Supplemental Guidance for the Classification of Wetlands for the Update of the National Wetland Inventory for Minnesota

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1. Cowardin Classification System Guidance

The primary classification system used for the National Wetland Inventory (NWI) was described by Cowardin et al. (1979). All wetland classification definitions for the 2010 update of the Minnesota NWI follows Cowardin et al. (1979) and Dahl et al. (2009) unless otherwise noted below. The following section describes the valid codes and descriptions of the Cowardin classification system as applied to the 2010 Minnesota NWI update. A full list of valid codes is provided in Table 1-1. For examples of the NWI classes and how they were interpreted, please see the Photo Interpretation Guide for the 2010 Minnesota NWI Update.

Table 1-1

Valid codes for NWI update of Minnesota

System	Subsystem	Class	Subclass	Water Regime	Special Modifier
L	L1	UB		H, K	h, x
L	L2	UB		F, H, K	b, d, h, x
		AB		F, H, K	b, d, h, x
		EM	2	F, H, K	b, d, h, x
		US		A, C, K	b, d, h, x
		RS		A, C, K	b, d, h, x
		RB		F, H, K	b, d, h, x
P		UB		F, H, K	b, d, h, x
		AB		F, H, K	b, d, h, x
		EM	1	A, B, C, F, K	b, d, f, h, x, q
		EM	2	C, F, H, K	b, d, h, x,
		FO	1, 2, 4	A, B, C, F, K	b, d, h, x, q
		SS	1, 2, 3, 4	A, B, C, F, K	b, d, h, x, q
		US		A, C, K	b, d, h, x
		RB		F, H, K	b, d, h, x
		ML		B	d, q
R	R2	UB		H	h, x
		AB		H	h, x
		US		A, C	h, x
		EM	2	F, H	h, x
		RS		A, C	h, x
		RB		H	h, x
					h, x
R	R3	UB		F, H	h, x
		US		A, C	h, x
		RS		A, C	h, x
		RB		F, H	h, x
R	R4	SB		A, C	h, x

1.1.Cowardin Classes

The Cowardin classification system is a hierarchical system developed to standardize the classification of wetlands and deepwater habitats of the United States. At the highest level are five systems; marine, estuarine, riverine, lacustrine, and palustrine. Only three of these systems are relevant to the inland wetlands found in Minnesota; riverine, lacustrine, and palustrine.

Within the riverine and lacustrine systems, there are subsystems. In Minnesota, we have lower perennial rivers, upper perennial rivers, and intermittent streams for riverine subsystems. There are also two lacustrine subsystems, limnetic and littoral. The palustrine system has no subsystems. Within each of these systems and subsystems there are several classes that are defined either on the dominant vegetation (e.g. scrub-shrub and forested) or the dominant substrate (e.g. unconsolidated bottom). Additional details of the classification system including the definition of each system, subsystem, class, and subclass can be found in Cowardin et al. (1979) and Dahl et al. (2009).

Only a subset of the Cowardin wetland types occurs in Minnesota. Santos and Gauster (1993) included a list of valid Cowardin wetland types for Minnesota in their regional user's guide to the National Wetland Inventory Maps. No estuarine or marine wetlands are found in Minnesota. There are no tidal riverine systems either. Valid classes for the remaining systems and subsystems were derived from Cowardin et al. (1979). These wetland classes are listed in Table 1-2.

General guidance for wetland classes:

- All wetland polygons will be classified to the Cowardin class level.
- Estuarine, Marine and Tidal Riverine systems will not be used.
- Use of subclasses will be limited to emergent, scrub-shrub, and forested wetlands and must be identified for these classes (section 1.2).
- Only the systems, subsystems, and classes listed in Table 1-1 should be used for the NWI update.
- Mixed classes are allowed as specified by Dahl et al. (2009), but should be minimized (section 1.1.1).

