MN Wetland Professional Certification Program
NE MN Regional Training

BOARD OF WATER AND SOIL RESOURCES

Minnesota Wetland Professional Certification Program

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Remaining MWPCP 2025 Courses

- Regional Training –Hermantown– August 12-13
- Introduction to Wetland Delineation & Regulations- Brainerd - September 8-12
- Introduction to Wetland Delineation &Regulations- Shoreview- October 6-10
- Hydrogeomorphic Method of Classifying Wetlands- Duluth- October 28-29
- Wetland Banking & Monitoring for Consultants- Shoreview- November 12-13

2

Agenda for Regional Training

Minnesota Wetland Professional Certification Program

Day One

- WCA Activity in NE MN
- 2024 Statute Changes
- TEP Procedures in NE MN
- Trail Projects
- Complicated Violations

Day Two

- Preservation Wetland Banks
- Intro to HGM
- Red Parent Material
- Sloped Wetlands
- Delineating Sloped Wetlands Field Exercise

3

Wetland Banking in NE MN

- 11 Established Wetland Banks in BSA 1
  - (Cook, Lake, St Louis, Carlton)
- Approximately 890 available credits
- 8 Established Wetland Banks in BSA 2
  - (Koochiching, Lake of the Woods, Roseau, St Louis)
- Approximately 110 available credits

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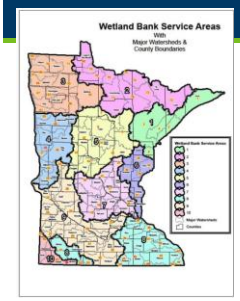
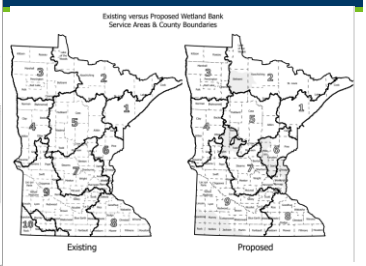
Wetland Banking in NE MN





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NE MN Mitigation Strategies

The following alternative mitigation options are recommended for NE watersheds:

1. Expanded Use of Preservation. Clarify for applicants and staff that preservation is a viable and accepted mitigation option in NE Minnesota and expand eligibility criteria to allow credit for larger amounts of upland areas that provide habitat connections and/or water quality benefits to aquatic resources.
2. Restoration and/or Protection of Riparian Corridors and Streams. Allow mitigation credit for the preservation or restoration of buffers adjacent to trout streams and other sensitive northeast streams, and for stream restoration projects that include such actions as re-meandering lost channels, stream bank stabilization, and day-lighting buried/piped streams.
3. Hydrology Stabilization. Restoring and stabilizing the natural hydrologic regime of altered waterways can restore the functionality of adjacent or nearby wetlands.
4. Peatland Hydrology Restoration. The hydrologic restoration of partially drained peatlands through strategic ditch blocks can improve the affected peatland and provide downstream water quality and quantity benefits.
5. Approved Watershed Plan Implementation Projects. Allow wetland mitigation credit for the completion of certain approved watershed plan implementation projects as a means to address water quality within NE Minnesota.


Siting of Wetland Mitigation in Northeast Minnesota

Issues, Recommendations, and Alternatives

From the Interagency Northeast Mitigation Siting Team

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Actions Eligible for Credit

- Restoration of completely drained wetland
- Restoration of partially drained wetland
- Vegetative restoration of farmed wetlands
- Protection of wetland previously restored via conservation easements
- Wetland Creations
- Restoration and protection of Exceptional Natural Resource Value
- Preservation of wetlands
- (Upland) buffer areas

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Preservation

Subp. 9. **Preservation of wetlands.** In greater than 80 percent areas, up to 12.5 percent of wetland areas and adjacent buffer that are protected by a permanent conservation easement are eligible for replacement credit. The easement must be in a format prescribed by the board and granted to and accepted by the board after approval of the replacement or banking plan application. Wetland areas on private lands that have been restored or protected using public conservation funds are not eligible for replacement credit under this subpart. To be eligible for credit under this subpart, the technical evaluation panel must determine that there is a high probability the wetland will be degraded or impacted and the wetland:

(1) contains or benefits an exceptional resource identified in subpart 8;

(2) is of a type or function that is rare, difficult to replace, or of high value to the watershed;

(3) contains a rare or declining plant community; or

(4) is of a type that is not likely to regenerate, such as northern white cedar.

