

Technical Criteria For Identifying Calcareous Fens in Minnesota

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INTRODUCTION

This document describes the technical criteria currently used by the Minnesota Department of Natural Resources (DNR) for identifying calcareous fens under Minnesota Statutes 103G.223 and associated Minnesota Rules Chapter 8420.0935 (Appendix A). These criteria have been used by the DNR since 2005, when they were published in the following report:

Final Report to the U.S. EPA: Test of the Technical Criteria for Identifying and Delineating Calcareous Fens in Minnesota and Draft Revised Technical Criteria for Identifying Calcareous Fens in Minnesota by Jeanette H. Leete, MN DNR with Welby R. Smith, MN DNR; Joannes A. Janssens, Lambda Max; Norm Aaseng, MN DNR, April 13, 2005.

The technical criteria in this document are excerpted directly from that document for ease of reference and to denote that with ten years of experience with application, the DNR no longer considers them to be “draft.” This document also provides details on data collection methods and analysis/reporting standards. For additional background on calcareous fens and the development of these technical criteria, refer to the aforementioned report, which is available at: [MNDNR Files webpage](#). It should be noted that the DNR continues to collect and analyze data on calcareous fens and similar communities, which may lead to future revisions of the technical criteria.

A list of calcareous fens identified by the DNR is available at: [MNDNR Files webpage](#)

TECHNICAL CRITERIA (DEFINITION)

Calcareous fens possess four specific characteristics: 1) calciphytic vegetation, 2) histosols or histic epipedons, 3) hydrology, and 4) water chemistry. These characteristics and their technical criteria are essential for identification and delineation purposes. The four technical criteria specified must all be met for an area to be identified as a calcareous fen.

HYDROLOGY TECHNICAL CRITERION

An area meets the hydrology technical criterion when the hydrology is characterized by having stable, typically upwelling groundwater inflows sufficient to maintain saturation for the development of a histosol or a histic epipedon soil.

SOILS TECHNICAL CRITERION

An area meets the soils technical criteria when the soils are characterized by the presence of either a histosol or a histic epipedon. Calcium carbonate precipitates, such as tufa deposits, may frequently be associated with calcareous fens and high carbonate content in this case is not indicative of a mineral soil.

WATER CHEMISTRY TECHNICAL CRITERION

Water chemistry of calcareous fens should be characterized by measurement of the following parameters: specific conductance ($\mu\text{S}/\text{cm}$), pH, alkalinity ($\text{mg}/\text{l CaCO}_3$), ratio of the concentration of calcium plus magnesium ions ($[\text{Ca}+\text{Mg}]$) to total cations ($\% \text{ meq}/\text{l}$), and alkalinity/total anions ($\% \text{ meq}/\text{l}$). Of these parameters, it is imperative that specific conductance, pH, and alkalinity be measured in the field (in situ). Samples could be collected for laboratory determination of the other parameters. Standard methods (APHA, most recent edition) should be used for sample collection techniques and sample preparation and handling.

An area meets the water chemistry technical criterion when the following conditions are met: pH of 6.7 or more; calcium of 30 mg/l or more; alkalinity of 1.65 meq/l or more; and, specific conductance of 500 $\mu\text{S}/\text{cm}$ or more. [Data for other parameters must be collected to provide further water chemistry definition of calcareous fens.]

VEGETATION TECHNICAL CRITERION

The Minnesota DNR has developed a regionalized list of vascular plant calciphiles (Table 1) and a statewide list of bryophyte calciphiles (Table 2) indicative of calcareous fens of the State.

An area meets the calcareous fen vegetation technical criterion when, under normal circumstances, the area has a natural community index value of 50 or more by summing the appropriate regional index values of the vascular plant plus the bryophyte calcareous fen indicator species. Where both bryophyte and vascular plant data are available and the site's latitude is greater than 47 degrees, the natural community index value must exceed 80. Plot size and shape are dependent upon the professional judgment of field personnel.