Table 1-2
Valid Classes for NWI Update of Minnesota

System	Subsystem	Class	Code
Lacustrine	Limnetic	Unconsolidated Bottom	L1UB
	Littoral	Rock Bottom	L2RB
		Unconsolidated Bottom	L2UB
		Aquatic Bed	L2AB
		Rocky Shore	L2RS
		Unconsolidated Shore	L2US
		Emergent	L2EM
Palustrine		Rock Bottom	PRB
		Unconsolidated Bottom	PUB
		Aquatic Bed	PAB
		Unconsolidated Shore	PUS
		Moss-Lichen	PML
		Emergent	PEM
		Scrub-Shrub	PSS
		Forested	PFO
Riverine	Lower Perennial	Rock Bottom	R2RB
		Unconsolidated Bottom	R2UB
		Aquatic Bed	R2AB
		Rocky Shore	R2RS
		Unconsolidated Shore	R2US
		Emergent	R2EM
	Upper Perennial	Rock Bottom	R3RB
		Unconsolidated Bottom	R3UB
		Rocky Shore	R3RS
		Unconsolidated Shore	R3US
	Intermittent	Streambed	R4SB

1.1.1 Mixed Classes

Mixed classes should be avoided if possible (areas of homogenous classes should be delineated as separate polygons). In cases where the classes are interspersed without clear spatial definition of the classes, the mixed classes should be limited to: FO/SS, FO/EM, SS/EM, UB/SS, and AB/SS with no reciprocals.

1.2.Wetland Subclass

The historical application of the Cowardin subclasses in the Minnesota NWI is inconsistent with current guidance. Some historical subclasses such as subclass 5 for palustrine emergent wetlands were used in Minnesota, but have been abandoned in recent guidance or re-purposed (Dahl et al. 2009). In addition, many of the subclasses are difficult to reliably determine using remote sensing data. For this reason, the federal wetlands mapping standard (FGDC 2009) only requires subclasses for the emergent, scrub-shrub, and forested classes.

General guidance for subclasses:

- Subclasses will be only be used for scrub-shrub, forested, and emergent wetland classes and must be identified for these classes.
- Whenever possible, the most specific subclass, such as broad-leaved deciduous (PFO1) should be used instead of the more generic subclasses, such as deciduous (PFO6).
- There are no broad leaved evergreen tree species in Minnesota, so that subclass (PFO3) should not be used. However, there are broad-leaved evergreen shrub species (PSS3).
- Based on discussions of the technical advisory committee, sub-class 5 (dead) for both scrub-shrub wetlands and forested wetlands should be avoided. Wetlands should be classified based on the dominant (>30% cover) living life form or substrate.
- Valid subclasses for the Minnesota NWI are in Table 1-3.
- Mixed subclasses on forested and scrub-shrub classes should be avoided if possible (section 1.2.1)

Table 1-3
Subclasses for the NWI Update of Minnesota

Class	Subclass
Emergent	1-Persistent 2-Nonpersistent
Scrub-Shrub	1-Broad-leaved deciduous 2-Needle-leaved deciduous 3-Broad-leaved evergreen 4-Needle-leaved evergreen 6-Deciduous* 7-Evergreen*
Forested	1-Broad-leaved deciduous 2-Needle-leaved deciduous 4-Needle-leaved evergreen 6-Deciduous* 7-Evergreen*

* The more specific subclasses will be used whenever possible.

1.2.1 Mixed subclasses

Mixed subclasses on forested and scrub-shrub should be avoided if possible (areas of homogenous subclasses should be delineated as separate polygons). In cases where the classes are interspersed without clear spatial definition of the subclasses, the mixed classes should be limited to: 1/2, 1/3, 1/4, 2/4 and 3/4 with no reciprocals.

1.3.Water Regime Modifier Issues

To fully describe wetlands and deepwater habitats, one must apply certain modifiers at the class level or lower. The water regime modifier describes the hydrologic characteristics of the wetland including the frequency and duration of inundated or saturated conditions. Because detailed hydrologic records are seldom available, the assignment of water regime modifiers relies on interpretation of water levels from images taken at various times as well as interpretation based on the plant communities.

There are some differences in water regime definitions between various guidance documents (Cowardin et al. 1979; Santos and Gauster 1993; Dahl et al. 2009). The Minnesota NWI update will use the water regimes A, B, C, F, H, and K as defined by Dahl et al. (2009). There are no tidal or sub-tidal water regimes. The Minnesota NWI update will also not use the E water regime (seasonally flooded – saturated) due to its potential overlap with the C water regime. The Intermittently Flooded (J) water regime is generally considered to only occur in the western United States. This water regime is also excluded from the Minnesota NWI update. In addition, due to the difficulty in determining the difference between Intermittently Exposed (G) and Permanently Flooded (H) with limited temporal data, the G class will not be used.

