average temperature pattern

Climate stations used

- (1) ROY LAKE [USC00397326], Lake City, SD
- (2) BROOKINGS 2 NE [USC00391076], Brookings, SD
- (3) ASTORIA 4S [USC00390422], White, SD
- (4) TYLER [USC00218429], Tyler, MN

- (5) PIPESTONE [USC00216565], Pipestone, MN
- (6) LAKE WILSON [USC00214534], Lake Wilson, MN
- (7) WAUBAY NWR [USC00398980], Waubay, SD
- (8) WEBSTER [USC00399004], Webster, SD
- (9) SUMMIT 1 W [USC00398116], Summit, SD
- (10) CLARK [USC00391739], Clark, SD
- (11) WATERTOWN RGNL AP [USW00014946], Watertown, SD
- (12) WATERTOWN 1W [USC00398930], Watertown, SD
- (13) CASTLEWOOD [USC00391519], Castlewood, SD
- (14) CLEAR LAKE [USC00391777], Clear Lake, SD
- (15) CANBY [USC00211263], Canby, MN
- (16) DE SMET [USC00392302], De Smet, SD
- (17) ARLINGTON 1 W [USC00390281], Arlington, SD

Influencing water features

Ponded water conditions and calcareous organic material strongly influences the soil-water-plant relationship. Very localized and uncommon hydrogeologic conditions where there are upwellings or lateral flows of mineral rich groundwater provides the framework for organic soil production and wetland plant communities.

Wetland description

Under the Cowardin wetland classification system this site falls into the Palustrine Emergent Wetland.

Soil features

The common soil features of soils in this site are the calcareous mucky peat subsoil. The soils in this site are very poorly drained and formed in organic deposits within glacial moraines. The peat (fibric material) organic surface layer is 8 to 12 inches thick. The saturated hydraulic conductivity is very high to high and a constant positive water potential is at the surface in all months of the year. A crust consisting of calcium carbonate, manganese, and iron about 1 to 5 inches thick is common in some areas. The soils show no evidence of rills, wind scoured areas, or pedestalled plants. The soil surface is stable and intact. Subsurface soil layers are nonrestrictive to water movement and root penetration. These soils are not susceptible to water erosion. Ponded water conditions and calcareous organic material strongly influences the soil-water-plant relationship. This site is represented by the Seelyeville soil series.

Table 4. Representative soil features

Parent material	(1) Organic material
Surface texture	(1) Peat (2) Mucky peat

Drainage class	Very poorly drained
Permeability class	Slow to moderately slow
Soil depth	203 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (Depth not specified)	28.96–37.85 cm
Calcium carbonate equivalent (Depth not specified)	60%
Electrical conductivity (Depth not specified)	2 mmhos/cm
Soil reaction (1:1 water) (Depth not specified)	6.6–7.8
Subsurface fragment volume <=3" (Depth not specified)	5%
Subsurface fragment volume >3" (Depth not specified)	2%

Ecological dynamics

Unlike many terrestrial ecological sites, calcareous fens do not have a single, uniform plant community. Instead, they are a wetland complex typically comprised of different structural parts each with its own plant community or vegetation zone. Calcareous fens develop under very localized and uncommon hydrogeologic conditions where there are upwellings or lateral flows of mineral rich groundwater. On a glacial landscape, these rare hydrogeologic conditions are generally limited to three topographic locations: hillsides, lake/pond shorelines, and mounds on glacial outwash channels (Amon et al. 2002). These groundwater discharge sites support wetland plants whose root materials do not decompose because they are constantly suspended in cold, anoxic water. Peat deposits typically range from a few feet thick to over 10 feet thick representing thousands of years of accumulation (Malterer et al. 1988, Miner and Ketterling 2003, Yu et al. 2003).

