# Photo Interpretation Guide

**For Updating The**

# National Wetland Inventory

**In Minnesota**

May 2016

DUCKS UNLIMITED

Minnesota Department of Natural Resources

U.S. FISH & WILDLIFE SERVICE

# Introduction



# Classification

## 1.1 Purpose of Photo Interpretation Guide

This document is intended to serve as a visual key to be used as a training tool and reference material for the photo interpreters updating the National Wetland Inventory (NWI) in Minnesota. Its purpose is to:

> ***provide visual examples of each NWI class at the ground and aerial level (using different seasons and types) to assist the photo interpreters classifying the wetlands in Minnesota.***

This key does not attempt to show an exhaustive representation for all variations within each NWI class; only the most common or significant representations are included herein. Additional examples will be provided as the NWI update progresses throughout Minnesota.

## 1.2 Contact Information


| **Ducks Unlimited** | **U.S. Fish and Wildlife Service** | **MN DNR** |
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## 1.3 Wetland and Deepwater Habitats Classification Scheme

For the update of the National Wetland Inventory in Minnesota the Cowardin *et al.* Classification System will be used as modified by the Minnesota DNR. See the *Supplemental Guidance for the classification of Wetlands for the Update of the National Wetland inventory for Minnesota* for further information on these modifications. For reference, a classification key has been provided on pages 2 and 3 of this document.

Fig 1.1.

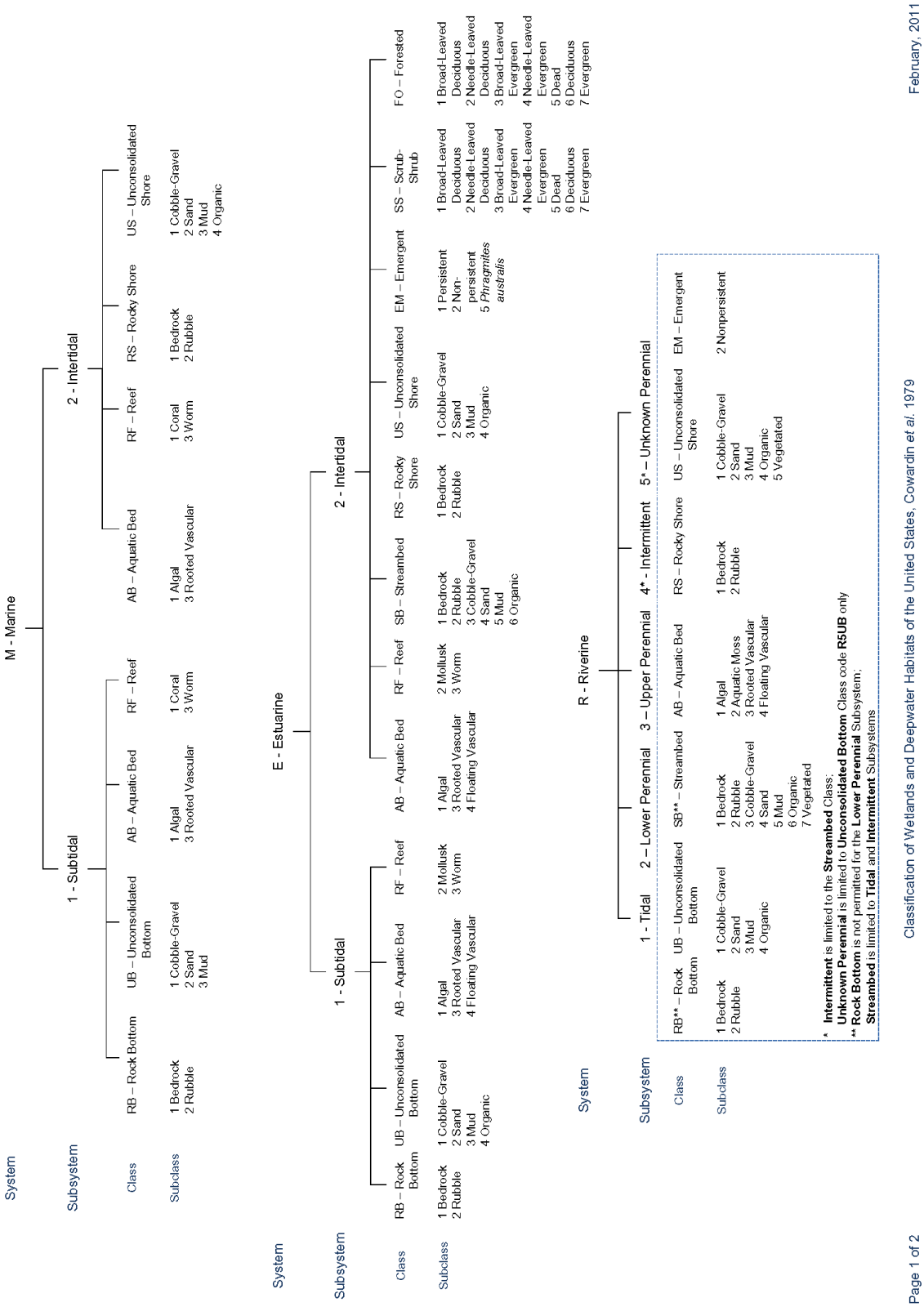
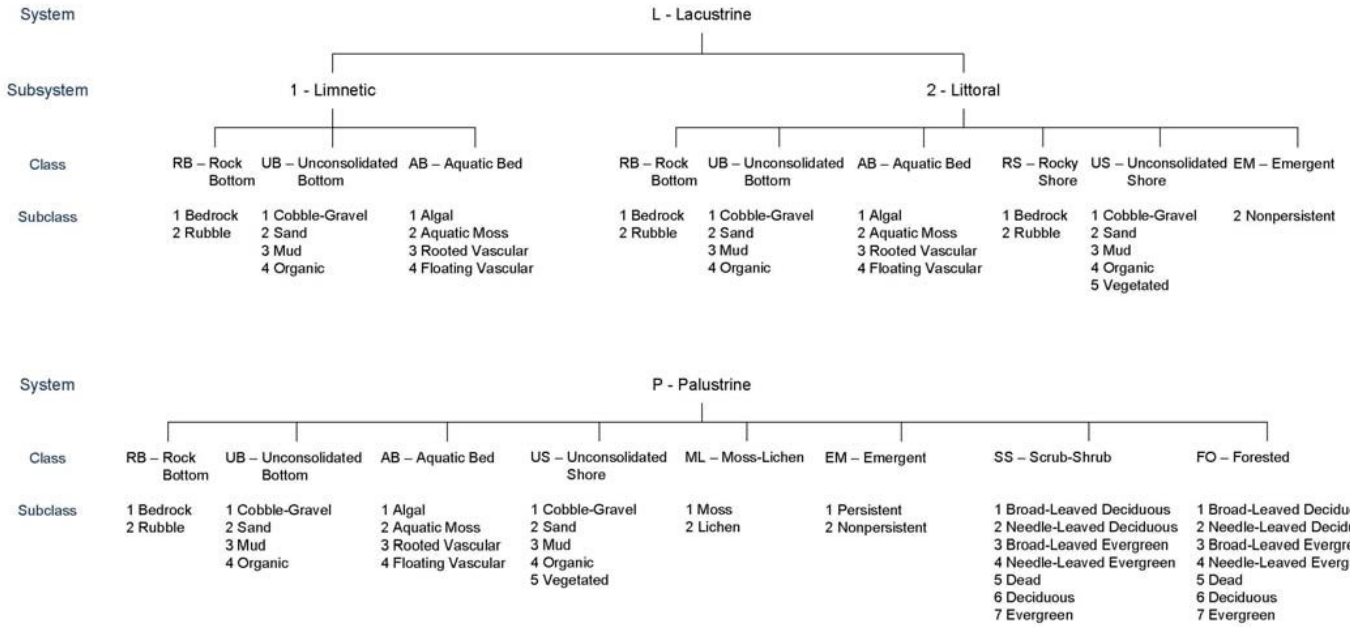

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION
System
M - Marine
Subsystem
1 - Subtidal
2 - Intertidal
Class
RB – Rock Bottom
UB – Unconsolidated Bottom
AB – Aquatic Bed
RF – Reef
AB – Aquatic Bed
RF – Reef
RS – Rocky Shore
US – Unconsolidated Shore
Subclass
1 Bedrock
2 Rubble
1 Cobble-Gravel
2 Sand
3 Mud
1 Algal
3 Rooted Vascular
1 Coral
3 Worm
1 Algal
3 Rooted Vascular
1 Coral
3 Worm
1 Bedrock
2 Rubble
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic
System
E - Estuarine
Subsystem
1 - Subtidal
2 - Intertidal
Class
RB – Rock Bottom
UB – Unconsolidated Bottom
AB – Aquatic Bed
RF – Reef
AB – Aquatic Bed
RF – Reef
SB – Streambed
RS – Rocky Shore
US – Unconsolidated Shore
EM – Emergent
SS – Scrub-Shrub
FO – Forested
Subclass
1 Bedrock
2 Rubble
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic
1 Algal
3 Rooted Vascular
4 Floating Vascular
2 Mollusk
3 Worm
1 Algal
3 Rooted Vascular
4 Floating Vascular
2 Mollusk
3 Worm
1 Bedrock
2 Rubble
3 Cobble-Gravel
4 Sand
5 Mud
6 Organic
1 Bedrock
2 Rubble
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic
5 Vegetated
1 Persistent
2 Non-persistent
5 Phragmites australis
1 Broad-Leaved Deciduous
2 Needle-Leaved Deciduous
3 Broad-Leaved Evergreen
4 Needle-Leaved Evergreen
5 Dead
6 Deciduous
7 Evergreen
1 Broad-Leaved Deciduous
2 Needle-Leaved Deciduous
3 Broad-Leaved Evergreen
4 Needle-Leaved Evergreen
5 Dead
6 Deciduous
7 Evergreen
System
R - Riverine
Subsystem
1 - Tidal
2 – Lower Perennial
3 – Upper Perennial
4* - Intermittent
5* – Unknown Perennial
Class
RB** – Rock Bottom
UB – Unconsolidated Bottom
SB** – Streambed
AB – Aquatic Bed
RS – Rocky Shore
US – Unconsolidated Shore
EM – Emergent
Subclass
1 Bedrock
2 Rubble
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic
1 Bedrock
2 Rubble
3 Cobble-Gravel
4 Sand
5 Mud
6 Organic
7 Vegetated
1 Algal
2 Aquatic Moss
3 Rooted Vascular
4 Floating Vascular
1 Bedrock
2 Rubble
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic
5 Vegetated
2 Nonpersistent
* Intermittent is limited to the Streambed Class;
Unknown Perennial is limited to Unconsolidated Bottom Class code R5UB only
** Rock Bottom is not permitted for the Lower Perennial Subsystem;
Streambed is limited to Tidal and Intermittent Subsystems
Classification of Wetlands and Deepwater Habitats of the United States, Cowardin et al. 1979
February, 2011
Page 1 of 2