Given the limited temporal data (typically only one spring image and maybe just a few relatively recent summer images), it will be difficult to classify water regime on the basis of water observation alone. Instead, it will be important to make inferences based on plant community, landscape position, and other factors. Fortunately, Cowardin et al. (1979) simplifies this task somewhat by restricting the water regimes for each class to only a few possibilities. In addition, water regimes are further restricted somewhat by regional wetland characteristics. For example, Cowardin allows for forested wetlands to have all water regimes except sub-tidal regimes. However, Minnesota does not have any tree species that can tolerate permanent or semi-permanent flooding (like Cypress). This is confirmed by the statistics for water regimes in the original NWI for Minnesota.

General guidance for water regime:

- Water regime modifiers will be applied to all wetland polygons.
- Only the A, B, C, F, H, and K water regimes as defined by Dahl et al. (2009) will be used in Minnesota.
- The (E) water regime from Dahl et al. (2009) will not be used. Instead, it will be incorporated into the (C) water regime.
- Due to the potential difficulty of reliably separating F, G, and H water regimes without long-term hydrologic records, the G water regime will not be used. Instead wetlands with more permanent water regimes will be classified as either semi-permanently flooded (F) or permanently flooded (H).
- The (J) water regime will not be used.
- Water regimes for each valid Cowardin class are listed in Table 1-4, with most-likely water regimes indicated by the abbreviation “ML”.

Table 1-4

Water Regime Modifiers for the NWI Update of Minnesota

	Water Regime					
Cowardin Class	**A**	**B**	**C**	**F**	**H**	**K**
L1UB					ML	P
L2UB				P	ML	P
L2AB				P	ML	P
L2EM				P	ML	P
L2US	ML		P			P
L2RS	ML		P			P
L2RB				P	ML	P
PUB				P	ML	P
PAB				P	ML	P
PEM	P	P	ML	P	P	P
PFO	P	ML	ML	P		P
PSS	P	ML	ML	P		P
PUS	ML		P			P
PRB				P	ML	P
PML		ML				
R2UB					ML	
R2AB					ML	
R2US	ML		P			
R2EM				ML	P	
R2RS	ML		P			
R2RB					ML	
R3UB				P	ML	
R3US	ML		P			
R3RS	ML		P			
R3RB				P	ML	
R4SB	ML		P			

* The most-likely water regimes are indicated by “ML”. Possible, but not-likely, water regimes are indicated by “P”.

1.4.Special Modifier Issues

Special modifiers were used extensively in the original NWI and will be used in the NWI update (Table 1-6). The most commonly used special modifier in the original NWI for Minnesota was the (d) modifier for partly drained or ditched. Many of Minnesota's wetlands are partly drained or ditched and this characteristic is readily interpretable from most aerial imagery. The application of special modifiers for beaver impacts and excavated wetlands were also frequently used. As with the partly drained wetlands, these characteristics are readily identifiable from aerial photos. Diked and impounded wetlands can be photo-interpreted, but oftentimes ancillary data such as the impoundment structures GIS database from the DNR Division of Waters may be needed to identify these features.

Little used modifiers include the modifiers for farmed, artificial substrate, and spoils. The farmed modifier was little used at least in part due to policy decisions not to map most farmed wetlands in the original NWI for Minnesota. The current policy is to map these farmed wetlands, where they exist. The typical farmed wetland in Minnesota is usually a depression that is wet in the spring and it shows signs of cultivation. It may be cropped during the summer, but crop stress is often evident. Please see the Photo Interpretation Guide for the 2010 Minnesota NWI Update for examples of identifying farmed wetlands. Based on discussions with the technical advisory committee, the spoils modifier (s) will not be used in the NWI update for Minnesota. In addition, the artificial modifier (r) will not be used in the NWI update for Minnesota. Wastewater ponds will be coded as PUBKh.