Groundwater minerals consist primarily of calcium and other carbonates which are held in suspension until the water is discharged at the surface whereby these carbonates precipitate out of solution and form layers or deposits of marl (calcium rich mud or mudstone) and tufa (porous, crunchy rock of calcium carbonate). A typical fen complex consists of a small, circular or linear discharge zone often with a floating mat of vegetation. Below the discharge zone are often marl flats or slopes with relatively short, sparse vegetation interrupted by small pools of standing water. This transitions into a border zone or zones of wetland vegetation typically with a sharp or gradual transition from organic substrates to the mineral soils of more common, surrounding wetland or upland vegetation.

Discharge zone vegetation (often a floating mat) is relatively species poor and often dominated by coarse sedges and cattails, e.g. water sedge (*Carex aquatilis*), and broadleaf cattail (*Typha latifolia*), whereas the marl flat zone is typically very species rich and dominated by shorter, finer leaved graminoids, e.g. common threesquare (*Schoenoplectus pungens*), needle beaksedge (*Rhynchospora capillacea*), prairie sedge (*Carex prairea*), spiked muhly (*Muhlenbergia glomerata*), and marsh arrowgrass (*Triglochin palustris*). Marl flats also have an abundance of calcium loving and distinctive forbs, e.g. grass of Parnassus (*Parnassia glauca*), Ontario lobelia (*Lobelia kalmii*), lesser fringed gentian (*Gentianopsis virgata*), and northern bog aster (*Symphyotrichum boreale*). A floating-leaved aquatic plant – the lesser bladderwort (*Utricularia minor*) is frequently found in the tiny pools of water that occur throughout the marl flat zone, as is stonewart (Chara spp.) which, although it looks like a submerged aquatic vascular plant, is actually a multicelluar algae.

Below or outside of the marl flat may be border zones of wetland vegetation. These may vary from wet meadow types dominated by fine-stemmed grasses and sedges, e.g. bluejoint (*Calamagrostis canadensis*), or prairie cordgrass (*Spartina pectinata*); to deep marsh vegetation of cattails and bulrushes, or the water may converge into a stream channel along the downslope edge of the marl flat with riparian vegetation including shrubs.

In a study of Midwestern fens across 11 states, including South Dakota, Amon, et al. (2002) concluded that calcareous fens could best be distinguished from other wetland types by 4 characteristics: 1) they are dependent upon mineral rich groundwater discharge which moves through and saturates the root zone for most of the year; 2) unlike ponded wetlands, they do not experience flooding or long term inundation; 3) they develop organic soils, not from sphagnum mosses, but from fibrous roots and brown mosses, and develop carbonate deposits like marl and tufa; 4) they have botanically diverse plant communities dominated by non-emergent graminoids.

In one respect, calcareous fens are extremely stable, undisturbed environments. Only a continuously saturated, anoxic environment could allow the accumulation of peat deposits of 3 to 10 feet thick typical of many calcareous fens. Given the vagarity of the climate on the Great Plains including long term droughts, it is even more remarkable that such permanent and stable saturated conditions have persisted even on such a small scale as these fens. By the same token, these calcareous fens are embedded in a landscape where bison were abundant and prairie fires were frequent. Because of the soft, saturated peaty substrates and floating mats of vegetation fens are somewhat dangerous to large animals who may break through and become bogged down and eventually die in these fens. It seems likely that given alternative water holes, bison and elk would have avoided these boggy traps. Likewise, while prairie fires would have burned across the surface, the perpetually saturated nature of a fen precludes the damage or consumption of the peaty substrates. The fens that did dry up, would have been consumed by fire.

Most calcareous fens are small in size, rarely more than a few acres, which makes them especially vulnerable to hydrologic alteration, ground or surface water pollution, excessive trampling by livestock, invasion by exotic plant species, and easily damaged by herbicide drift or direct application of herbicides. While many calcareous fens discharge water that ultimately ends up in natural streams or ponds (which provide readily accessible water for livestock), some fens have dispersed flows into wetlands. Many such fens have been altered by ditching, damming or excavating for stock ponds. Ditching drains the water away from the root zone making those substrates unsuitable for wetland plants. Without constant saturation, the peat and organic soil begins to oxidize and decompose.