NOTE: *If a disturbed site has calcareous fen soil, hydrology, and water chemistry but the calciphile point total ranges from 30 to 50, the area will be considered to meet calcareous fen criteria. If a disturbed site has calcareous fen soil, hydrology, and water chemistry but a calciphile point total of less than 30, the disturbed area may have the potential to support a calcareous fen plant community*

Table 1: Regionalized List of 29 Vascular Plant Indicators to Identify Calcareous Fens in Minnesota

Species	NW	MN valley	SE	SW
Aster borealis	1	5	5	5
Berula pusila	-	5	5	-
Betula pumila	1	5	5	-
Bidens coronata	-	5	5	-
Bromus ciliatus	1	5	5	-
Cardamine bulbosa	5	5	5	5
Carex aquatilis	1	5	25	25
Carex hystericina	1	5	5	25
Carex interior	1	5	5	5
Carex prairea	25	25	25	25
Carex sterilis	25	25	25	25
Cladium mariscoides	5	25	-	-
Eleocharis rostellata	25	25	-	-
Eriophorum angustifolium	1	1	5	5
Gentianopsis procera	1	5	25	25
Liparis loeselii	1	5	5	5

Lobelia kalmii	1	25	25	25
Oxypolis rigidior	-	5	5	-
Parnassia glauca	5	25	25	25
Potentilla fruticosa	1	25	25	-
Primula mistassinica	25	-	-	-
Rhynchospora capillacea	25	25	25	25
Salix candida	5	5	5	-
Scirpus cespitosus	5	25	25	-
Scleria verticillata	25	25	25	25
Tofieldia glutinosa	5	25	-	-
Triglochin maritima	1	25	25	25
Triglochin palustris	25	25	25	25
Valeriana edulus	-	5	5	-

Note: Where the table does not contain a value in a regional column, that plant is not expected to occur in that region. In the unlikely case that it should occur, it will receive the maximum score for that plant.

Table 2. Bryophyte species occurring in Minnesota’s calcareous fens in order of descending IPV*.

(IPV = frequency of occurrence in CF times the quotient of the frequency in CF with the frequency in non-CF ecotopes). The species with an IPV >1.000 are obligate and near-obligate (25 point) indicators, with and IPV >0.100 and <1.000 are facultative (5 point) indicators, and those with an IPV <0.100 are occasional (1 point) species. The column labeled ‘n CF’ lists the number of calcareous -fen ecotopes in which the species occurs (out of a total of 128), ‘n tot’ the total number of ecotopes in Minnesota where the species has been found (out of a total of 1128). The values in the columns labeled ‘CFB’, ‘CFPnw’, ‘CFPsw’, and ‘CFPse’ are the relative abundance of the species in the extreme rich fens of boreal forested region, and the calcareous fens of the NW, SW, and SE prairie sub-regions. The relative abundance is calculated as the 100 times quotient of the number of vouchers collected for the species over the total number of vouchers within the regions or sub-region (total number of vouchers for CFB = 928, CFPnw = 1806, CFPse = 1332, and CFPsw = 2339).

obligate and near-obligate species (OB)

Acronym	Species name	IPV	n		boreal	prairie		
			CF	tot	CFB	CFPnw	CFPse	CFPsw
BRYUULIG	Bryum uliginosum	inf.	1	1		0.06		
CATONIGR	Catoscopium nigrum	inf.	5	5	0.86	0.06		
PALUSQUA	Paludella squarrosa	inf.	3	3	1.29			
ANEUPING	Aneura pinguis	7.6766	52	75	1.62	4.26	3.53	7.52
LIMPCOSS	Limprichtia cossonii	6.0073	46	69	11.96	13.95	0.23	11.59
CAMPSTEL	Campylium stellatum	4.1284	67	138	15.52	39.76	9.53	15.82
DREPADUN	Drepanocladus aduncus	3.4381	74	178	4.09	2.60	14.04	16.84
BRYUPSEU	Bryum pseudotriquetrum	3.3978	76	187	6.68	18.22	3.60	10.94
BRACRIVU	Brachythecium rivulare	3.2648	50	100	2.48	1.94	15.24	3.72
CALRCUSP	Calliergonella cuspidata	2.7283	31	54	2.05	0.61	2.33	5.69