A new modifier is proposed specifically for the Minnesota NWI update. Wetlands that have peatland (bog/fen) signatures (typical vegetation may include Sphagnum, Leatherleaf, Sedges, Black Spruce, and Tamarack) should be assigned the (q) modifier. Peatlands are readily identifiable from color-infrared imagery (Hop et al. 2000).

Guidance for special modifiers:

- Special modifiers will be applied using the definitions provided by Dahl et al. (2009), except that the special modifier for spoils (s) and artifical (r) will not be used.
- Farmed wetlands will be identified whenever possible using the guidance in the Photo Interpretation guide.
- An additional special modifier will be added and applied to indicate peatlands (based on the presence of Sphagnum peat mat or other peatland indicators).
- Do not use the r (artificial) special modifier.
- Wastewater stabilization ponds will be coded PUBKh.

Table 1-6
Valid Special Modifiers for the NWI Update of Minnesota

Special Modifiers
Beaver (b)
Partly drained/ditched (d)
Farmed (f)
Diked/impounded (h)
Peatland (q)
Excavated (x)

1.5.Water Chemistry Modifier Issues

The water chemistry modifiers were virtually ignored in the original NWI for Minnesota. Only four polygons were associated with water chemistry modifiers. Certain peatlands identified with the special modifier (q) are likely to be acidic, but pH cannot be reliably determined from remote sensing data. Therefore, water chemistry modifiers will not be applied for the NWI update for Minnesota.

1.6.Soil Modifier Issues

The original NWI did make some use of the soils modifiers, but their use was inconsistent. The most reliable mapped information on soils in Minnesota is from the USDA Soil Survey Geographic (SSURGO) Data. Application of soil modifiers in the absence of additional field work would be no better than simply relying on SSURGO. Therefore, soil modifiers will also not be applied to the NWI update for Minnesota.

1.7.References

Cowardin, L.M., V. Carter, F.C. Golet, and E.T.LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Dept. of Interior, Fish and Wildlife Service, Office of Biological Services. Washington, D.C. 79 pp.

Dahl, T.E., J. Dick, J. Swords and B.O. Wilen. 2009. Data Collection Requirements and Procedures for Mapping Wetland, Deepwater and Related Habitats of the United States. Division of Habitat and Resource Conservation, National Standards and Support Team, Madison, WI. 96 pp.

Hop, K., D. Faber-Langendoen, M. Lew-Smith, N. Aaseng, and S. Lubinski. 2000. USGS-NPS Vegetation Mapping Program: Voyageurs National Park, Minnesota, Appendix F: Photo Interpretation Mapping Conventions and Visual Key. U.S. Dept. of Interior, U.S. Geological Survey, Upper Midwest Environmental Sciences Center. La Crosse, WI. 137 pp.

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Santos, K.M. and J.E. Gauster. 1993. User's Guide to National Wetland Inventory Maps (Region 3) and to "Classification of Wetlands and Deepwater Habitats of the United States". U.S. Dept. of Interior, Fish and Wildlife Service, National Wetlands Inventory, Region 3. Bloomington, MN. 40 pp.

2. Simplified Plant Community Classification System

(Adapted from Eggers and Reed 1997)

There are 15 classes in the Eggers and Reed (1997) classification system. This document describes a Simplified Plant Community Class to be used for a remote sensing-based update of the National Wetland Inventory for Minnesota. The 15 plant community classes from Eggers and Reed (1997) are re-grouped into 9 simplified plant community classes with one additional class for non-vegetated aquatic communities (e.g. substrate types for certain systems/sub-systems including unconsolidated bottom, rock bottom, rocky shore, unconsolidated shore, and streambed). This simplification of the Eggers and Reed classification system is designed to provide information on wetland plant communities to the end users of the updated NWI within the bounds of what is currently possible to achieve with reasonable accuracy with remote sensing data.

2.1.Combining Classes

1) Combine the Sedge Meadow, Fresh Wet Meadow, Wet to Wet-Mesic Prairie, and the herbaceous form of the Calcareous Fen into a single simplified Inland Wet Meadow class.

2) Combine the various bog types and subtypes of Eggers and Reed into a single simplified Bog class.

3) Combine the Shrub-Carr, Alder Thicket, and the shrub form of the Calcareous Fen into a single simplified Shrub Wetland class.