The hydrology of calcareous fens is complicated and difficult to quantify (Thompson et al. 1992, Almendinger and Leete 1998). Clearly these fens depend upon a reliable quantity and quality of groundwater discharge. Ditching alters the hydrology at the fen itself, but the hydrology can also be altered at the recharge end of the aquifer. Gravel mines can remove substantial portions of a near surface aquifer that feeds a fen or alter the recharge zone of such an aquifer. Large irrigation, municipal, or industrial wells can remove enough water from an aquifer to interrupt, if not totally dry up a fen. A relevant example comes from a proposed expansion the Lincoln-Pipestone Rural Water System in southwestern Minnesota. The original proposal called for increased pumping from the “Burr Well Field,” a series of wells located on an aquifer called the “Burr Unit of the Prairie Coteau Aquifer.” This Burr Unit was later mapped out to be an aquifer that, in aerial extent, measured more than 6 miles long and 4 miles wide, with a water-bearing sand and gravel lens that varied from 50 to 95 feet thick, underlain by 159 feet of clay and overlain by 50 to 100 feet of glacial till (Plank et al. 1998). At least six calcareous fen complexes were documented in the vicinity of this Burr Unit. By monitoring the hydraulic pressure at four of these fens while pumping from the aquifer, it was established that at least three of these fens were hydrologically connected to the Burr Unit and were negatively affected by substantial pumping from this Burr Unit aquifer (Plank et al. 1998).

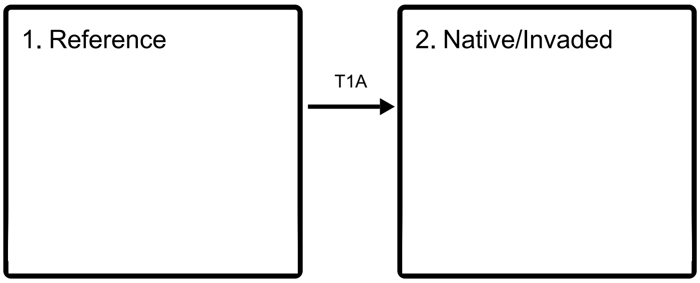
Likewise, the water chemistry of fens is complicated and has not been entirely explained. For example, what causes the plants of the marl flat zone to be rather short and sparse? One theory is that the high calcium content causes phosphorus to precipitate out of solution into chemical forms that are not available to plants, thereby resulting in a nutrient poor condition that limits the growth of taller, more robust vegetation (Amon, et al. 2002). While these nutrient relationships remain mostly untested, it seems likely that the contamination of aquifers that supply water to calcareous fens could significantly alter the native flora and fauna of these habitats. Ground water recharge areas that are located in cropland or urban areas would seem especially vulnerable to increased levels of nutrients like nitrogen and phosphorus.

Like grassland ecological sites, calcareous fens support a diverse plant community that includes increaser and decreaser species based upon their palatability to livestock. Unfortunately, livestock preference of many fen plant species have not been determined.

It is clear that intensive livestock use can alter the surface hydrology of calcareous fen when cattle trample narrow ditches through the shallower peat mats as they trail through the fen. This has the effect of ditching and presumably lowers the water table in at least those portions of the fen so affected.