Acronym	Species name	IPV	n	n	boreal	prairie		
					CFB	CFP	CFP	CFP
SCORSCOR	Scorpidium scorpioides	1.8590	22	39	4.74	5.09		
CINCSTYG	Cinclidium stygium	1.8283	14	21	3.13			
MOERHIBE	Moerckia hibernica	1.6324	15	24	2.59	0.55		
CALLTRIF	Calliergon trifarium	1.5196	16	27	3.34	1.33		
PLAGELLI	Plagiomnium ellipticum	1.4570	59	215	2.91	1.38	14.19	7.48
CAMPPOLY	Campylium polygamum	1.2612	26	61	4.09	1.05	1.88	3.33
FISSADIA	Fissidens adianthoides	1.0535	22	52	4.85	0.50	1.13	

facultative species (FA)

Acronym	Species name	IPV	n	n	CFB	prairie				
						CF	tot	nw	se	sw
AMBLVARI	Amblystegium varium	0.8392	28	89	0.54	0.28	3.90	1.07		
TOMENITE	Tomenthypnum nitens	0.7384	21	60	2.37	0.72	0.15			
EURHHIAN	Eurhynchium hians	0.5224	12	30	0.43		1.50			
AMBLSEJU	Amblystegium serpens var. juratzkanum	0.5119	14	39	0.86	1.72	0.53	3.51		
BRACSALE	Brachythecium salebrosum	0.3318	25	148	0.32	0.11	4.65	8.85		
HAMALAPP	Hamatocaulis lapponicus	0.2612	2	3	0.32					
MEESTRIQ	Meesia triquetra	0.2612	4	8	0.65					
HELOBLAN	Helodium blandowii	0.2137	12	56	0.22	0.39	0.53	0.21		
PSEATURG	Pseudo-calliergon turgescens	0.1959	3	6	0.11	0.89				
CRATFILI	Cratoneuron filicinum	0.1889	9	37	0.86	0.89	2.10			
CONACOMP	Conardia compacta	0.1632	5	15		0.06		0.43		
HYPNLIND	Hypnum lindbergii	0.1582	19	168	0.86	0.72	2.85	0.09		
CAMPSTPR	Campylium stellatum var. protensum	0.1469	3	7		0.83		1.71		
DREPADPO	Drepanocladus aduncus var. polycarpus	0.1419	10	56	0.22	0.06	1.35	0.13		
RICDLATI	Riccardia latifrons	0.1175	6	26	0.97					

Occasional species (OC)

acronym	species name	IPV	n	n	CFB	prairie				
						CF	tot	nw	se	w
PLAGCUSP	Plagiomnium cuspidatum	0.0882	17	231	0.54	0.22	1.73	0.09		
DRESEND	Drepanocladus sendtneri	0.0871	2	5	0.11	0.22				