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Eligibility Requirements

- Greater than 80% area
- High probability the wetland will be degraded
  aka demonstrable threat
- Contains an exceptional natural resource value
- High value function that is difficult to replace
- Rare or declining plant community
- Type that is not likely to regenerate

State and federal rules generally convey the same basic eligibility concepts:
- The resource provides important functions in the watershed, and
- The resource contributes significantly to the ecological sustainability of the watershed.
- The resource is under a demonstrable threat

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Preservation Guidance

- Details information needed to support eligibility:
  - Wetland provides important functions
    - FQA, RAM, HGM
  - Contributes to ecological sustatainbility
    - Evaluate biological significance of site
  - Under demonstrable threat
    - Describe the site-specific situation

Guidance on Evaluating Potential Wetland Preservation Sites for Eligibility to Provide Compensatory Mitigation/Replacement in Minnesota

BWSR

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Preservation & ENRV

- Application procedures
- When to use ENRV
- Application requirements
- Description of "exceptional" resources
- Allocating ENRV credit

	Eligible Actions	Credit Range
1)	Restoration of an exceptional wetland by reestablishing natural hydrology.	50 to 100 percent
2)	Restoration of an exceptional wetland by reestablishing permanent native, non-invasive vegetation.	25 to 50 percent (75% for white cedar)
3)	Restoration of wetland or upland adjacent to an exceptional resource when the restoration activity significantly improves the water quality or habitat functions of the exceptional resource.	25 to 50 percent
4)	Preservation of wetland or upland in combination with a qualifying restoration activity (details on page 5).	12.5 percent

Local Government Units must have TEP concurrence to approve the allocation of credit under ENRV.

WETLAND CONSERVATION ACT

Restoration and Protection of Exceptional Natural Resource Value (ENRV)

Overview

Project eligibility and the allocation of credit under ENRV is determined by the LGU with the concurrence of the TEP.

Application and Review Procedures

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Exceptional Natural Resource Value

- Habitat for Endangered or threatened species
- Rare Native Plant Community
- Special fish or wildlife resource
- Difficult to replace or high watershed value
- Rare or declining community
- Not likely to regenerate

(1) The wetland provides important physical, chemical or biological functions for the watershed.

The applicant must identify the functions provided by each wetland resource on the site (and associated resources that are part of proposed preservation site), identify important functions in the watershed, and describe how the functions provided by the site are important for the watershed. Consulting and referencing any plans or other water or natural resource-related documents that discuss important functions in the watershed can help strengthen this portion of the assessment.

The following are the assessment methodologies available to document wetland functions and/or wetland condition:

(a) Floristic Quality Assessment (FQA). This assessment method should be conducted using Minnesota specific guidance (Milburn et al. 2007) and may include use of the rapid FQA method (MPCA 2014). This method is a vegetation-based ecological assessment approach to evaluating wetland condition. If FQA is used, the applicant should provide the full FQA report and data collected for agency consideration.

(b) Minnesota Routine Assessment Method (MnRAM). This method is designed to assess functions associated with Minnesota wetlands. The latest version on the BWSR website should be used. If MnRAM is used, score sheet and raw data from which the score was determined must be provided for each wetland resource proposed for preservation.

(c) The Hydrogeomorphic Approach (HGM) allows for the assessment of wetland functions for resources where HGM guidebooks are available. Currently, there are two guidebooks available for application in Minnesota: The Prairie Pothole Region, and Organic Flats, Slopes and Depressional Wetlands in the Northcentral and Northeast Region.

Additional documentation or assessments may be required to document that the resource provides important physical, chemical or biological functions for the watershed. For example, if the primary function provided by a wetland resource is wildlife habitat for a rare, threatened or endangered species, applicants should not only complete an assessment to document general function or condition of the site, but also document the ability of the resource to provide suitable habitat for that species.

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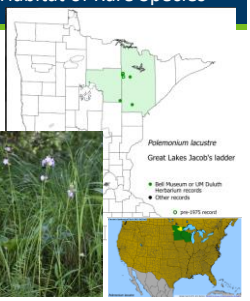
Example of ENRV- Habitat of Rare Species

- Polemonium Bog- known occurrence of rare species
- Polemonium lacustre- Jacobs Ladder



Credit Eligibility

Eligibility criteria that apply to each credit area are tabulated in Table 1. The credit areas are shown on Figure 18 as a heat map depicting the number of eligibility criteria that apply to each credit area.

1. Exceptional Natural Resource Value

Habitat for state-listed endangered or threatened species – as described in Section 5.2, 186 acres of the site provide direct, documented habitat for state-listed endangered or threatened species. The Polemonium Wetland Bank site hosts the largest and most stable population known globally of Western Jacobs Ladder (*Polemonium occidentale* subsp. *lacustre*), a plant listed by the MnDNR as endangered. MnDNR staff hypothesize a key reason that *Polemonium* thrives in this location is the unique hydrogeology of the area. Protecting the areas where *Polemonium* grows and surrounding wetlands is critical to maintaining the ecological processes that sustain the *Polemonium* habitat and population. *Polemonium* is found across approximately 185 acres of the site, in coniferous swamp communities dominated by either cedar or black spruce and tamarack along with hardwood swamp communities. Credit area wetlands containing *Polemonium* include: A-4, A-9, B-1, B-2, B-3, B-4, B-5, B-6, B-7, B-8, and B-9 (Figures 15.1 and 15.2).

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Wetland Contributes to sustainability of the Watershed

- Headwaters
- Functional Assessment
- Site of Biological Significance

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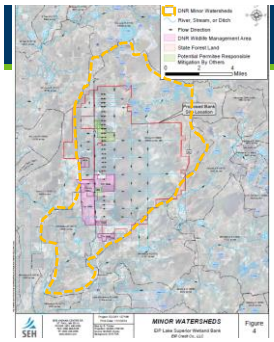

EIP Superior "watershed scale" project

- 24,000 acre bog restoration
- Restored the majority area of minor watershed

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Demonstrable Threat

- Past, current and future land uses
- Current level of protection
- Mineral Rights
- Common threats:
  - Development
  - Timber harvesting
  - Mining

(3) The wetland and its associated functions are under demonstrable threat of destruction or adverse modification.