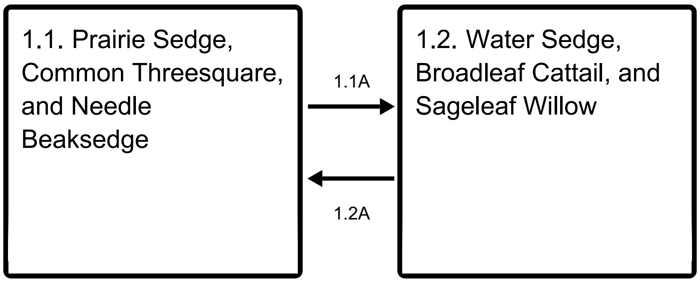
State and transition model

Ecosystem states



T1A - Hydrologic manipulation, Trampling, Herbicide use, Nutrient loading

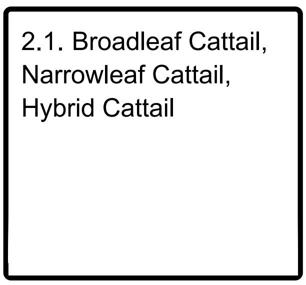
State 1 submodel, plant communities



1.1A - No Fire, Climate Variation

1.2A - Fire, Climate Variation

State 2 submodel, plant communities



State 1
Reference

This state represents what is believed to show the natural range of variability that dominates the dynamics of the ecological state prior to European settlement. This site, in the Reference State (State 1), is a complex community with different vegetation zones. The marl flat zones are dominated by prairie sedge, common threesquare, and needle beaksedge. Below or outside of the marl flat may be border zones of wetland vegetation. These may vary from wet meadow types dominated by fine-stemmed grasses and sedges, e.g. bluejoint, or prairie cordgrass; to deep marsh vegetation of cattails and bulrushes, or the water may converge into a stream channel along the downslope edge of the marl flat with riparian vegetation including shrubs. The discharge zone is typically dominated by water sedge and broadleaf cattail. Climatic variation, disturbance, and fire are drivers between community phases, while herbivory plays a very minor role as these areas are typically avoided by large ungulates. Invasion of non-native cattails may occur if the hydrology of the site is manipulated through ditching, draining, or excavating, nutrient loading, herbicide use, and/or trampling by livestock. Invasion may also occur due to changes in water pH. This will result in a transition to the Native/Invaded State (State 2).

Dominant plant species

- sageleaf willow (*Salix candida*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- meadow willow (*Salix petiolaris*), shrub
- prairie sedge (*Carex prairea*), grass
- common threesquare (*Schoenoplectus pungens*), grass
- needle beaksedge (*Rhynchospora capillacea*), grass
- spiked muhly (*Muhlenbergia glomerata*), grass
- marsh arrowgrass (*Triglochin palustris*), grass
- water sedge (*Carex aquatilis*), grass
- broadleaf cattail (*Typha latifolia*), grass
- grass of Parnassus (*Parnassia*), other herbaceous
- Ontario lobelia (*Lobelia kalmii*), other herbaceous
- lesser fringed gentian (*Gentianopsis virgata*), other herbaceous
- northern bog aster (*Symphyotrichum boreale*), other herbaceous

Community 1.1
Prairie Sedge, Common Threesquare, and Needle Beaksedge

This plant community is typical of the Marl Flat zone of the Calcareous Fen site. This area of the fen complex is dominated by marls (calcium rich mud or mudstone) and tufa (porous, crunchy rock of calcium carbonate). The zone is typically very species rich and dominated shorter, finer leaved graminoids such as prairie sedge, common threesquare, and needle beaksedge. Other graminoids that could occur on this site include spiked muhly and marsh arrowgrass. This vegetation zone also has an abundance of calcium-loving, distinctive forbs such as grass of Parnassus, Ontario lobelia, lesser fringed gentian, and northern bog aster. This zone is also interrupted by tiny pools of water that support floating aquatic plants such as lesser bladderwort and muticelluar algae like stonewart.

Dominant plant species

- prairie sedge (*Carex prairea*), grass
- common threesquare (*Schoenoplectus pungens*), grass

- needle beaksedge (*Rhynchospora capillacea*), grass
- grass of Parnassus (*Parnassia*), other herbaceous
- Ontario lobelia (*Lobelia kalmii*), other herbaceous
- lesser fringed gentian (*Gentianopsis virgata*), other herbaceous
- northern bog aster (*Symphyotrichum boreale*), other herbaceous

Community 1.2
Water Sedge, Broadleaf Cattail, and Sageleaf Willow

The Discharge zone vegetation is often found on a floating mat of organic material. This zone is often species poor and dominated by coarse sedges and cattails such as water sedge (*Carex aquatilis*), and broadleaf cattail (*Typha latifolia*). Shrub vegetation may include sageleaf willow (*Salix candida*), redosier dogwood (*Cornus sericea*), and meadow willow (*Salix petiolaris*).