Fig 1.2

## WETLANDS AND DEEPWATER HABITATS CLASSIFICATION




**MODIFIERS**

In order to more adequately describe the wetland and deepwater habitats, one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

| Water Regime | | | Special Modifiers | Water Chemistry | | | Soil |
|---|---|---|---|---|---|---|---|
| **Nontidal** | **Saltwater Tidal** | **Freshwater Tidal** | | **Coastal Halinity** | **Inline Salinity** | **pH Modifiers for all Fresh Water** | |
| A Temporarily Flooded | L Subtidal | S Temporarily Flooded-Tidal | b Beaver | 1 Hyperhaline | 7 Hypersaline | a Acid | g Organic |
| B Saturated | M Irregularly Exposed | R Seasonally Flooded-Tidal | d Partly Drained/Ditched | 2 Euhaline | 8 Eusaline | t Circumneutral | n Mineral |
| C Seasonally Flooded | N Regularly Flooded | T Semipermanently Flooded-Tidal | f Farmed | 3 Mixohaline (Brackish) | 9 Mixosaline | l Alkaline | |
| E Seasonally Flooded/ Saturated | P Irregularly Flooded | V Permanently Flooded-Tidal | h Diked/Impounded | 4 Polyhaline | 0 Fresh | | |
| F Semipermanently Flooded | | | r Artificial | 5 Mesohaline | | | |
| G Intermittently Exposed | | | s Spoil | 6 Oligohaline | | | |
| H Permanently Flooded | | | x Excavated | 0 Fresh | | | |
| J Intermittently Flooded | | | | | | | |
| K Artificially Flooded | | | | | | | |

# R2UBG

**SYSTEM:** Riverine
**SUBSYSTEM:** Lower Perennial
**CLASS:** Unconsolidated Bottom
**SUBCLASS:**
**MODIFIER:** Intermittently Exposed

**COMMENTS:** Riverine Systems consist of a flowing body of water or a connecting link between two bodies of standing water. R2s have no tidal influence and are characterized by slow moving water with a low gradient. Vegetated areas on either side of the R2 are to be classified separately.

Fig 2.1.1 Wyanett_50_051611_R2UBH


Fig 2.1.2 SPRING 2010 INFRARED


Fig 2.1.3 SPRING 2008

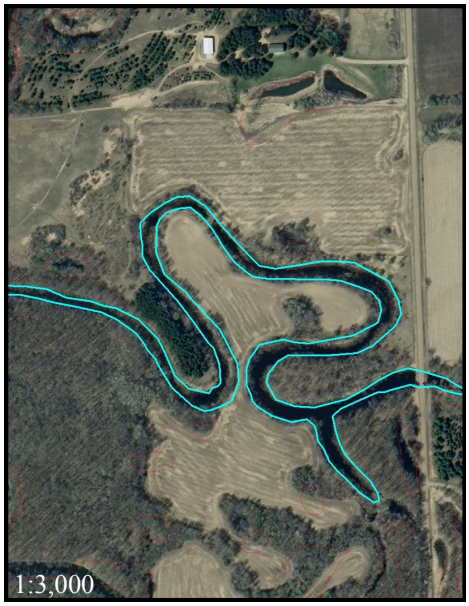



Fig 2.1.4 SUMMER 2010

# R2UBFx

**SYSTEM:** Riverine
**SUBSYSTEM:** Lower Perennial
**CLASS:** Unconsolidated Bottom
**SUBCLASS:**
**MODIFIER:** Semipermanently Flooded
**SPECIAL MODIFIER:** Excavated

**COMMENTS:** The code R2UBFx is to be used for ditches that appear to have flow and rivers that have been altered. These features must be delineated if they are more than 15 feet across or have been easily picked up by the segmentation process.

Fig 2.1.5 USGS 24K Topographic Map

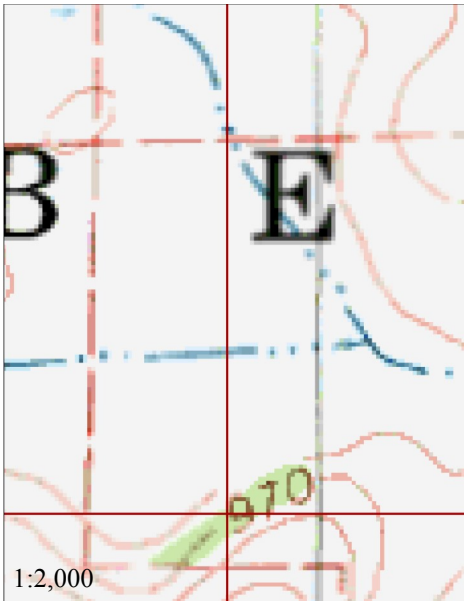



Fig 2.1.6 SPRING 2010 INFRARED

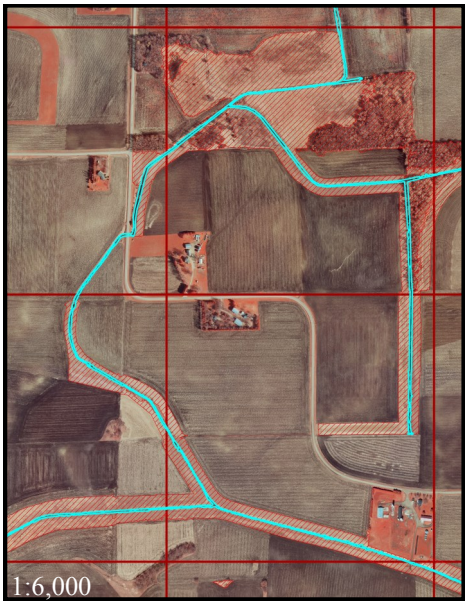



Fig 2.1.7 SPRING 2008

# L1UBH

**SYSTEM:** Lacustrine
**SUBSYSTEM:** Limnetic
**CLASS:** Unconsolidated Bottom
**SUBCLASS:**
**MODIFIER:** Permanently Flooded

**COMMENTS:** L1UBH is the portion of this body of water that exceeds 2.5 meters in depth (8.2 ft). Additional information such as bathymetry may be needed to assist in separating L1 from L2 classes. Note that according to federal wetlands mapping standard (FGDC 2009), Lacustrine wetlands may not have a subclass assigned.

Fig 2.2.1 MarineOnStCroix_44_051811_L1UBH

Fig 2.2.2 SPRING 2010

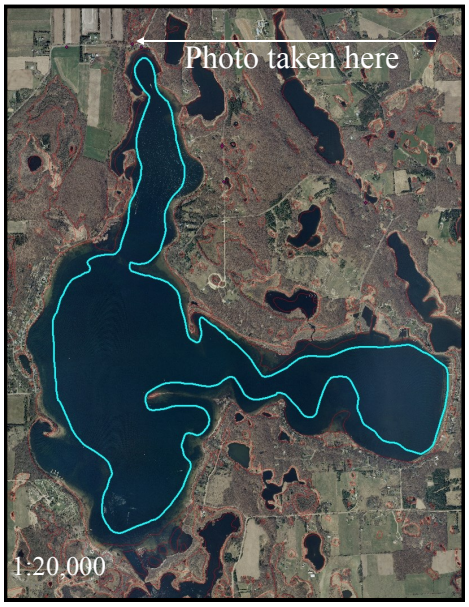



Fig 2.2.3 SPRING 2010 INFRARED

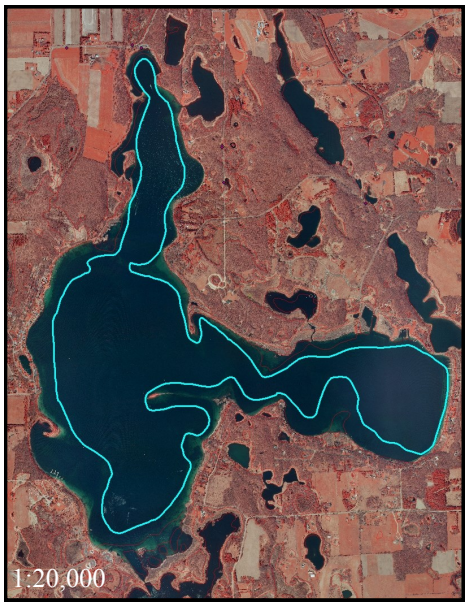
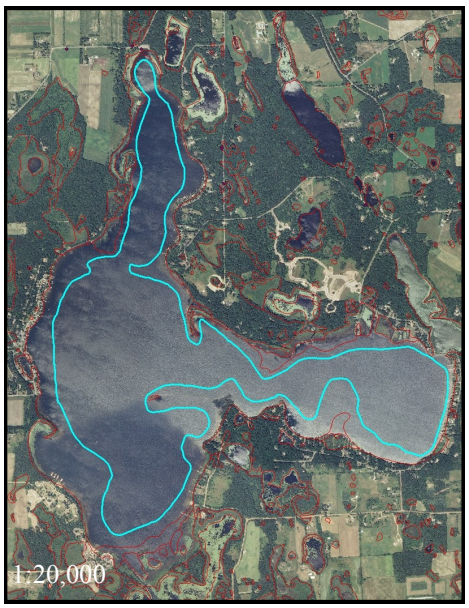



Fig 2.2.4 SUMMER 2008



# L2UBG

**SYSTEM:** Lacustrine
**SUBSYSTEM:** Littoral
**CLASS:** Unconsolidated Bed
**SUBCLASS:**
**MODIFIER:** Intermittently Exposed

**COMMENTS:** There may be some L1 inside of this L2 class depending on the depth of water. L2 features must have a depth of less than 2.5m (8.2ft).