Demonstrable threats may include activities that adversely alter, degrade or destroy wetlands and are exempt, not regulated, or otherwise allowed under Section 404 of WCA. Examples may include, but are not limited to, certain agricultural, silvicultural, development, and excavation activities. The applicant must address how the activity would result in the destruction or adverse modification of the wetland functions. The applicant should also provide examples of how the activity has occurred in the past and why it is likely to occur on or otherwise affect the proposed preservation site. Copies of any plans, permits or existing contracts to conduct the activity onsite or on comparable sites should be provided for agency consideration.

Demonstrable threats may also include case-specific situations where a wetland resource is within areas under intense development pressure. The information provided for agency review should include evaluation and documentation of current and projected land uses or demographic trends indicating that the resource is under demonstrable threat. The applicant may provide examples of how current protections do not prevent the threat. At a minimum, the analysis should include adjacent land use evaluation, which may include prospective land uses, land uses occurring in the area that reasonably could occur on adjacent properties, presence of onsite or offsite drainage systems and the extent of their potential future effect on the resource, and identification of roads, utilities, easements, mineral rights, or other existing land uses present within at least ¼ mile of the site.

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Example of Demonstrable Threat

- Otter Creek Wetland Bank
- Showed surrounding landuses to demonstrate threat of development
- Major intersection of State and Interstate highways
- Commercially zoned
- Near growing commercial district

Surrounding Land Use Map
Figure 4

Otter Creek Wetland Bank
Cloquet, Minnesota

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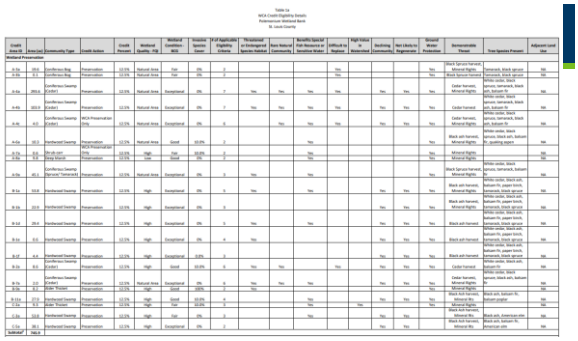

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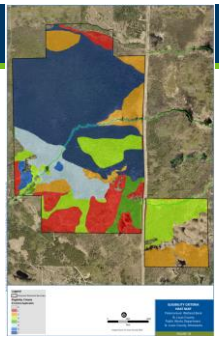
Eligibility Heat Map



- Used eligibility criteria
- Mapped areas based on number of eligibility criteria met
- Provided vision why areas were eligible for preservation

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Crediting

- 12.5% for both preservation and buffer areas
- upland cannot receive more credit that preservation areas
- Less emphasis on upland and wetland buffer areas

Wetland Bank Credit Allocation Table [1]

Map ID	Credit Action [2]	Acres [3]	Credit Allocation			
			WCA Credit		Corps Credit	
			% Credit	Credit Amount	% Credit	Credit Amount
1	Preservation – Coniferous Swamp	32.5	12.5	4.0625	12.5	4.0625
2	Preservation or Buffer – Shrub Carr and Shallow Marsh	5.8	12.5	0.7250	12.5	0.7250
3	Upland Buffer	1.7	12.5	0.2125	12.5	0.2125
4	Otter Creek/Otter Creek Tributary	0.4	0	0	0	0
	TOTAL EASEMENT SIZE:	40.4	TOTAL:	5.0000	TOTAL:	5.0000

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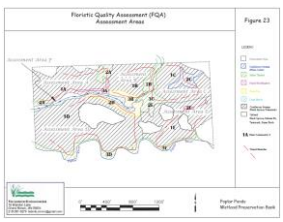
Monitoring

- Minimum of five years of monitoring
- Longer timeline to monitor for evasives and emerald ash borer
- Consider credit release schedule if going longer
  - Don't want to leave such a small amount of credit in final releases



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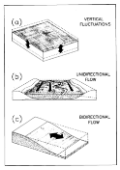

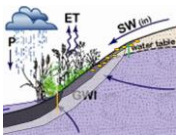

Hydrogeomorphic Classification of Wetlands in MN: The Background and Science of HGM

BOARD OF WATER AND SOIL RESOURCES

Minnesota Wetland Professional Certification Program

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Hydrogeomorphic Method

Establishes classes based on geomorphology, hydrology and hydraulic functions of wetlands.