acronym	species name	IPV	n		boreal		prairie	
			CF	tot	CFB	CFP	CFP	CFP
RICDPALM	Riccardia palmata	0.0840	3	10	0.43			
HYPNPRAT	Hypnum pratense	0.0837	10	88	0.22		2.18	0.09
LEPDHUMI	Leptodictyum humile	0.0804	4	17			0.45	0.13
ATRIUNDU	Atrichum undulatum	0.0653	1	2			0.08	
DREPSORD	Drepanocladus sordidus	0.0653	1	2	0.11			
ORTHPUMI	Orthotrichum pumilum	0.0653	2	6	0.11	0.06		
PHILCAPI	Philonotis capillaris	0.0653	1	2			0.08	
PHILMARC	Philonotis marchica	0.0653	1	2			0.08	
LESKPOLY	Leskea polycarpa	0.0615	4	21	0.22	0.17	0.08	0.17
AULAPALU	Aulacomnium palustre	0.0531	14	25 5	1.08	0.28	0.83	
BRYULICU	Bryum lisae var. cuspidatum	0.0522	2	7			0.15	
HYGATENA	Hygroamblystegium tenax	0.0495	5	38	0.11		0.45	
CAMPRADI	Campylium radicale	0.0454	4	27	2.05	0.06	0.08	
CALLGIGA	Calliergon giganteum	0.0452	6	58	0.97	0.17		
PLAHRIPA	Platyhypnidium riparioides	0.0373	2	9			0.23	
MYULJULA	Myurella julacea	0.0367	3	19	0.32			
HAMAVERN	Hamatocaulis vernicosus	0.0348	4	34	0.75			
BRACDIGA	Brachythecium digastrum	0.0326	1	3			0.08	
DICEVARI	Dicranella varia	0.0326	1	3				0.04
PTEGFILI	Pterigynandrum filiforme	0.0326	2	10	0.11		0.08	
AMBLSERP	Amblystegium serpens	0.0320	5	56		0.06	0.53	0.04
HELOPALU	Helodium paludosum	0.0237	2	13			1.65	
BRACOEDI	Brachythecium oedipodium	0.0228	6	10 9	2.16		0.60	
CAMPCHRY	Campylium chrysophyllum	0.0227	4	50	0.22	0.17	0.23	
HELOBLHE	Helodium blandowii var. helodioides	0.0218	1	4			0.15	
RICRNATA	Ricciocarpos natans	0.0218	1	4		0.06		
CLIMAMER	Climacium americanum	0.0201	2	15			0.23	
LESKGRAC	Leskea gracilescens	0.0163	3	39	0.43		0.15	
ATRIALTE	Atrichum altocristatum	0.0154	2	19			0.15	
BRACPLUM	Brachythecium plumosum	0.0154	2	19			0.15	
SPHAWARN	Sphagnum warnstorffii	0.0146	5	11 7	2.26			
BRACACUM	Brachythecium acuminatum	0.0143	4	77			0.23	0.13
ENTOSEDU	Entodon seductrix	0.0137	2	21			0.08	0.04
THUIRECO	Thuidium recognitum	0.0137	5	12 4	0.97		0.08	
PLATDENT	Plagiothecium denticulatum	0.0134	4	82	0.11	0.06	0.45	
CEPHPLSP	Cephalozia pleniceps ssp. sphagnorum	0.0131	1	6	0.11			
FISSDUBI	Fissidens dubius	0.0131	2	22			0.30	