Fig 2.2.5 Veseli_23_051811_L2UBH

Fig 2.2.6 SPRING 2010


Fig 2.2.7 SPRING 2010 INFRARED

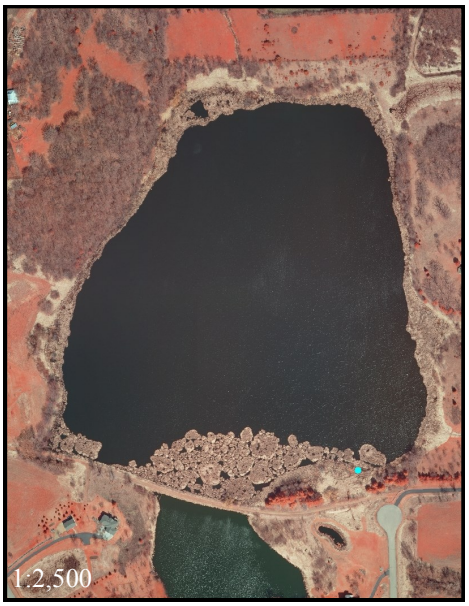



Fig 2.2.8 SUMMER 2008

# L2UBGx

**SYSTEM:** Lacustrine
**SUBSYSTEM:** Littoral
**CLASS:** Unconsolidated Bottom
**SUBCLASS:**
**MODIFIER:** Intermittently Exposed
**SPECIAL MODIFIER**: Excavated

**COMMENTS:** The L2UB feature is not present before the 2010 images, indicating that it is manmade. Because of this an x (Excavated) special modifier must be included.

Fig 2.2.9 Mayer_34_051711_L2UBHx


Fig 2.2.10 SPRING 2010


Fig 2.2.11 SPRING 2010 INFRARED


Fig 2.2.12 SUMMER 2008

# PUBG

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Unconsolidated Bed
**SUBCLASS:**
**MODIFIER:** Intermittently Exposed

**COMMENTS:** Open water with an area of less than 20 acres is classified as PUB. Based on the size of this particular pond, it is assumed that over an extended period of time there will be dry seasons that will cause intermittent exposure. Ponds with bathymetry or topographic contours showing depth can be determined to be permanently flooded (H regime)

Fig 2.3.1 StPaulEast_18_051711_PUBG

Fig 2.3.2 SPRING 2010

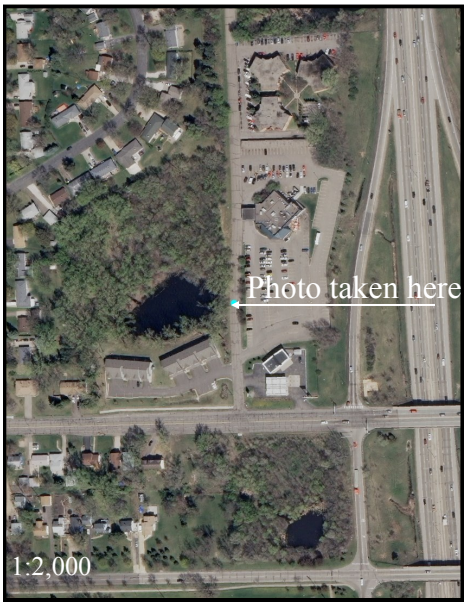



Fig 2.3.3 SPRING 2010 INFRARED


Fig 2.3.4 SUMMER 2008

# PUBGb

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Unconsolidated Bed
**SUBCLASS:**
**MODIFIER:** Intermittently Exposed
**SPECIAL MODIFIER:** Beaver Pond

**COMMENTS:** Open water with an area of less than 20 acres is classified as PUB. Beaver ponds are characterized in aerial imagery by the delta-shaped feature of open water typically in line with a stream.

Fig 2.3.5 SPRING 2010 COLOR

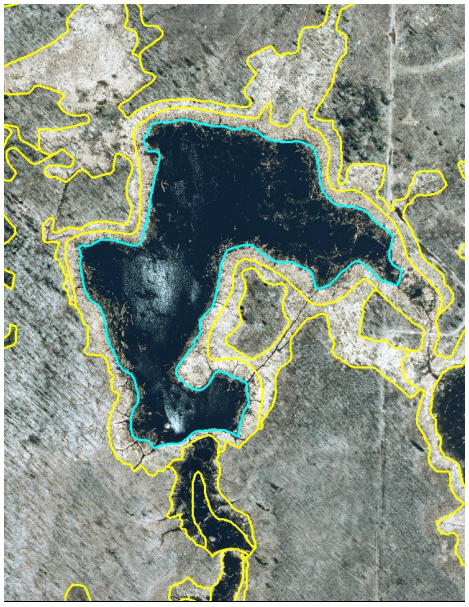


Fig 2.3.6 SPRING 2010 INFRARED

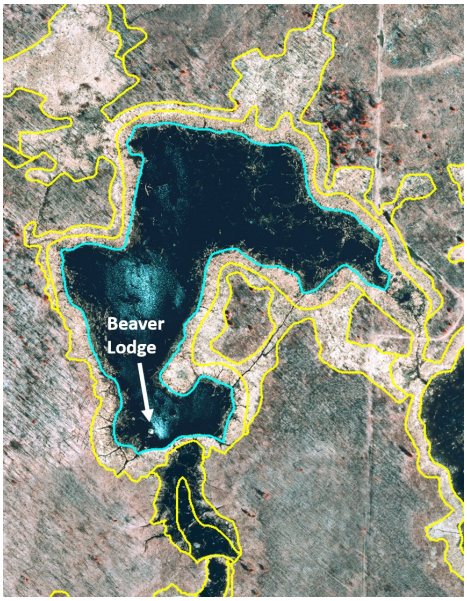
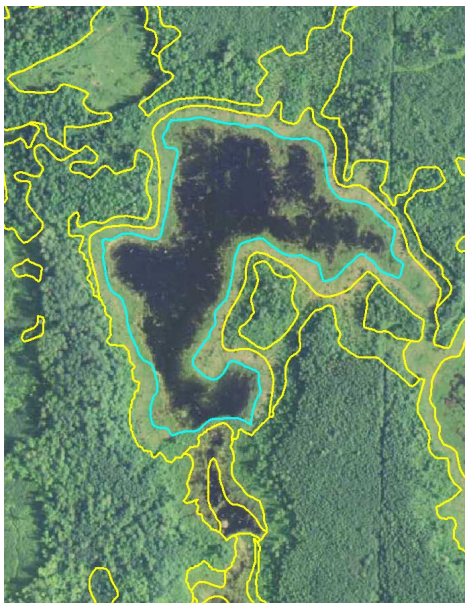



Fig 2.3.7 SUMMER 2013



# PUBFx

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Unconsolidated Bed
**SUBCLASS:**
**MODIFIER:** Semipermanently Flooded
**SPECIAL MODIFIER**: Excavated

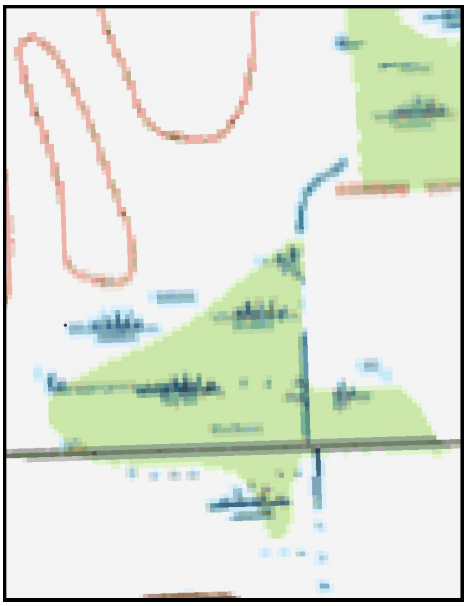
**COMMENTS:** This area appears to be a retention pond for the surrounding subdivision and therefore is given an x (Excavated) special modifier.

Fig 2.3.8 MinnNorth_19_051611_PUBFx

Fig 2.3.9 SPRING 2010


Fig 2.3.10 SUMMER 2008


Fig 2.3.11 USGS 24K Topographic Map



# PABKh

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Aquatic Bed
**SUBCLASS:**
**MODIFIER:** Artificially Flooded
**SPECIAL MODIFIER**: Diked/Impounded

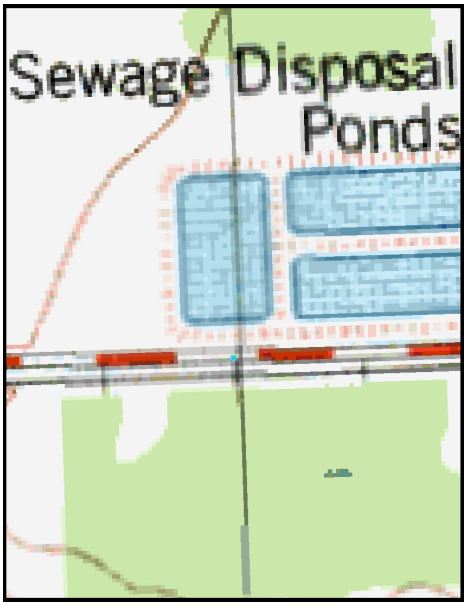
**COMMENTS:** Waste water treatment ponds are artificially flooded and are usually diked/impounded. Summer images should be used to determine if open water features have algal/moss/or vascular plants growing. If so they should be classified as an AB class rather than UB.

Fig 2.3.12 Mayer_23_051711_PUBKh


Fig 2.3.13 SPRING 2010


Fig 2.3.14 SUMMER 2008


Fig 2.3.15 USGS 24K Topographic Map



# PABG

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Aquatic Bed
**SUBCLASS:** Floating Vascular
**MODIFIER:** Intermittently Exposed

**COMMENTS:** AB wetlands are characterized by a pale green sheen that usually appears only in the summer.

Fig 2.3.16 Wright_10_051811_PABG

Fig 2.3.17 SPRING 2010


Fig 2.3.18 SUMMER 2008

# PEM1F

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Emergent
**SUBCLASS:** Persistent
**MODIFIER:** Semipermanently Flooded

**COMMENTS:** Emergents tend to appear smoother and brighter than surrounding vegetation. Dark spotted areas visible within the emergent vegetation indicate surface water. The level of flooding in this wetland does not appear to fluctuate much throughout the seasons but may dry out in drought years, indicating an F (Semipermanently Flooded) rather than a C (Seasonally Flooded) water regime. Note that EM present throughout most years will be given a 1 (Persistent) subclass.