Classification Name	Definition
Lacustrine	Wetland occurs within a topographic depression that has a closed elevation contour that allows the accumulation of surface water and is restricted to the margin of a depressional lake basin.
Riverine	Wetland occurs on a nearly level landform and lies along and is influenced by flooding from a stream, river or flow-through ditch.
Slope	Wetland occurs on a slope (generally >2%) with groundwater discharge as its primary source of hydrology.
Mineral Flat	Wetland occurs on a nearly level landform, is not significantly influenced by flooding from a stream, river or flow-through ditch and has predominately mineral soils.
Organic Flat	Wetland occurs on a nearly level landform, is not significantly influenced by flooding from a stream, river or flow-through ditch and has predominately organic soils.
Depression	Wetland occurs within a topographic depression that has a closed elevation contour that allows the accumulation of surface water and is not associated with the margin of a depressional lake basin.

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HGM Classes

- RIVERINE
- DEPRESSION
- SLOPE
- MINERAL SOIL FLATS
- ORGANIC SOIL FLATS
- ESTUARINE FRINGE
- LACUSTRINE FRINGE

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Classification System based on Functions

Brinson, M. M. (1993). "A hydrogeomorphic classification for wetlands," Technical Report WRP-DE-4, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

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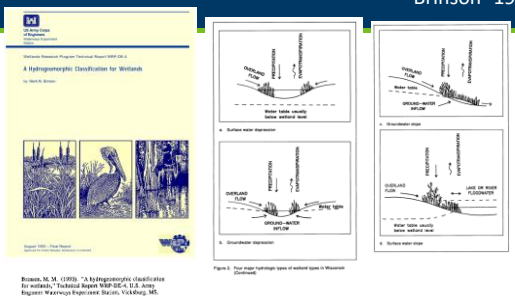
Brinson- 1993



Brinson, M. M. (1993). "A hydrogeomorphic classification for wetlands," Technical Report WRP-DE-4, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

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Smith et a. 1995

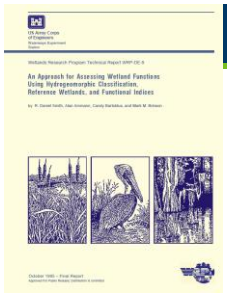

Table 1
Hydrogeomorphic Classes of Wetlands Showing Dominant Water Sources, Hydrodynamics, and Examples of Subclasses

Hydrogeomorphic Class (geomorphic setting)	Water Source (dominant)	Hydrodynamics (dominant)	Examples of Regional Subclass	
			Eastern USA	Western USA and Alaska
Riverine	Overbank flow from channel	Unidirectional and horizontal	Bottomland hardwood forests	Riparian forested wetlands
Depressional	Return flow from groundwater and interflow	Vertical	Prairie pothole marshes	California vernal pools
Slope	Return flow from groundwater	Unidirectional, horizontal	Fens	Avalanche chutes
Mineral soil flats	Precipitation	Vertical	Wet pine flatwoods	Large playas
Organic soil flats	Precipitation	Vertical	Peat bogs; portions of Everglades	Peat bogs
Estuarine fringe	Overbank flow from estuary	Bidirectional, horizontal	Chesapeake Bay marshes	San Francisco Bay
Lacustrine fringe	Overbank flow from lake	Bidirectional, horizontal	Great Lakes marshes	Flathead Lake marshes

Smith, R. D., Ammann, A., Bartoldus, C., and Brinson, M. M. (1995). "An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices," Technical Report WRP-DE-9, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

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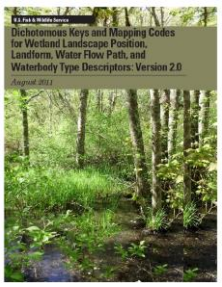
Tiner- 2011



Tiner, R.W. 2011. Dichotomous Keys and Mapping Codes for Wetland Landscape Positio Landform, Water Flow Path, and Waterbody Type Descriptors: Version 2.0. U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Northeast Region, Hadley, MA.

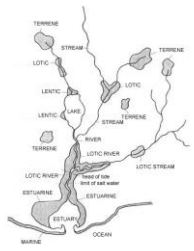


Figure 1. General landscape positions for wetlands, with a few waterbodies shown (ocean,

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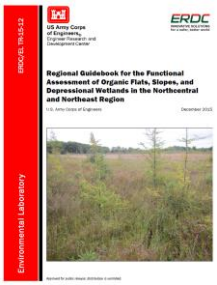
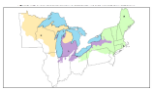
Regional Guidebook for Organic Wetlands- 2015



- Characterizes wetlands based on HGM class in NCNE
- Assessment Variables
- Functions
  - Water Storage
  - Biogeochemical cycling
  - Plant Community
  - Wildlife Habitat
- Assessment Protocol



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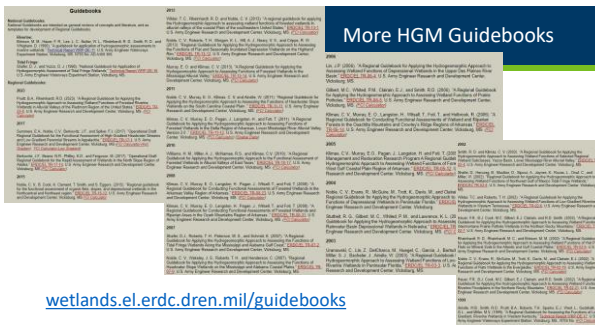
More HGM Guidebooks



wetlands.el.erdc.dren.mil/guidebooks

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HGM System Key- BWSR 2022

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2024 MN Statute Amendments

Wetland type.