acronym	species name	IPV	n		boreal		prairie	
			CF	tot	CFB	CFP	CFP	CFP
FRULINFL	Frullania inflata	0.0131	1	6	0.11			
PYLLSELW	Pylaisiella selwynii	0.0122	3	51	0.32		0.08	
LOPCHETE	Lophocolea heterophylla	0.0118	5	14 3	0.11	0.11	0.30	0.04
MARCPOLY	Marchantia polymorpha	0.0104	2	27		0.06	0.15	
WARNEXAN	Warnstorfia exannulata	0.0104	2	27		0.06	0.08	
CAMPHISP	Campylium hispidulum	0.0095	3	65	0.54		0.08	
BRACOXYC	Brachythecium oxycladon	0.0093	2	30			0.15	
PHYTPYRI	Physcomitrium pyriforme	0.0093	1	8			0.08	
SPHAFUSC	Sphagnum fuscum	0.0084	4	12 9	0.65			
CEPHCOCO	Cephalozia connivens var. compacta	0.0082	1	9	0.32			
PHILFONT	Philonotis fontana	0.0082	1	9			0.53	
PLADJUNG	Platydictya jungermannioides	0.0082	1	9				0.09
RHIZGRAC	Rhizomnium gracile	0.0082	1	9	0.11			
FISSOSMU	Fissidens osmundioides	0.0077	2	36	0.43			
LEPDRIPA	Leptodictyum riparium	0.0077	2	36			0.08	0.04
SPHAFIMB	Sphagnum fimbriatum	0.0069	2	40			0.75	
FRULOAKE	Frullania oakesiana	0.0065	1	11	0.11			
CONCCONI	Conocephalum conicum	0.0061	2	45	0.11		0.08	
THUIDELI	Thuidium delicatulum	0.0060	3	10 1			0.38	
PLACASPL	Plagiochila asplenoides	0.0053	2	51	0.22			
BRACPOPU	Brachythecium populeum	0.0038	1	18			0.23	
MYLIANOM	Mylia anomala	0.0036	1	19	0.11			
TORLFRAG	Tortella fragilis	0.0036	1	19	0.22			
CHILPALL	Chiloscyphus pallescens	0.0034	1	20			0.08	
POLYSTRI	Polytrichum strictum	0.0032	3	18 7	0.43			
ATRIOERS	Atrichum oerstedianum	0.0028	1	24			0.08	
DISTCAPI	Distichium capillaceum	0.0028	1	24	0.11			
LEPTPYRI	Leptobryum pyriforme	0.0028	1	24	0.11			
TAXIDEPL	Taxiphyllum deplanatum	0.0027	1	25			0.08	
SPHAANGU	Sphagnum angustifolium	0.0026	3	22 7	0.22		0.08	
BRACERYT	Brachythecium erythrorrhizon	0.0026	2	10 4	0.11	0.06		
BRYERECU	Bryoerythrophyllum recurvirostre	0.0023	1	30		0.06		
SPHACAPI	Sphagnum capillifolium	0.0018	2	14 6	0.11		0.15	
STEESEER	Stereocleus serrulatus	0.0017	1	39			0.08	
CLIMDEND	Climacium dendroides	0.0015	2	17 5			0.75	

acronym	species name	IPV	n		boreal	prairie		
			CF	tot	CFB	CFP	CFP	CFP
ORTHOBTU	Orthotrichum obtusifolium	0.0015	1	45	0.11			
PLAGCILI	Plagiomnium ciliare	0.0014	1	47				0.17
SPHASUSS	Sphagnum subsecundum s.s.	0.0013	1	50			0.08	
SPHASQUA	Sphagnum squarrosum	0.0013	1	51			0.08	
CEPHCONN	Cephalozia connivens	0.0012	1	56	0.11			
ORTHELEG	Orthotrichum elegans	0.0011	1	61	0.11			
POLYCOMM	Polytrichum commune	0.0011	1	63			0.08	
BRACREFL	Brachythecium reflexum	0.0010	1	64			0.08	
ENTOCLAD	Entodon cladorrhizans	0.0010	1	66			0.08	
PLEUSCHR	Pleurozium schreberi	0.0009	2	29 7	0.22			
PYLLPOLY	Pylaisiella polyantha	0.0009	1	76		0.17		
DICRUNDU	Dicranum undulatum	0.0008	1	79	0.11			
CERAPURP	Ceratodon purpureus	0.0008	1	83			0.08	
EURHPULC	Eurhynchium pulchellum	0.0008	1	84			0.30	
SPHACENT	Sphagnum centrale	0.0008	1	87			0.15	
ANOMMINO	Anomodon minor	0.0007	1	95	0.11			
HYLOSPLE	Hylocomium splendens	0.0007	1	96	0.11			
CALLCORD	Calliergon cordifolium	0.0007	1	10 1			0.15	
PLAYREPE	Platygyrium repens	0.0004	1	16 2	0.11			
PTIDPULC	Ptilidium pulcherrimum	0.0004	1	16 8	0.11			
DICRPOLY	Dicranum polysetum	0.0004	1	17 6	0.11			
SPHAMAGE	Sphagnum magellanicum	0.0003	1	24 1	0.11			

Appendix A Minnesota Regulations

The following are current references to Minnesota Statutes and Rules. For any possible updates, the Minnesota Revisor of Statutes maintains currently accurate listings at The Office of the Revisor of Statutes.