Fig 2.3.19 Hopkins_07_051711_PEM1F

Fig 2.3.20 SPRING 2010

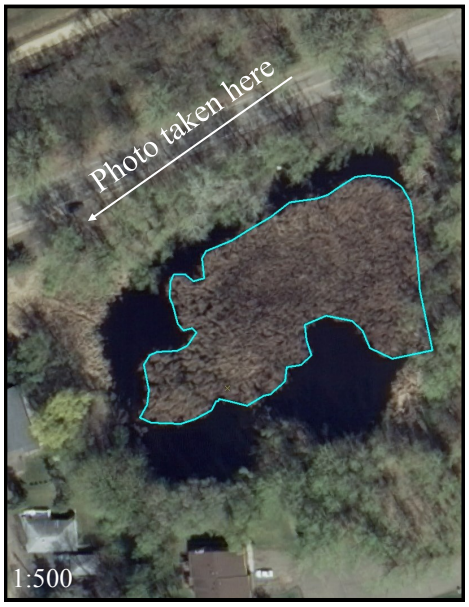



Fig 2.3.21 SPRING 2010 INFRARED


Fig 2.3.22 SUMMER 2008

# PEM1C

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Emergent
**SUBCLASS:** Persistent
**MODIFIER:** Seasonally Flooded

**COMMENTS:** Cattails are present in the field verification photo, indicating a C (Seasonally Flooded) water regime. Areas of SS may need to be delineated separately.

Fig 2.3.23 MarineOnStCroix_72_051811_PEM1C

Fig 2.3.24 SPRING 2010


Fig 2.3.25 SPRING 2010 INFRARED


Fig 2.3.26 SUMMER 2008

# PEM1Cx

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Emergent
**SUBCLASS:** Persistent
**MODIFIER:** Seasonally Flooded
**SPECIAL MODIFIER**: Excavated

**COMMENTS:** The wetland shown in this example has been dug out to provide material for the build up of the adjacent road. Because of this, the wetland classification includes an x (Excavated) special modifier. Cattails on the outer edge of the wetland will receive a C (Seasonally Flooded) water regime and must be delineated separately from the open water they surround.

Fig 2.3.27 StPaulEast_23_051711_PEM1Cx

Fig 2.3.28 SPRING 2010


Fig 2.3.29 SPRING 2010 INFRARED


Fig 2.3.30 SUMMER 2008

# PEM1B

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Emergent
**SUBCLASS:** Persistent
**MODIFIER:** Saturated

**COMMENTS:** Saturated Emergent wetlands will not have surface water. The presence of an open water moat or an floating mats that moves around the body of water are good indicators of an emergent saturated wetland. Use the most recent imagery when delineating floating mats.

Fig 2.3.31 SUMMER 2008

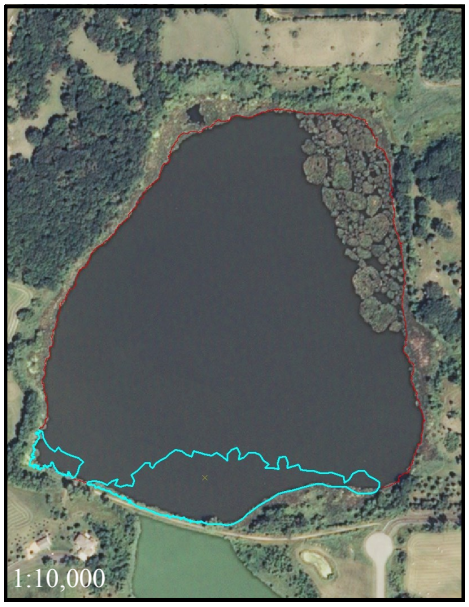



Fig 2.3.32 SUMMER 2009

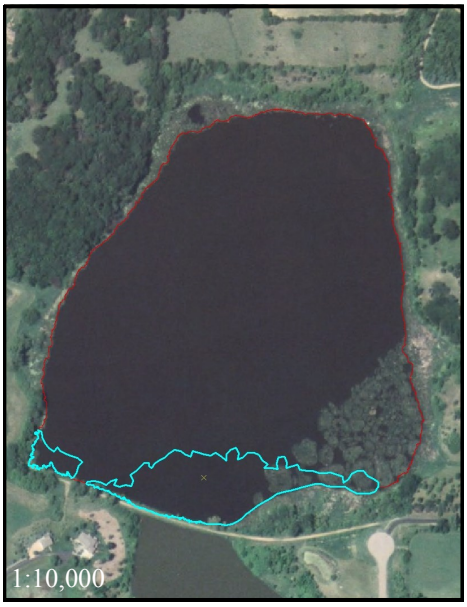



Fig 2.3.33 SUMMER (unknown year)

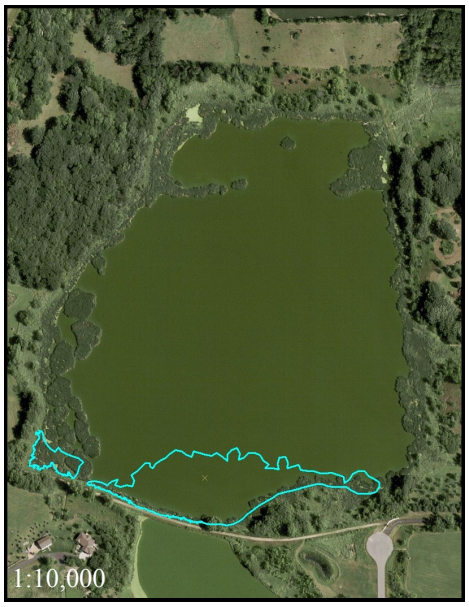
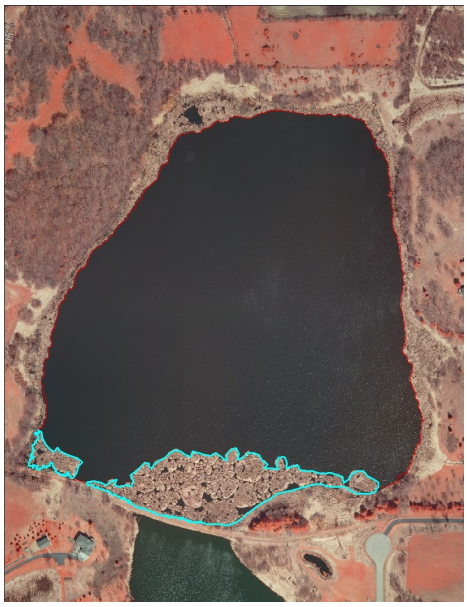



Fig 2.3.34 SPRING 2010



# PEM1A

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Emergent
**SUBCLASS:** Persistent
**MODIFIER:** Temporarily Flooded

**COMMENTS:** The EM wetland shown in this example is given an A (Temporarily Flooded) water regime because although water usually lies below the surface, water may be visible for brief periods during the spring. A wetland of this type may have a visible depression or be discolored from the surrounding vegetation.

Fig 2.3.35 MarineOnStCroix_01_0051811_PEM1A

Fig 2.3.36 SPRING 2010


Fig 2.3.37 SPRING 2010 INFRARED


Fig 2.3.38 SUMMER 2008

# PEM1Ad

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Emergent
**SUBCLASS:** Persistent
**MODIFIER:** Temporarily Flooded
**SPECIAL MODIFIER**: Partly Drained/Ditched

**COMMENTS:** A ditch can be seen running through this wetland in both images and topographic map. A d (Partly Drained/Ditched) special modifier should be included in the classification of wetlands where a ditch is clearly visible. A topographic map may be helpful in determining if a wetland is partly drained/ditched.

Fig 2.3.39 Wyanett_20_051611_PEM1Ad


Fig 2.3.40 SPRING 2010

Photo taken here

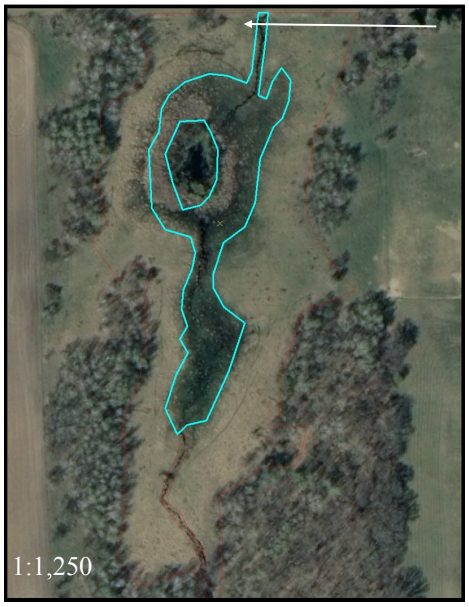
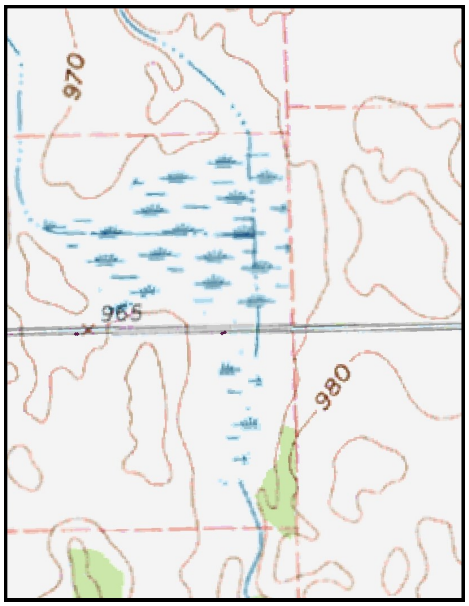



Fig 2.3.41 SUMMER 2008


Fig 2.3.42 USGS 24k Topographic Map



# PSS1F

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Scrub-Shrub
**SUBCLASS:** Broad-Leaved Deciduous
**MODIFIER:** Semipermanently Flooded

**COMMENTS:** Wetlands characterized as Scrub-Shrub (SS) must be less than 20 ft (6m) tall and can be distinguished in aerial images by a rough texture. The SS shown appears to be very wet in both the spring aerial images and the field verification images. Because it is unlikely that SS could survive in a permanently flooded area, this wetland is given an F (Semipermanently Flooded) water regime.