Table 2-1
Simplified Plant Community Classes

	Modified Plant Community Class	Eggers and Reed Plant Community Class
1	Seasonally Flooded Basin	Seasonally Flooded Basins - 16B
2	Wet Meadow	Sedge Meadow - 13A Fresh (Wet) Meadows - 15B Wet to Wet-Mesic Prairies - 15A Calcareous Fens (Herbaceous Type) - 14A
3	Shallow Marsh	Shallow Marshes - 13B
4	Deep Marsh	Deep Marshes - 12B
5	Shallow Open Water Community	Shallow Open Water Communities -16A
6	Peatland	Open Bog (Herbaceous Type) - 10A Open Bog (Shrub Type) - 7A Coniferous Bogs - 4A
7	Shrub Wetland	Shrub-Carrs - 8B Alder Thickets - 8A Calcareous Fens (Shrub Type) - 7B
8	Hardwood Wetland	Hardwood Swamps - 3B Floodplain Forests - 3A
9	Coniferous Swamps	Coniferous Swamps - 4B
10	Non-Vegetated Aquatic Community	NA

2.2.Classification Cross-Walk to Cowardin

Implementing this simplified plant community class is primarily a process of re-coding from the Cowardin et al (1979) the data from the Cowardin classification system including wetland classes, subclasses, water regime modifiers, and special modifiers. The applicability of the cross-walk between the Cowardin classification system and the simplified plant community classification system requires special attention to how the Cowardin codes are applied.

1) Split the Cowardin palustrine emergent class (PEM) across four simplified plant community classes based on water regime; Seasonally Flooded Basins (PEMA), Inland Wet Meadow (PEMB), Shallow Marshes (PEMC & PEMF), and Deep Marshes (PEMH).

2) There is some potential for class confusion between simplified Inland Wet Meadow class and the Seasonally Flooded Basin class. Particular attention is required during the photo-interpretation of the temporarily flooded (A) water regime for the PEM class to ensure proper class separation. The Eggers and Reed classification key states that Seasonally Flooded Basins are often cultivated or dominated by annuals such as smartweed and wild millet. Wetlands with photo-signatures indicating dominant plant communities are obligate wetland species (such as Typha) should not be classified as PEMA.

3) Split the Cowardin PAB class across Deep Marshes (PABF) and Shallow Open Water Communities (PABH) based on water regime.

4) Split the Cowardin forested wetland class (PFO) into Coniferous Wetland (PFO2 & PFO4) and Hardwood Wetland (PFO1) plant community classes based on sub-class. With the exception of the coniferous wetlands that should be placed in the peatland class (see rule 8).

5) The peatland community class crosses the PEM, PSS, and PFO Cowardin classes. Additional interpretation beyond what is typically required for the NWI is needed to effectively separate the peatland community class. Wetlands that have photo-signatures that indicate closed canopy black spruce stands, sphagnum-moss/leather-leaf, sphagnum/sedge, sphagnum/tamarack, or possessing other peatland indicators such as the characteristic open water moat will be assigned a new special modifier (q) that will then be used to complete the cross-walk for the simplified peatland community class.

   NOTE: This class is most closely related the Eggers and Reed bog classes, but the relationship is not expected to be perfect. According to Eggers and Reed, bogs have the following plant characteristics:

- *Tamarack (PFO2) and/or black spruce (PFO4) are dominant; growing on a continuous sphagnum moss mat and acid, peat soils*
- *Shrubs are ericaceous and evergreen (PSS3, PSS4) growing on a sphagnum moss mat layer; peat soils are acidic*
- *Sphagnum moss mat on acid peat soils; leatherleaf, pitcher plants, certain sedges, and other herbaceous species (PEM) tolerant of low nutrient conditions may be present*

  The presence of a sphagnum moss mat and ericaceous shrubs can usually be photo-interpreted. In some cases, the tree canopy can be too dense to view the underlying layers. However, depending upon the characteristics of the tree canopy, the presence of a sphagnum mat can be inferred. The Native Plant Community Classification System refers to some wetlands with extensive sphagnum coverage as poor fens. Eggers and Reed does not make this distinction. These poor fens are difficult to separate from bogs without detailed field studies. In fact, fens and bogs may occur within the same wetland complex.