"Wetland type" means a wetland type classified according to *Wetlands of the United States*, United States Fish and Wildlife Service Circular 39 (1971 edition), as ~~enumerated in this subdivision~~ or *A Hydrogeomorphic Classification for Wetlands*, United States Army Corps of Engineers (August 1993), including updates, supplementary guidance, and replacements, if any, as determined by the board.

HGM Class	Circular 39	Eggers & Reed	Cowardin Vegetation Class	Typical Water Regimes
Depression	1	Seasonally Flooded Basin	PEM- Emergent	Seasonally Flooded
Riverine	1	Floodplain Forests	PFO- Forested	Temporary Flooded
Depression	2	Sedge Meadows	PEM- Emergent	Saturated
Slope				
Organic Flat				
Riverine	2	Fresh (wet) Meadows	PEM- Emergent	Saturated
Depression				
Mineral Flat				
Depression	2	Wet to Wet-Mesic Prairie	PEM- Emergent	Saturated
Slope	2	Calcareous Fens	PEM- Emergent	Saturated
Depression	3	Shallow Marsh	PEM- Emergent	Semi-permanently Flooded (up to 6")
Lacustrine Fringe				
Depression	4	Deep Marsh	PEM- Emergent PAB-aquatic bed	Semi-permanently to permanently Flooded (6"-3')
Lacustrine Fringe				
Depression	5	Shallow, Open Water	PEM- Emergent PUB-Unconsolidated Bottom	Permanently Flooded (up to 6.2')
Lacustrine Fringe				
Mineral Flat	6	Shrub Carr	PSS- Scrub-shrub	All regimes except permanently
Sloped				Flooded (Saturated most of growing season)
Mineral Flat	6	Alder Thicket	PSS- Scrub-shrub	All regimes except permanently
Sloped				Flooded (Saturated most of growing season)
Mineral Flat	7	Hardwood Swamp	PFO- Forested	All regimes except permanently
Sloped				Flooded (Saturated most of growing season)
Mineral Flat	7	Coniferous Swamp	PFO- Forested	All regimes except permanently
Organic Flat				Flooded (Saturated most of growing
Sloped				season)
Organic Flat	8	Open Bog	PML- Moss-lichen	Saturated
Organic Flat	8	Coniferous Bog	PFO- Forested	Saturated

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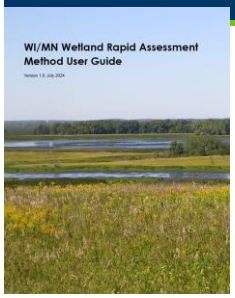
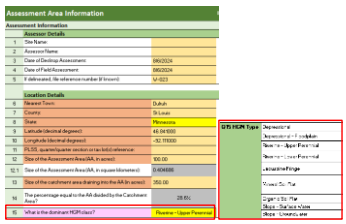
Wetland Rapid Assessment Method





Assessment Area Information		
Assessment Information		
Assessor Details		
1	Site Name	
2	Assessor Name	
3	Date of Desktop Assessment	09/2024
4	Date of Field Assessment	09/2024
5	If delineated, file reference number (if known)	M-023
Location Details		
6	Nearest Town	Duluth
7	County	St Louis
8	State	Minnesota
9	Latitude (decimal degrees)	46.841000
10	Longitude (decimal degrees)	-92.119300
11	PLSS, quarter/quarter section or tax lot(s) reference	
12	Size of the Assessment Area (AA, in acres)	100.00
12.1	Size of the Assessment Area (AA, in square kilometers)	0.404686
13	Size of the catchment area draining into the AA (in acres)	350.00
14	The percentage equal to the AA divided by the Catchment Area?	28.6%
15	What is the dominant HGM class?	Riverine - Upper Perennial

GIS HGM Type	Depressional
	Depressional - Floodplain
	Riverine - Upper Perennial
	Riverine - Lower Perennial
	Lacustrine Fringe
	Mineral Flat
	Organic Flat
	Slope - Surface Water
	Slope - Groundwater

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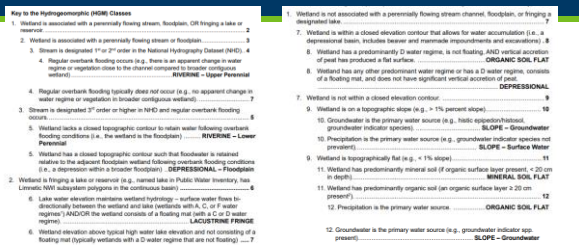
HGM Determination Key from WIMN RAM