Fig 2.3.43 Mayer_19_051711_PSS1F


Fig 2.3.44 SPRING 2010


Fig 2.3.45 SPRING 2010 INFRARED


Fig 2.3.46 SUMMER 2008

# PSS1C

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Scrub-Shrub
**SUBCLASS:** Broad-Leaved Deciduous
**MODIFIER:** Seasonally Flooded

**COMMENTS:** SS and EM classifications can be distinguished from one another by their different textures. SS will appear coarse or rough while EM will appear smooth. This area is given a C (Seasonally Flooded) water regime because there appears to be a significant amount of water in the spring with less flooding in the summer.

Fig 2.3.47 Mayer_32_051711_PSS1C


Fig 2.3.48 SPRING 2010


Fig 2.3.49 SPRING 2010 INFRARED

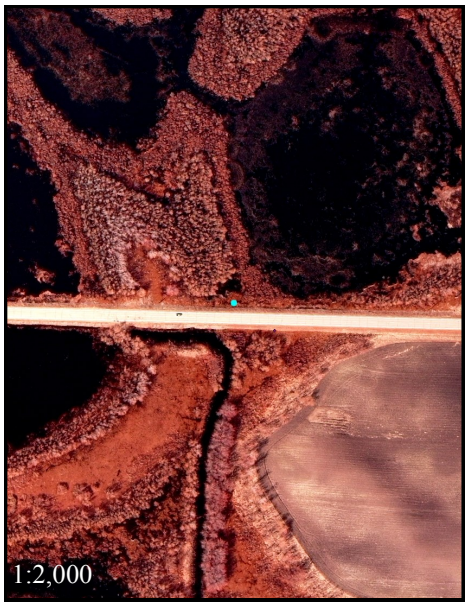



Fig 2.3.50 SUMMER 2008

# PSS1B

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Scrub-Shrub
**SUBCLASS:** Broad-Leaved Deciduous
**MODIFIER:** Saturated

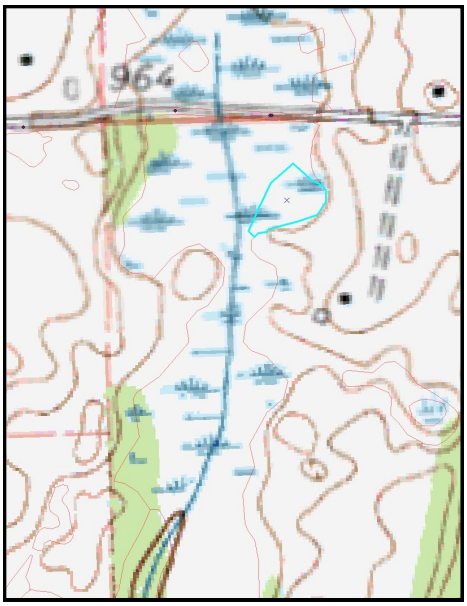
**COMMENTS:** B (Saturated) water regimes are characterized by water that is present just below the surface and is rarely visible. A topographic map may be helpful in determining if an area has the potential for a high water table.

Fig 2.3.51 Wyanett_14_051611_PSS1B


Fig 2.3.52 SPRING 2010


Fig 2.3.53 SUMMER 2008


Fig 2.3.54 USGS 24K Topographic Map



# PSS1A

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Scrub-Shrub
**SUBCLASS:** Broad-Leaved Deciduous
**MODIFIER:** Temporarily Flooded

**COMMENTS:** Water regimes tend to get less wet as distance from a body of water increase. In this case, SS near the body of water should have a C (Seasonally Flooded) because flooding is visible in both the spring and summer, while the area closer to the road has only some flooding visible during the spring and should be assigned an A (Temporarily Flooded) water regime. Note that in thick stands of vegetation flooding may not be easily seen.

Fig 2.3.55 Wyanett_70_051611_PSS1A


Fig 2.3.56 SPRING 2010


Fig 2.3.57 SPRING 2010 CLOSE UP


Fig 2.3.58 SUMMER 2008

# PFO1C

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Forested
**SUBCLASS:** Broad-Leaved Deciduous
**MODIFIER:** Seasonally Flooded

**COMMENTS:** Vegetation in forested wetlands must stand taller than 20ft (6m). FO1 (Broad-Leaved Deciduous) wetlands are characterized by the absence of foliage in the spring with visible foliage in the summer months. The southern portion of this forested area appears to be flooded in the spring indicating that a C (Seasonally Flooded) water regime should be used. Water regime can be difficult to determine in densely vegetated areas.

Fig 2.3.59 Mayer_10_051711_PFO1C

Fig 2.3.60 SPRING 2010


Fig 2.3.61 SPRING 2010 INFRARED


Fig 2.3.62 SUMMER 2008

# PFO1B

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Forested
**SUBCLASS:** Broad-Leaved Deciduous
**MODIFIER:** Saturated

**COMMENTS:** When surface water is not usually present but photos and topography suggests that it is often near the surface, a B (Saturated) water regime should be assigned.

Fig 2.3.63 Wyanett_21_051611_PFO1B


Fig 2.3.64 SPRING 2010


Fig 2.3.65 SUMMER 2008

# PFO1A

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Forested
**SUBCLASS:** Broad-Leaved Deciduous
**MODIFIER:** Temporarily Flooded

**COMMENTS:** A (Temporarily Flooded) water regimes are often found within a floodplain where surface water only appears briefly.

Fig 2.3.66 Bloomington_08_051811_PFO1A


Fig 2.3.67 SPRING 2010


Fig 2.3.68 SPRING 2010 INFRARED

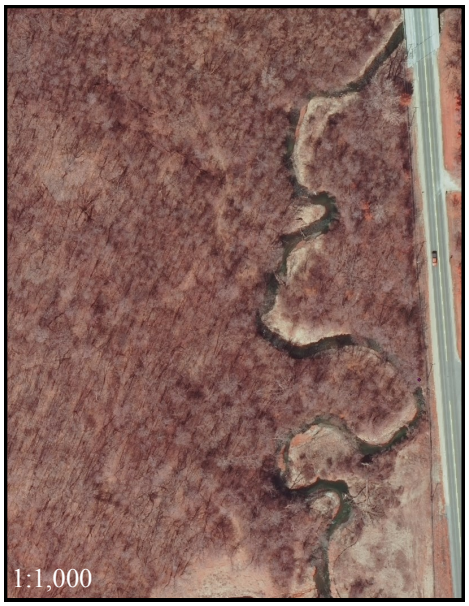



Fig 2.3.69 SUMMER 2008

# PFO1/EM1A

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Forested/ Emergent
**SUBCLASS:** Broad-Leaved Deciduous/ Persistent
**MODIFIER:** Temporarily Flooded

**COMMENTS:** FO/EM mixed classes have vegetation greater than 20ft (6m) throughout an area with an understory of emergent vegetation. When coding mixed classes, the class with the greatest vegetation height will be named first. For example, FO/SS, FO/EM, SS/EM are correctly coded.

Fig 2.4.1 MarineOnStCroix_47_051811_PFO1/EM1A

Fig 2.4.2 SPRING 2010


Fig 2.4.3 SPRING 2010 INFRARED


Fig 2..4.4 SUMMER 2008

# PFO1/2Bd

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Forested
**SUBCLASS:** Broad-Leaved Deciduous/ Needle-Leaved Deciduous
**MODIFIER:** Saturated
**SPECIAL MODIFIER:** Partially Drained/Ditched

**COMMENTS:** Although mixed classes should be avoided when possible, they are sometimes necessary when classes cannot be separated from one another.

Fig 2.4.5 Wyanett_59_051611_PFO1/2Ad


Fig 2.4.6 SPRING 2010

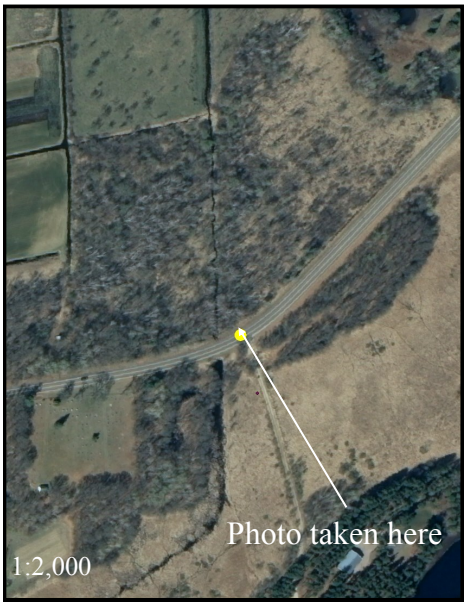
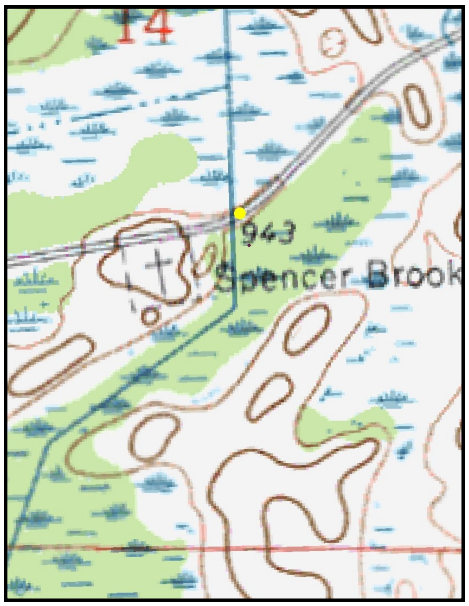



Fig 2.4.7 SUMMER 2008


Fig 2.4.8 USGS 24K Topographic Map



# PFO1/EM1C

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Forested/ Emergent
**SUBCLASS:** Broad-Leaved Deciduous/ Persistent
**MODIFIER:** Seasonally Flooded

**COMMENTS:** EM should be clearly seen though leaf-off forested wetlands (FO) in spring imagery in FO/EM mixed classes.

Fig 2.4.9 StPaulWest_02_051611_PFO1/EM1C

Fig 2.4.10 SPRING 2010


Fig 2.4.11 SPRING 2010 INFRARED

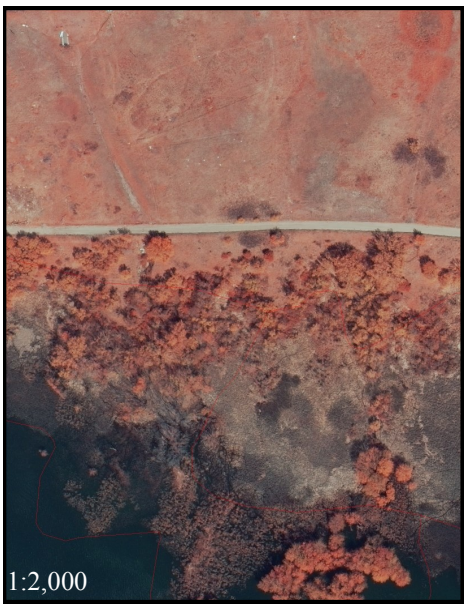



Fig 9.4.12 SUMMER 2008

# PFO1/SS1A

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Forested/ Scrub-Shrub
**SUBCLASS:** Broad-Leaved Deciduous/ Broad-Leaved Deciduous
**MODIFIER:** Temporarily Flooded

**COMMENTS:** An FO/SS mixed class has woody vegetation less than 20ft (6m) in height and greater than 20ft (6m) intermixed. The EM in these photos should be classified and digitized separately.