Dominant plant species

- sageleaf willow (*Salix candida*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- meadow willow (*Salix petiolaris*), shrub
- water sedge (*Carex aquatilis*), grass
- broadleaf cattail (*Typha latifolia*), grass

Pathway 1.1A
Community 1.1 to 1.2

Climatic variation, no fire and/or lack of disturbance will shift this community to the 1.2 Water Sedge/Shrub/Broadleaf Cattail (Discharge zone) plant community phase.

Pathway 1.2A
Community 1.2 to 1.1

Climatic variation, fire and/or disturbance will shift this community to the 1.2 Prairie Sedge-Common Threesquare-Needle Beaksedge (Marl flat zone) within the Reference State (State 1).

State 2
Native/Invaded

The Native/Invaded State is characterized by a shift from native species to inclusion of invasive cattail species such as narrowleaf (*Typha angustifolia*) and hybrid cattail (Typha x glauca) due to hydrologic manipulation from ditching, draining, or excavating, nutrient loading, herbicide use, and/or trampling by livestock. The various forms of manipulation result in a lowered water table, which allows peat and organic soils to decompose in absence of saturation. This altered site provides an environment for non-natives and exotics to invade.

Dominant plant species

- narrowleaf cattail (*Typha angustifolia*), grass
- hybrid cattail (*Typha ×glauca*), grass
- common reed (*Phragmites australis*), grass
- redtop (*Agrostis gigantea*), grass
- prairie sedge (*Carex prairea*), grass
- hardstem bulrush (*Schoenoplectus acutus*), grass
- needle beaksedge (*Rhynchospora capillacea*), grass
- spiked muhly (*Muhlenbergia glomerata*), grass
- marsh arrowgrass (*Triglochin palustris*), grass
- purple loosestrife (*Lythrum salicaria*), other herbaceous
- grass of Parnassus (*Parnassia*), other herbaceous
- Ontario lobelia (*Lobelia kalmii*), other herbaceous
- lesser fringed gentian (*Gentianopsis virgata*), other herbaceous
- northern bog aster (*Symphyotrichum boreale*), other herbaceous

Community 2.1
Broadleaf Cattail, Narrowleaf Cattail, Hybrid Cattail

This community phase is still a complex of native and invasive vegetation. Native vegetation will still include species such broadleaf cattail, prairie sedge, and water sedge, but also will include invasive species such as narrowleaf cattail, hybrid cattail, common reed, purple loosestrife, redtop (*Agrostis gigantea*), and others.

Dominant plant species

- broadleaf cattail (*Typha latifolia*), grass
- narrowleaf cattail (*Typha angustifolia*), grass
- hybrid cattail (*Typha ×glauca*), grass

Transition T1A
State 1 to 2

Hydrological manipulation such as ditching, draining, or excavating, nutrient loading from the watershed, herbicide use and/or trampling by livestock may all lead to this shift in plant community. Invasion of nonnative cattails, common reed (*Phragmites australis*), and invasive forbs such as purple loosestrife (*Lythrum salicaria*) leads to a Native/Invaded State (State 2).

Additional community tables

Inventory data references

There is no NRCS clipping data and other inventory currently available for this site. Information presented here has been derived using field observations from range-trained personnel. Those involved in developing this site include: Stan Boltz, Range Management Specialist, NRCS; and Dave Ode, Botanist/Plant Ecologist (retired) State of South Dakota.

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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	12/19/2025
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:

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

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

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

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:**

17. **Perennial plant reproductive capability:**