Key to the Hydrogeomorphic (HGM) Classes

1. Wetland is associated with a perennially flowing stream, floodplain, OR fringing a lake or reservoir 2
2. Wetland is associated with a perennially flowing stream or floodplain 3
3. Stream is designated 1st or 2nd order in the National Hydrography Dataset (NHD). 4
4. Regular overbank flooding occurs (e.g., there is an apparent change in water regime or vegetation close to the channel compared to broader contiguous wetland) ..... **RIVERINE – Upper Perennial**
4. Regular overbank flooding typically does not occur (e.g., no apparent change in water regime or vegetation in broader contiguous wetland) 7
3. Stream is designated 3rd order or higher in NHD and regular overbank flooding occurs 5
5. Wetland lacks a closed topographic contour to retain water following overbank flooding conditions (i.e., the wetland is the floodplain) ..... **RIVERINE – Lower Perennial**
5. Wetland has a closed topographic contour such that floodwater is retained relative to the adjacent floodplain wetland following overbank flooding conditions (i.e., a depression within a broader floodplain) ..**DEPRESSIONAL – Floodplain**
2. Wetland is fringing a lake or reservoir (e.g., named lake in Public Water Inventory, has Limnetic NWI subsystem polygons in the continuous basin) 6
6. Lake water elevation maintains wetland hydrology – surface water flows bi-directionally between the wetland and lake (wetlands with A, C, or F water regimes") AND/OR the wetland consists of a floating mat (with a C or D water regime) ..... **LACUSTRINE FRINGE**
6. Wetland elevation above typical high water lake elevation and not consisting of a floating mat (typically wetlands with a D water regime that are not floating) 7
1. Wetland is not associated with a perennially flowing stream channel, floodplain, or fringing a designated lake 7
7. Wetland is within a closed elevation contour that allows for water accumulation (i.e., a depressional basin, includes beaver and manmade impoundments and excavations) ..8
8. Wetland has a predominantly D water regime, is not floating, AND vertical accretion of peat has produced a flat surface. ..... **ORGANIC SOIL FLAT**
8. Wetland has any other predominant water regime or has a D water regime, consists of a floating mat, and does not have significant vertical accretion of peat. ..... **DEPRESSIONAL**
7. Wetland is not within a closed elevation contour 9
9. Wetland is on a topographic slope (e.g., > 1% percent slope)..... 10
10. Groundwater is the primary water source (e.g., histic epipedon/histosol, groundwater indicator species) ..... **SLOPE – Groundwater**
10. Precipitation is the primary water source (e.g., groundwater indicator species not prevalent)..... **SLOPE – Surface Water**
9. Wetland is topographically flat (e.g., < 1% slope)..... 11
11. Wetland has predominantly mineral soil (if organic surface layer present, < 20 cm in depth)..... **MINERAL SOIL FLAT**
11. Wetland has predominantly organic soil (an organic surface layer ≥ 20 cm present") 12
12. Precipitation is the primary water source. ..... **ORGANIC SOIL FLAT**
12. Groundwater is the primary water source (e.g., groundwater indicator spp. present)..... **SLOPE – Groundwater**

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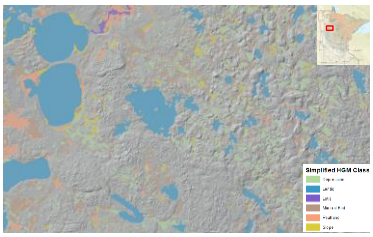
Parameters of HGM

- Geomorphology- landscape position
  - Where a wetland situated and the shape of the landscape
- Hydrology- water source and output
  - Why the wetland is there
- Hydraulics- hydrodynamics
  - What it does



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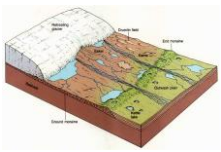
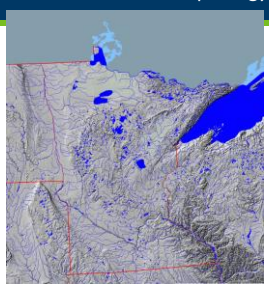
Geomorphology

Study of physical features on the surface of the earth and their relation to its geologic structures

- Landscape position
- Parent material
- Surface shape





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Glacial Geology of MN

Glaciation of the Quaternary period (oldest to youngest):

- Nebraskan
- Kansan
- Illinoian
- Wisconsin
  - Wadena lobe
  - Rainy-Superior lobe
  - Des Moines lobe

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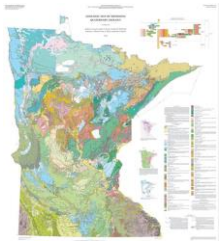
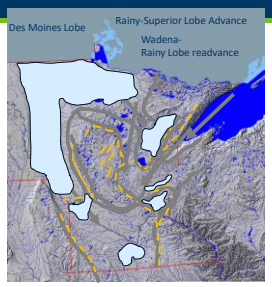
In MN, geomorphology is result of glacial geology





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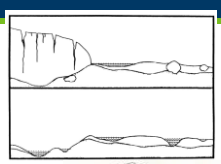
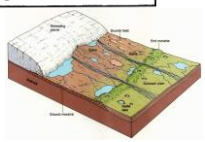
How Glaciers Create Wetlands

- Kettle depressions
- Glacial lakes
- Surficial shape of landscape
- Fluvial-Lacustrine systems following glacial outwash
- Deposition of material with different properties





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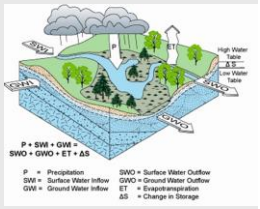
Wetland Hydrology