Fig 2.4.13 Hopkins_37_051711_PFO1/SS1A

Fig 2.4.14 SPRING 2010


Fig 2.4.15 SPRING 2010 INFRARED


Fig 2.4.16 SUMMER 2008

# PFO2/SS1B

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Forested/ Scrub-Shrub
**SUBCLASS:** Needle-Leaved Deciduous/ Broad-Leaved Deciduous
**MODIFIER:** Saturated

**COMMENTS:** If possible, separate FO and SS class. Vegetation taller than 20ft (6m) should appear green in spring and summer images, while shorter vegetation only appears green during summer months. The presence of tamarack suggests saturated soils.

Fig 2.4.17 Wyanett_46_051611_PFO2/SS1B


Fig 2.4.18 SPRING 2010


Fig 2.4.19 SUMMER 2008

# PSS1/EM1A

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Scrub-Shrub/ Emergent
**SUBCLASS:** Broad-Leaved Deciduous/ Persistent
**MODIFIER:** Temporarily Flooded

**COMMENT** The field verification photo shows and area of EM1C with PSS1/EM1A in the background. The area of EM near the road and on the edge of this wetland should be delineated separately from the mixed SS1/EM1 class.

Fig 2.4.20 MarineOnStCroix_06_051811_PSS1/EM1A

Fig 2.4.21 SPRING 2010


Fig 2.4.22 SPRING 2010 INFRARED


Fig 2.4.23 SUMMER 2008

# PSS1/EM1C

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Scrub-Shrub/ Emergent
**SUBCLASS:** Broad-Leaved Deciduous/ Persistent
**MODIFIER:** Seasonally Flooded

**COMMENTS:** EM vegetation will be visibly brighter underneath SS.

Fig 2.4.24 Bloomington_19_051811_PSS1/EM1C


Fig 2.4.25 SPRING 2010


Fig 2.4.26 SPRING 2010 INFRARED


Fig 2.4.27 SUMMER 2008

# PSS3/EM1Bq

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Scrub-Shrub/ Emergent
**SUBCLASS:** Broad-Leaved Deciduous/ Persistent
**MODIFIER:** Saturated
**SPECIAL MODIFIER:** Bog

**COMMENTS:** Found in areas where commercial logging is practiced or sometimes clear cutting for utility lines in bog habitats . After the harvest or clear cutting, the resulting habitat will be a mixture of emergent sedge (typically as a result of soil disturbance from equipment) and leftover arecaceae understory. Summer imagery will vary widely in areas of logging. Use the spring imagery to make a determination on attribution.

Fig 2.4.28 SPRING 2010 INFRARED

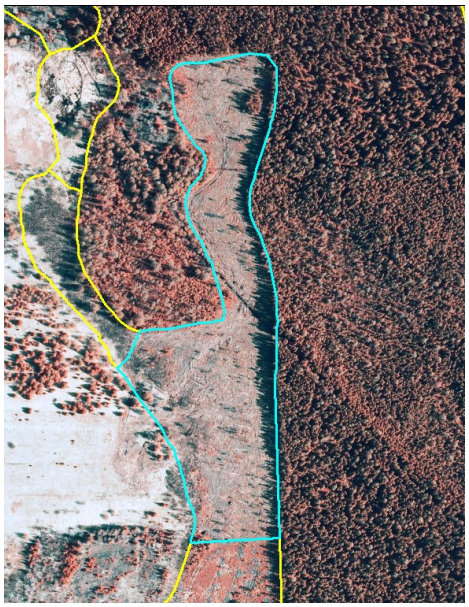


Fig 2.4.29 SPRING 2010 COLOR

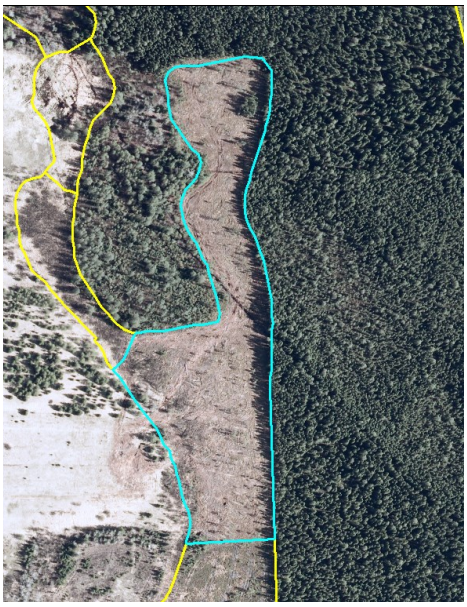
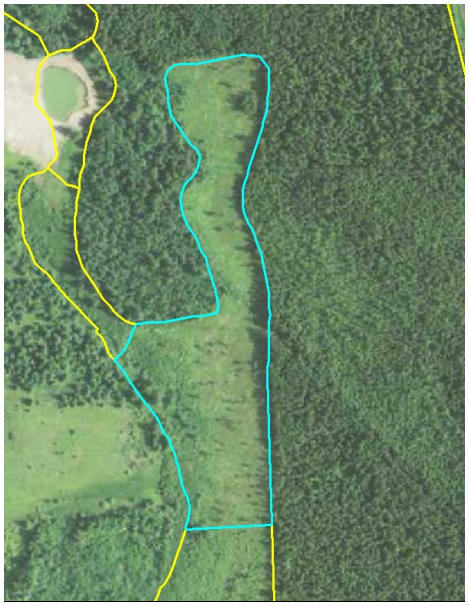


Fig 2.4.30 SUMMER 2013



# Delineating and Classifying Farmed Wetlands
# Delineating and Classifying Peatlands

**Explanation**

The definition of a farmed wetland (f) from Dahl et al. (2009) is:

**"Farmed wetlands occur where the soils surface has been mechanically or physically altered for production of crops, but hydrophytes will become reestablished if farming is discontinued. Farmed wetlands will be identified by using the attributes Pf (Palustrine farmed). Cultivated cranberry bogs many be classified as Palustrine farmed wetland or as Palustrine scrub/shrub – farmed"**

In Minnesota the Pf code will not be used. Instead, all farmed wetlands that meet the rules described below will be classified as PEM1Af . Wetlands in farm fields that have wetland vegetation for at least two of the three summer images will be classified as PEM1Ad (without the f modifier).

Effectively drained areas are very prevalent in western MN and will show up very well on imagery as "soil scars" or wet basins when in fact they are tile drained or remnant basins. These areas hold water only for brief periods, but the soil signatures will persist, making them recognizable on imagery despite being effectively gone. These areas will not be identified in the MN NWI.

Although there is some subjectivity and variability between years in differentiating between effectively drained wetlands, farmed wetlands, and partially drained and ditched wetlands, the following rules will be used as a guide to classifying these wetlands in a consistent manner.

The following sources will be used to differentiate effectively drained, farmed, and partially drained and ditched wetlands: original NWI polygons, 2008 NAIP imagery (typical precipitation year), 2009 NAIP imagery (dryer precipitation year) and 2010 NAIP imagery (typical precipitation year with river flooding). For the purposes of the Minnesota NWI update, the photo interpreter will look for signs of wetland hydrology in the summer imagery within agricultural areas in order to determine whether or not hydrophytes could become reestablished. The signs of wetland hydrology for summer imagery include crop distress, bare spots (due to drowned out, not cropped, altered pattern), and standing water in agriculturally cropped fields. Dark soil areas within agricultural fields in the spring imagery will not be mapped as farmed wetlands unless signs of wetland hydrology are identified in the summer imagery. These areas will be considered effectively drained. The delineation of the boundary of farmed wetlands will be determined by the 'wettest' year or the imagery showing the largest extent of the farmed wetland (Figure 3). Wetland areas within farm fields that contain wetland vegetation will be classified as wetlands with the partially drained or ditched modifier (d) if there is evidence of drainage.

**Examples of visibility of wetland hydrology for farmed wetlands:**

| | | |
|---|---|---|
|  |  |  |
| Summer 2003 – visible | Summer 2006 – visible | Summer 2008 – barely visible |
|  |  |  |
| Summer 2009 – not visible | Summer 2010 – visible | Spring 2010 – slightly visible |

# PEM1Af

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Emergent
**SUBCLASS:** Persistent
**MODIFIER:** Temporarily Flooded
**SPECIAL MODIFIER**: Farmed

**COMMENTS:** An f (Farmed) special modifier is given when an area appears to be farmed most years but is visibly wet in two of the three image years (summer). There will often be only agricultural vegetation present; however, if not farmed, wetland vegetation would return.