Table 2 – Cross-Walk from Cowardin to Simplified Plant Community Type

System	Subsystem	Class	Subclass	Water Regime	Code	Modifier	Plant Community Class
Lacustrine	Limnetic	Rock Bottom		H	L1RBH		Non-Vegetated Aquatic Community
		Unconsolidated Bottom		H	L1UBH		Non-Vegetated Aquatic Community
		Aquatic Bed		H	L1ABH		Shallow Open Water Community
	Littoral	Rock Bottom		F	L2RBF		Non-Vegetated Wetland
				H	L2RBH		
		Unconsolidated Bottom		F	L2UBF		Shallow Open Water Community
				H	L2UBH		
		Aquatic Bed		F	L2ABF		Shallow Open Water Community
				H	L2ABH		
		Rocky Shore		A	L2RSA		Non-Vegetated Aquatic Community
				C	L2RSC		
		Unconsolidated Shore		A	L2USA		
				C	L2USC		
		Emergent	2-Nonpersistent	F	L2EM2F		Shallow Open Water Community
				H	L2EM2H		
Riverine	Lower Perennial	Rock Bottom		F	R2RBF		Non-Vegetated Aquatic Community
				H	R2RBH		
		Unconsolidated Bottom		F	R2UBF		Non-Vegetated Aquatic Community
				H	R2UBH		
		Aquatic Bed		F	R2ABF		Shallow Open Water Community
				H	R2ABH		
		Rocky Shore		A	R2RSA		Non-Vegetated Aquatic Community
				C	R2RSC		
		Unconsolidated Shore		A	R2USA		
				C	R2USC		
		Emergent	2-Nonpersistent	F	R2EM2F		Shallow Open Water Community
				H	R2EM2H		
	Upper Perennial	Rock Bottom		F	R3RBF		Non-Vegetated Aquatic Community
				H	R3RBH		
		Unconsolidated Bottom		F	R3UBF		Non-Vegetated Aquatic Community
				H	R3UBH		
		Aquatic Bed		F	R3ABF		Shallow Open Water Community
				H	R3ABH		
		Rocky Shore		A	R3RSA		Non-Vegetated Aquatic Community
				C	R3RSC		
		Unconsolidated Shore		A	R3USA		
				C	R3USC		
	Intermittent	Streambed		A	R4SBA		
				C	R4SBC		

Table 2-2 – Cross-Walk from Cowardin to Simplified Plant Community Type (Continued)

System	Subsystem	Class	Subclass	Water Regime	Code	Modifier	Plant Community Class
Palustrine	Palustrine	Rock Bottom		F	PRBF		Non-Vegetated Aquatic Community
				H	PRBH		
		Unconsolidated Bottom		F	PUBF		Shallow Open Water Community
				H	PUBH		
		Aquatic Bed		F	PABF		Deep Marsh
				H	PABH		Shallow Open Water Community
		Unconsolidated Shore		A	PUSA		Non-Vegetated Aquatic Community
				C	PUSC		
		Moss-Lichen		B	PMLB	q	Peatland
		Emergent	1-Persistent	A	PEM1A		Seasonally Flooded Basin
				B	PEM1B	not q	Wet Meadow
						q	Peatland
				C	PEM1C		Shallow Marsh
				F	PEM1F		
			2-Nonpersistent	F	PEM2F		Deep Marsh
				H	PEM2H		
		Scrub-Shrub	1-Broad-leaved deciduous	A	PSS1A		Shrub Wetland
				B	PSS1B		
				C	PSS1C		
			2-Needle-leaved deciduous	A	PSS2A		Shrub Wetland
				B	PSS2B	not q	Shrub Wetland
						q	Peatland
				C	PSS2C		Shrub Wetland
			3-Broad-leaved evergreen	B	PSS3B	q	Peatland
			4-Needle-leaved evergreen	A	PSS4A		Shrub Wetland
				B	PSS4B	not q	Shrub Wetland
					PSS4B	q	Peatland
				C	PSS4C		Shrub Wetland
		Forested	1-Broad-leaved deciduous	A	PFO1A		Hardwood Wetland
				B	PFO1B		
				C	PFO1C		
			2-Needle-leaved deciduous	A	PFO2A		Coniferous Wetland
				B	PFO2B	not q	Coniferous Wetland
						q	Peatland
				C	PFO2C		Coniferous Wetland
			4-Needle-leaved evergreen	A	PFO4A		Coniferous Wetland
				B	PFO4B	not q	Coniferous Wetland
						q	Peatland
				C	PFO4C		Coniferous Wetland

Water regimes shaded blue are the most likely regime for the associated Cowardin class.