- Inputs
  - Precipitation
  - Surface water inflow
  - Groundwater inflow
- Outputs
  - Surface water outflow
  - Groundwater outflow
  - Evapotranspiration

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Hydrology of HGM Classes

HGM Class (subclass)	Hydrology Inputs	Hydrology Outputs	Hydraulics
RIVERINE	surface flow precipitation groundwater	surface flow evapotranspiration	unidirectional
DEPRESSIONAL- surface	surface flow precipitation	groundwater recharge evapotranspiration	unidirectional
DEPRESSIONAL- ground	groundwater precipitation	intermittent surface flow evapotranspiration groundwater recharge	unidirectional
SLOPED- surface	surface flow precipitation	surface flow evapotranspiration groundwater recharge	unidirectional
SLOPED- ground	groundwater surface water precipitation	surface flow evapotranspiration	unidirectional
MINERAL SOIL FLATS	precipitation intermittent surface flow	evapotranspiration intermittent surface flow	unidirectional
ORGANIC SOIL FLATS	groundwater precipitation	intermittent surface flow Evapotranspiration	unidirectional
ESTUARINE FRINGE	surface flow tidal exchange precipitation	tidal exchange surface flow Evapotranspiration	bidirectional
LACUSTRINE FRINGE	surface flow groundwater precipitation	return flow to lake surface flow evapotranspiration	bidirectional

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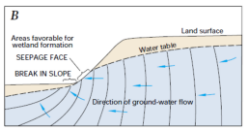
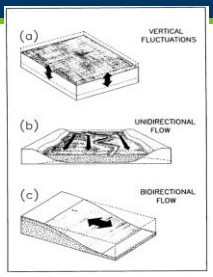
Hydraulics- how water moves through landscape



- Uni-directional
  - Horizontal or Vertical
- Bi-directional
  - Estuarine and lacustrine fringe



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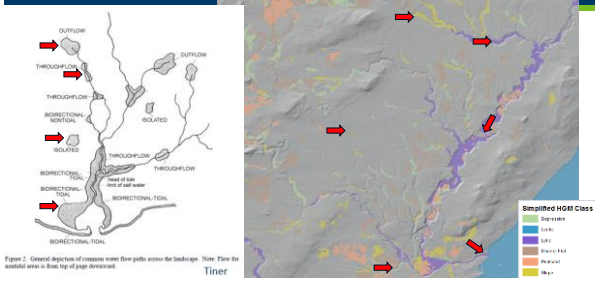
Water Flow Paths & Landscape Position of Wetland



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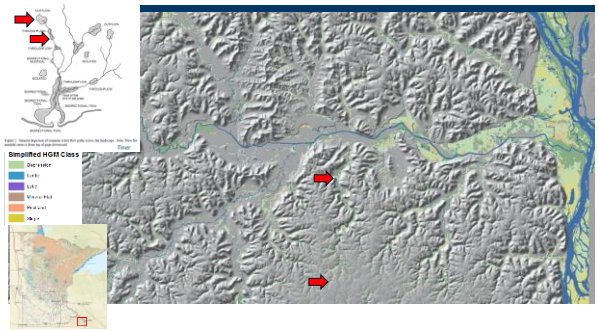

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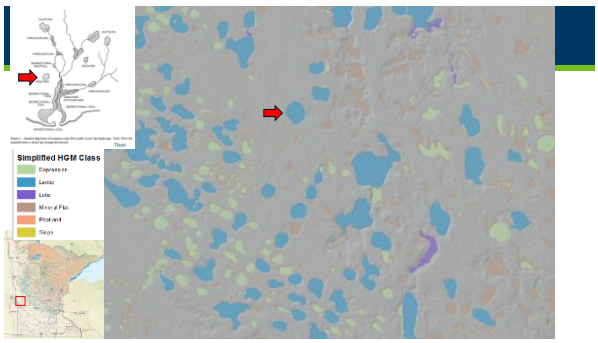

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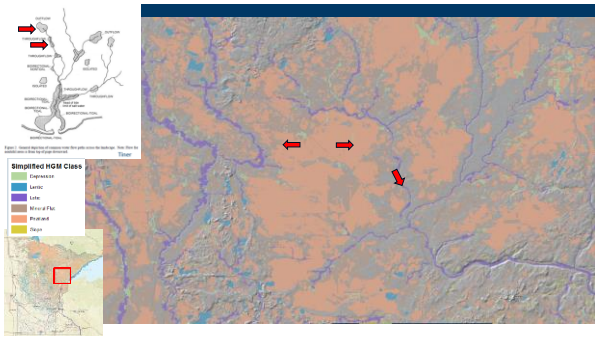

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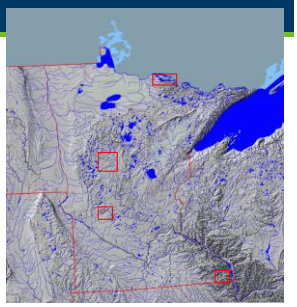
Glaciers left different HGM classes of wetlands in MN