Fig 2.5.1 SUMMER 2008

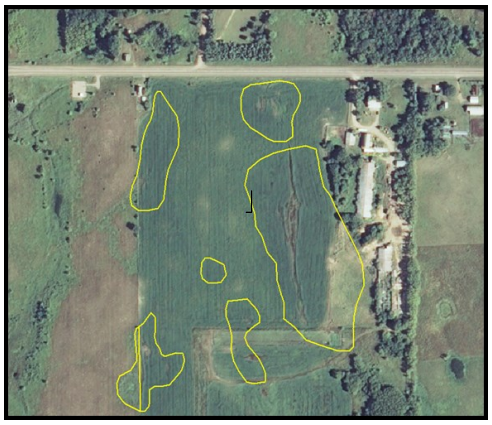
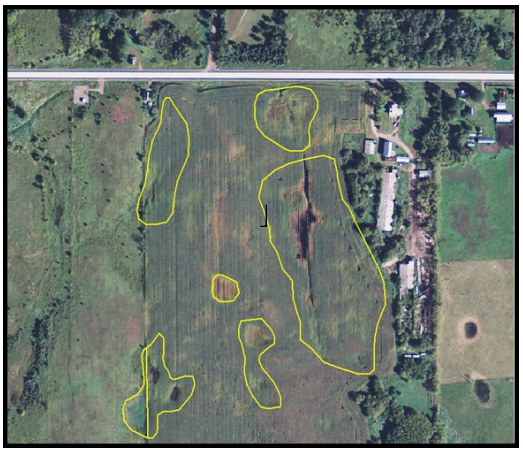


Fig 2.5.2 SUMMER 2009

Fig 2.5.3 SPRING 2010 INFRARED

Fig 2.5.4 SUMMER 2010



# PEM1A(d)

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Emergent
**SUBCLASS:** Persistent
**MODIFIER:** Temporarily Flooded
**SPECIAL MODIFIER**: Partially Drained/Ditched

**COMMENTS:** An area is an emergent wetland (PEM1A) if the original NWI classification identified it as a wetland and there is still wetland vegetation in one of three image years (summer) **or** if wetland vegetation is present in two of three image years. Because this wetland is located in the middle of a farm field it can be assumed that it has been tiled or ditched in the past. A d (Partially Drained/Ditched) modifier may or may not be given.

Fig 2.5.5 SUMMER 2008


Fig 2.5.6 SUMMER 2009


Fig 2.5.7 SPRING 2010


Fig 2.5.8 SUMMER 2010

# Effectively Drained

**COMMENTS:** These areas are identified by a dark soil and soil scars in agricultural areas which indicate past wetland hydrology, but are effectively drained and do not currently support wetland vegetation. Summer imagery should be free of most crop stress in at least two of the three dates. Note the tile drain in the ground photo and the dark signature in the aerial photos. These areas will not be delineated in the MN NWI wetlands layer.

Fig 2.5.9 Ground Photo of Tile Drainage

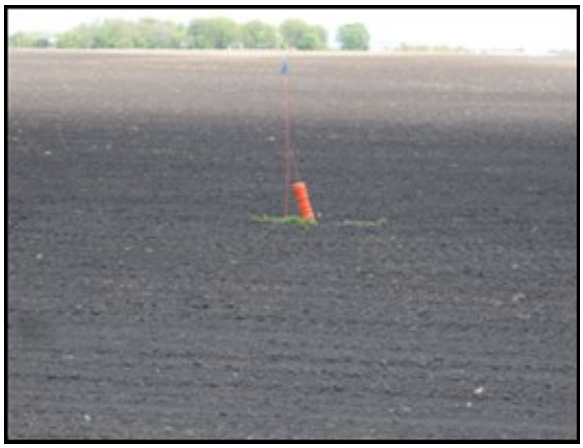


Fig 2.5.10 SPRING 2010

Fig 2.5.11 SPRING 2010 INFRARED

# Delineating and Classifying Peatlands

**Explanation:**

A new special modifier has been proposed specifically for the Minnesota NWI update. Interpretation beyond what is typically required for the NWI is needed to effectively separate the peatland community class. The peatland community crosses the PEM, PSS, and PFO Cowardin classes (typical vegetation includes sphagnum [peat moss], leatherleaf, sedges, black spruce, and tamarack).

*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 pre-

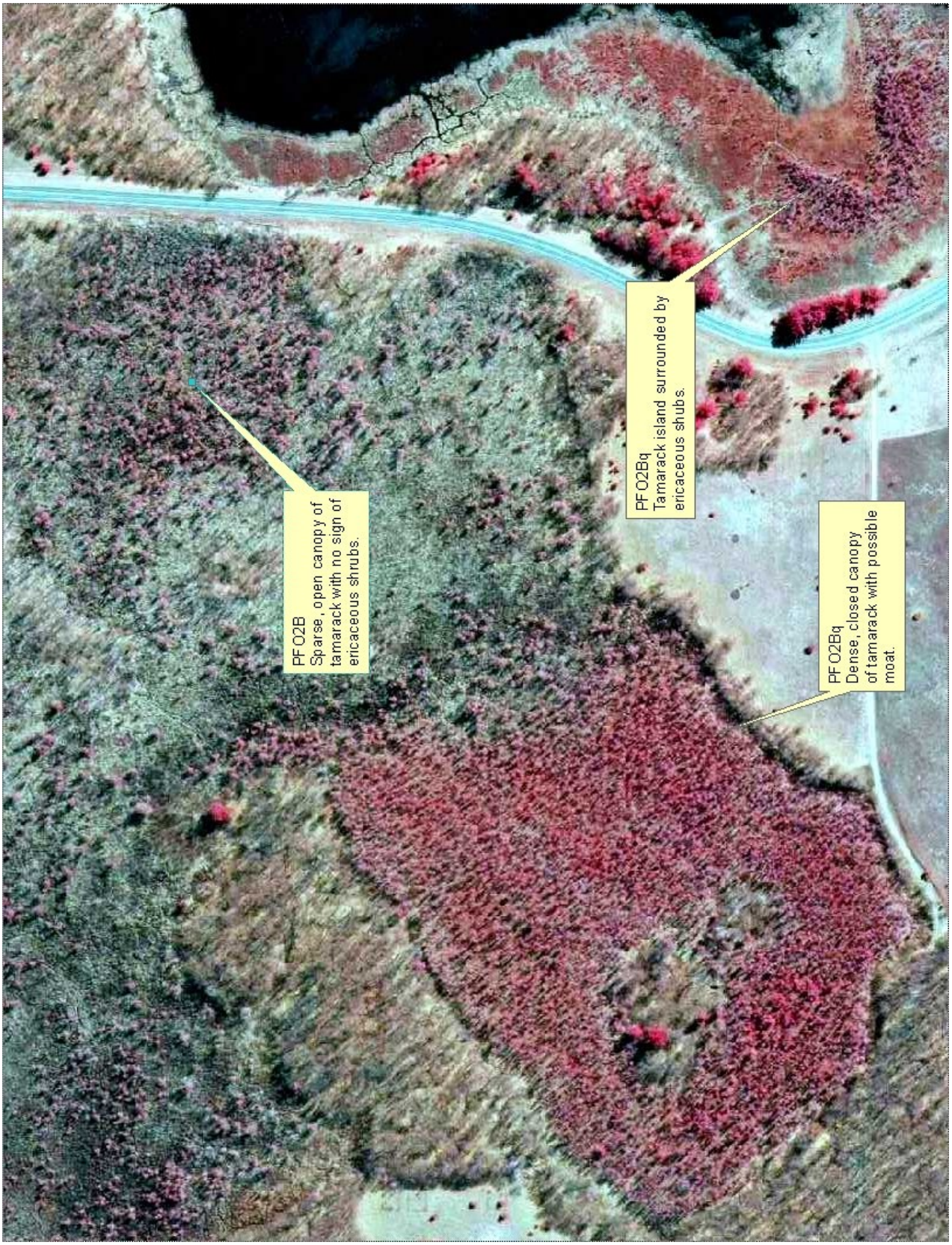
Wetlands interpreted as having a peatland signature, as described in Eggers and Reed, should be assigned a B (Saturated) water regime and the q (Peatland) special modifier. Coniferous bogs composed of tamarack and/or black spruce dominant trees growing on a continuous sphagnum mat should be coded as PFO2Bq or PFO4Bq, respectively. Open bogs with ericaceous and evergreen shrubs growing on a sphagnum moss mat layer will be assigned PSS3Bq. Effort should be made to separate coniferous bogs (PFO2Bq/PFO4Bq) from coniferous swamp (PFO2B/PFO4B), which may have tamarack without sphagnum, and thus would not receive a q modifier.

The presence of a sphagnum mat and ericaceous shrubs can usually be photo-interpreted. In some cases, the tree canopy may be too dense to view the underlying vegetation. 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 do 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.






# Delineating and Classifying Peatlands



# PSS3Bq

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Scrub-Shrub
**SUBCLASS:** Broad-Leaved Evergreen
**MODIFIER:** Saturated
**SPECIAL MODIFIER:** Bog (Specific to Minnesota)

**COMMENTS:** Mats of floating vegetation are often composed of Broad-Leaved Evergreen shrubs such as bog rosemary and Labrador tea. Because of this, these wetland features are classified as PSS3. Broad-Leaved Evergreen vegetation can be differentiated from emergent vegetation using infrared images. SS3 vegetation may also appear significantly darker than surrounding EM in spring images.

Fig 2.6.1 Wyanett_44_051611_PSS3C


Fig 2.6.2 SPRING 2010


Fig 2.6.3 SPRING 2010 INFRARED


Fig 2.6.4 SUMMER 2008

# PFO2Bq

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Forested
**SUBCLASS:** Needle-Leaved Deciduous
**MODIFIER:** Saturated
**SPECIAL MODIFIER**: Bog (Specific to Minnesota)

**COMMENTS:** Tamarack is a bog pioneer species. It is a Needle-Leaved Deciduous tree that appears medium red/orange in CIR images compared to the saturated red color of Needle-Leaved Evergreen trees. On aerial images tamarack will have a softer, feathered appearance.