2.3.References

Cowardin, L.M., V. Carter, F.C. Golet, and E.T.LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Dept. of Interior, Fish and Wildlife Service, Office of Biological Services. Washington, D.C. 79 pp.

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3. Simplified Key for Hydro-Geomorphemetric Classification

(Initially adapted from Tiner (2003) by Annis Water Resource Institute and subsequently modified by Minnesota DNR)

3.1.Landscape Position

1a	Wetland lies along a river, stream, lake, reservoir, or in-stream pond or within a relatively flat plain[1] contiguous to the water body.....	2
1b	Wetland does lie along one of these water bodies; it is surrounded by upland or borders a pond that is surrounded by upland……	Terrene
2a	Wetland lies along a lake or reservoir or within its basin (i.e., the relatively flat plain contiguous to the lake or reservoir)……	Lentic
2b	Wetland lies along a river or stream, or in-stream pond……..	3
3a	Wetland is the source of a river or stream and this watercourse does not flow through the wetland……	Terrene
3b	A river or stream flows through or alongside the wetland……	4
4a	Wetland is periodically flooded by river or stream……..	Lotic[2]
4b	Wetland is not periodically flooded by the river or stream……	Terrene

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3.2.Landform[1]

1a	Wetland occurs on a slope >2%……	Slope
1b	Wetland does not occur on a slope >2%……	2
2a	Wetland forms an island completely surrounded by water……	Island
2b	Wetland does not form an island……	3
3a	Wetland occurs in the shallow water zone of a permanent waterbody……..	Fringe
3b	Wetland does not occur in this zone……..	4
4a	Wetland forms a non-vegetated bank or is within the banks of a river or stream……	Fringe
4b	Wetland is a vegetated stream bank or is not within the banks……	5
5a	Wetland occurs on an active alluvial plain along a river……	Floodplain
5b	Wetland does not occur on an active floodplain……	6
6a	Wetland occurs in a distinct depression……..	Basin
6b	Wetland occurs on a nearly level landform……	Flat

[1] FEMA floodplain GIS data and LiDAR topography data are available for this assessment.
[2] Lotic wetlands can be separated into river and stream sections based on watercourse width.

3.3.Water Flow Path[3]

1a	Wetland is typically surrounded by upland; receives precipitation and runoff from adjacent areas with no apparent outflow.....	Isolated
1b	Wetland is not geographically isolated	2
2a	Wetland is a sink receiving water from a river, stream, or other surface water source, lacking surface-water outflow.....	Inflow
2b	Wetland is not a sink; surface water flows through or out of the wetland.....	3
3a	Water flows out of the wetland, but does not flow into this wetland from another source.....	Outflow
3b	Water flows in and out of the wetland or water table fluctuates due to presence of a lake or stream.....	4
4a	Water flows through the wetland through an identifiable channel.....	Throughflow
4b	Wetland occurs along a lake or reservoir and not along a river or stream; its water levels are subject to the rise and fall of lake or reservoir levels.....	Bidirectional-Nontidal

3.4.References

Tiner, R.W. 2003. Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type Descriptors. U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Northeast Region, Hadley, MA. 44 pp.

[3]Wetland is geographically isolated; hydrological relationship to other wetlands and watercourses may be more complex than can be determined by simple visual assessment of surface water conditions. If groundwater relationships are known one can apply other water flow paths as appropriate, but add "groundwater" to the term (e.g., outflow-groundwater). Surface water connections are emphasized because they are more readily identified than groundwater linkages. Water flow path for some bogs and similar wetlands may be paludified; paludification processes occur in areas of low evapotranspiration and high rainfall, peat moss moves uphill creating wetlands on hillslopes (i.e., wetland develops upslope of primary water source).