103G.223 CALCAREOUS FENS.

Calcareous fens, as identified by the commissioner by written order published in the State Register, may not be filled, drained, or otherwise degraded, wholly or partially, by any activity, unless the commissioner, under an approved management plan, decides some alteration is necessary. Identifications made by the commissioner are not subject to the rulemaking provisions of chapter 14 and section 14.386 does not apply.

History: 1991 c 354 art 6 s 9; 2004 c 221 s 43

8420.0935 STANDARDS AND CRITERIA FOR IDENTIFICATION, PROTECTION, AND MANAGEMENT OF CALCAREOUS FENS.

Subpart 1. Purpose.

The purpose of this part is to provide minimum standards and criteria for identifying, protecting, and managing calcareous fens as authorized by Minnesota Statutes, section 103G.223. Calcareous fens, as identified by the commissioner, must not be impacted or otherwise altered or degraded, wholly or partially, by any action, unless the commissioner, under an approved management plan, decides some alteration is necessary. The exemptions under part 8420.0420 and the sequencing provisions under part 8420.0520 do not apply to calcareous fens.

SUBP. 2. IDENTIFYING CALCAREOUS FENS.

A calcareous fen is a peat-accumulating wetland dominated by distinct groundwater inflows having specific chemical characteristics. The water is characterized as circumneutral to alkaline, with high concentrations of calcium and low dissolved oxygen content. The chemistry provides an environment for specific and often rare hydrophytic plants.

SUBP. 3. PROCEDURES TO LIST CALCAREOUS FENS.

- A. The commissioner must investigate wetlands to determine if the wetland is properly identified as a calcareous fen.
- B. The commissioner must, by written order published in the State Register, maintain a current list of known calcareous fens in the state and their location.
- C. The commissioner must provide an updated list of calcareous fens to the board for further distribution.

SUBP. 4. MANAGEMENT PLANS.

Calcareous fens must not be impacted or otherwise altered or degraded except as provided for in a management plan approved by the commissioner. The commissioner must provide technical assistance to landowners or project sponsors in the development of management plans.

SUBP. 5. RESTORATION.

The commissioner may approve management plans to restore or upgrade a previously damaged calcareous fen.

SUBP. 6. APPEALS.

- A. A landowner or project proposer may challenge the commissioner's determination that a wetland is a calcareous fen or the commissioner's calcareous fen management plan by requesting a hearing. The hearing shall be conducted in the same manner as water permit hearings under Minnesota Statutes, chapter 103G.
- B. The determination that a wetland is a calcareous fen may be appealed at any time by requesting a hearing. For a decision under a management plan, the hearing must be requested within 30 days after the notice of the commissioner's decision was mailed to the project proposer; otherwise the decision becomes final and may not be challenged by the project proposer.
- C. Appeal of the commissioner's decision after the hearing must be done in the manner provided for appeals from contested case decisions under Minnesota Statutes, chapter 14.

SUBP. 7. ENFORCEMENT PROCEDURES.

ENFORCEMENT PROCEDURES FOR CALCAREOUS FENS MUST BE CONDUCTED CONSISTENT WITH MINNESOTA STATUTES, SECTIONS 103G.141 AND 103G.2372, EXCEPT THAT NECESSARY RESTORATION OR REPLACEMENT ACTIVITIES, IF REQUIRED, MUST BE DETERMINED BY THE COMMISSIONER, IN CONSULTATION WITH THE LOCAL SOIL AND WATER CONSERVATION DISTRICT.

STATUTORY AUTHORITY: MS S 103G.2242

HISTORY: 34 SR 145