Fig 2.6.5 SUMMER 2008

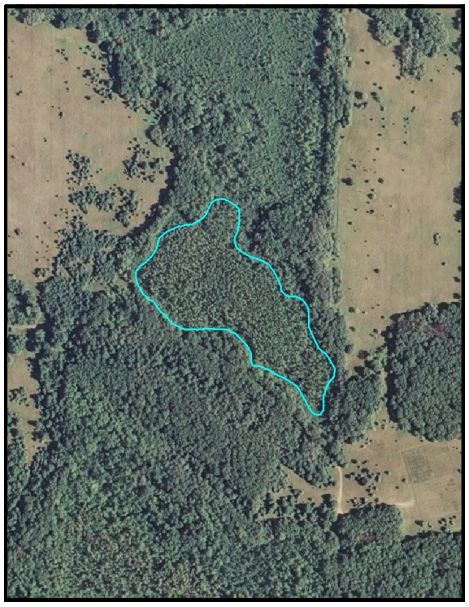


Fig 2.6.6 SPRING 2010

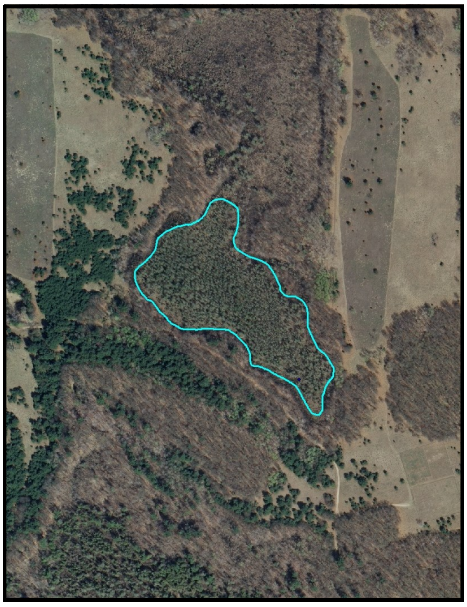


Fig 2.6.7 SPRING 2010 INFRARED

Fig 2.6.8 FALL 2010 GROUND PHOTO

# PFO4Bq

**SYSTEM:** Palustrine
**SUBSYSTEM:**
**CLASS:** Forested
**SUBCLASS:** Needle-Leaved Evergreen
**MODIFIER:** Saturated
**SPECIAL MODIFIER**: Bog (Specific to Minnesota)

**COMMENTS:** Black spruce (PFO4) and tamarack (PFO2) will appear similar in summer images. Black spruce can be distinguished from tamarack by using fall imagery (if available), color, texture and density in spring images. Black spruce stands retain leaves through out the year and will appear darker when compared to tamarack stands. Black spruces have smaller crowns and tend to grow in stands denser than tamarack. Because of this black spruce stands will appear smoother on aerial images.

Fig 2.6.9 SUMMER 2008

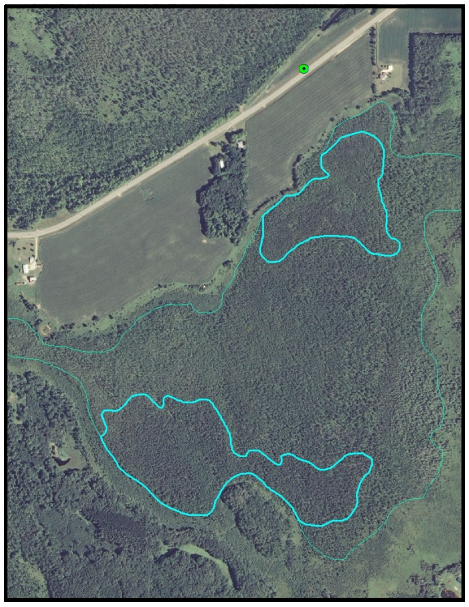


Fig 2.6.10 SPRING 2010

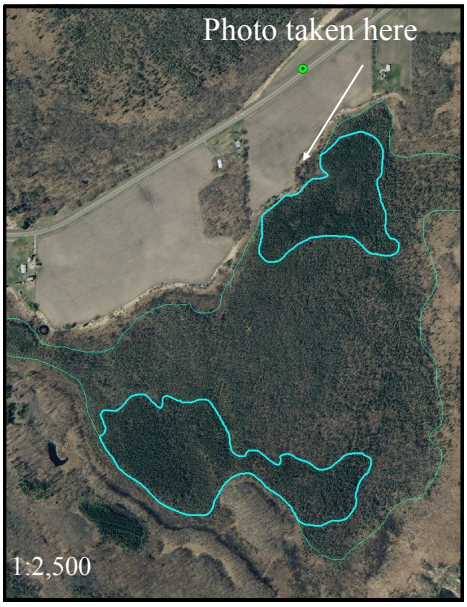



Fig 2.6.11 SPRING 2010 INFRARED

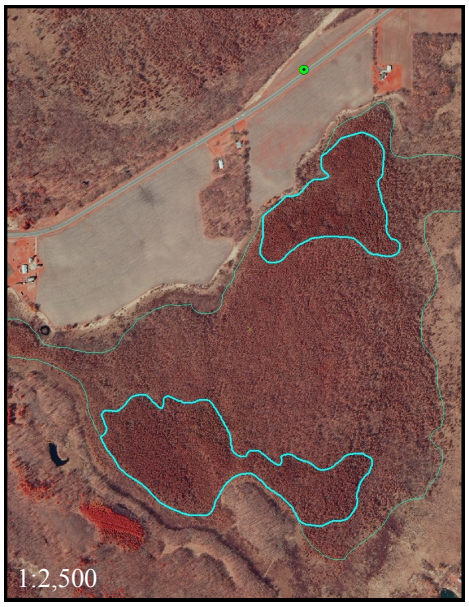



Fig 2.6.12 FALL 2008 GROUND PHOTO

# Clarification and Helpful Hints

- R2 is the only riverine subsystem used in Minnesota. The most common are R2UBG for rivers, R2UBH for larger rivers and R2UBFx for ditches and smaller rivers that have been redirected. An h (Diked/ Impounded) modifier may be given in some cases, the Mississippi River is a good example of a river that will have an h modifier.

- Only PEM, PSS, and PFO palustrine wetlands get a subclass. EM will be 1 (persistent) in all palustrine systems and 2 (non-persistent) in most littoral subsystems. PSS subclasses include 1,2,3 and 4. PFO subclasses include 1,2, and 4.

- All classified wetlands must have a valid water regime. Valid water regimes include A, B, C, F, G, H, and K. B water regimes are very rare and should be used with caution. G water regimes are mainly used with Riverine Systems, PUB wetlands that stay flooded and Littoral Systems. H water regimes are primarily used for Large rivers and lakes.

- r (Artificial) and s (Spoil) special modifiers are not used.

- When checking the topology make sure that you are checking for the entire extent and not just the visible extent. It is helpful to re-validate the topology at the end of fixing the errors to make sure that new errors have not been created.

- Watch out for unattributed polygons within an attributed wetland. This is okay if it is actually an upland and not just a polygon missed when merging.

- Make sure that you are **cutting and merging** from the existing segments and not creating features.

# Water Regimes

**A**: (*Temporarily Flooded*)- Floods in spring during most years, dry for the rest of the year. Emergent wetland with a bright signature (usually reed canary grass). Smoother in texture and often darker in color than C or F water regimes. Dense stands of emergent vegetation may have appear to be an A. Special care should be taken to distinguish dense cattail stands from reed canary grass.

**B**: (*Saturated*)- Substrate is saturated for most of the year, rarely floods. Floating Mats emergants on saturated soils or in depressions and sedge meadows may all be given a B water regime. To be used with all PSS3 and floating mats. Dense stands of Tamarack (PFO2) or Black Spruce (PFO4) that appear to be located within a depression can be given the Bq modifiers under

**C**: (*Seasonally Flooded*)- Cattails, flooded in spring and darker in summer. Usually rough in texture. May have animal trails throughout.

**F**- (*Semi-Permanently Flooded*)- Flooded throughout the year in most years. Semi-permanently flooded emergent wetlands are often found around the edges or with in lakes and ponds and likely has some open patches of water. Semi-Permanently Flooded bodies of water appear to have water in most years but may be dry in one of the image years.

**G**: (*Intermittently Exposed*)- Used for small rivers, ponds and sometimes littoral shore that are exposed in at least one image year..

**H**: (*Permanently Exposed*)- Used for rivers, large ponds and littoral systems.

**K**: (*Artificially Flooded*)- Used for rivers, ponds and littoral systems.

# L2EM2/ABG

**SYSTEM:** Lacustrine
**SUBSYSTEM:** Littoral
**CLASS:** Emergent/Aquatic Bed
**SUBCLASS:** Nonpersistent
**MODIFIER:** Intermittently Exposed

**COMMENTS:** This littoral area is classified as a split class because aquatic bed and non-persistent emergent vegetation each occupy more than 30% of the wetland area.

Fig 2.7.1 SUMMER 2008


Fig 2.7.2 SPRING 2010 INFRARED


Fig 2.7.3 SUMMER 2010

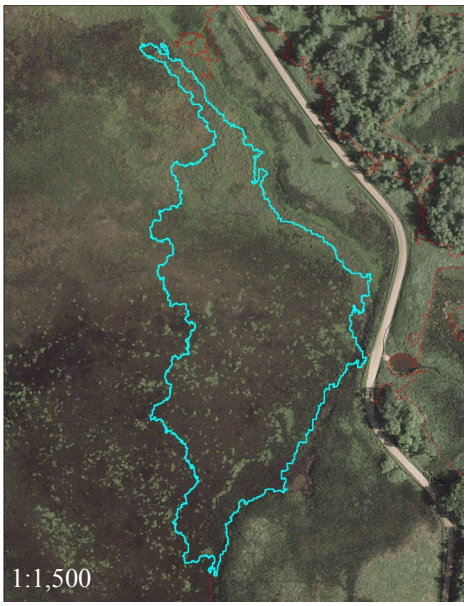



Fig 2.7.4 SUMMER 2011

# Which Water Regime: B, C, or F?

**COMMENTS:** This wetland appears to be very wet at all times of the year, every year. Based on the absence of patches of open water, this is likely not an F (Semipermanently Flooded). At first glance the area seems to be a B (Saturated), based on the density of the emergent vegetation and appearance of being saturated in all images. However, there is open water within the wetland and smaller "water tracks" in the emergent vegetation indicating that this wetland has standing water more often than can be described by a B special modifier. Also, in the Bing online imagery, the vegetation can clearly be identified as cattails and thus should be classified as C.

Fig 2.7.5 SUMMER 2008


Fig 2.7.6 SPRING 2010 INFRARED


Fig 2.7.7 SUMMER 2011


Fig 2.7.8 BING BIRDS EYE VIEW

# Which Water Regime: B or F?

**COMMENTS:** The pockets of emergent vegetation in this lake appear to be floating mats. However, because the pockets of vegetation do not move from year to year we assume that they are not floating. Thus, they would be classified as PEM1F rather than PEM1B.

Fig 2.7.9 SUMMER 2008

Fig 2.7.10 SUMMER 2009

Fig 2.7.11 SUMMER 2010

Fig 2.7.12 BING