- Kettle depressions
  - Depression and lacustrine fringe
- Glacial lakes
  - Organic and mineral flat
- Surficial shape of landscape
  - Mineral flat and sloped
- Fluvial-Lacustrine systems following glacial outwash
  - Riverine, mineral flat, sloped, organic flat



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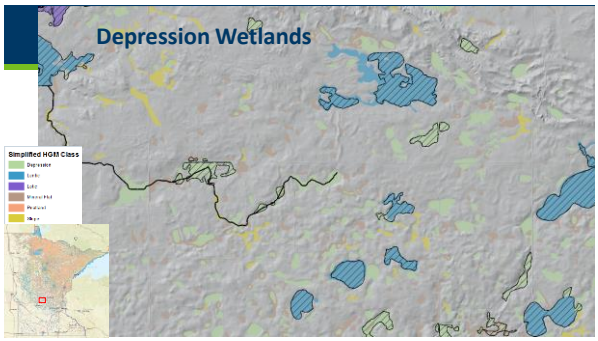

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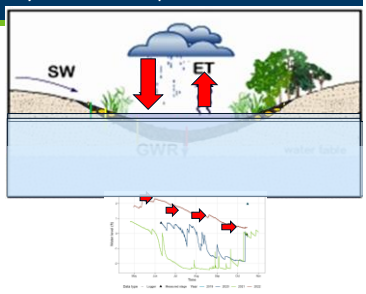
Hydraulics of Depression Wetlands

- Vertical uni-directional
- Evapotransporation
  - Increases and decreases with growing season
- Water table "bounces" with precipitation
- Vertical fluctuations often make hydrology and hydric soils difficult at wetland boundaries



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Common Indicators for Depression Wetlands

HGM Class	Typical Water Regimes	Hydrology Indicators Common to Water Regime	Soil Indicators Common to Water Regime
Depression	Seasonally Flooded	A1- Surface Water, B1- Water Marks, B3- Drift Deposits, B8- Sparsely Vegetated Concave Surface, B6- Surface Soil Cracks, C2-Dry-Season Water Table, D2- Geomorphic Position	A11- Depleted Below Dark Surface, A12- Thick Dark Surface, F1- Loamy Mucky Mineral, F3- Depleted Matrix, F6- Redox Dark Surface, F8- Redox Depression, S1- Sandy Mucky Mineral, S5- Sandy Redox
Depression	Saturated	A2- High Water Table, A3- Saturation, B2- Sediment Deposits, C3- Oxidized Rhizospheres along living roots, C7- Thin Muck Surface, C9- Saturation Visible on Aerial Imagery, D2-Geomorphic Position, D5- FAC-neutral Test	A11- Depleted Below Dark Surface, A12- Thick Dark Surface, F1- Loamy Mucky Mineral, F3- Depleted Matrix, F6- Redox Dark Surface, F8- Redox Depression, S1- Sandy Mucky Mineral, S5- Sandy Redox
Depression	Semi permanently flooded (up to 6")	A1- Surface Water, A2- High Water Table, B1- Water Marks, B7- Inundation Visible on Aerial Imagery, B14- True Aquatic Plants, D9- Gauge or Well Data	A1- Histosol, A2- Histic Epipedon, A3- Black Histic, A11- Depleted Below Dark Surface, A12- Thick Dark Surface

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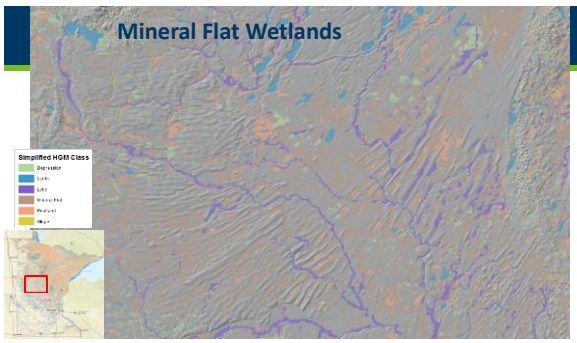
Mineral Flat Wetlands



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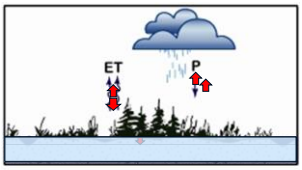
Hydraulics of Mineral Flats

- Vertical uni-directional
- Winter Precipitation
- Overland "seepage flow"
- Evapotransporation
  - Increases and decreases with growing season
- Water table "bounces" with precipitation
- Vertical fluctuations often make hydrology and hydric soils difficult at wetland boundaries



Surface Water - Extensive Flat

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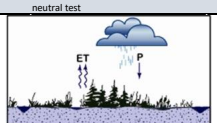
Common Indicators for Mineral Flat Wetlands

HGM Class	Typical Water Regimes	Hydrology Indicators Common to Water Regime	Soil Indicators Common to Water Regime
Mineral Flat	All regimes except permanently flooded (Saturated most of growing season)	A2- High Water Table, A3- Saturation, , B5- Iron Deposits, B9- Water-Stained Leaves, B10- Drainage Patterns, C2- Dry-Season Water Table, D2- Geomorphic Position, D3- Shallow Aquitard, D4- Microtopographic Relief, D5- FAC-neutral test	A11- Depleted Below Dark Surface, A12- Thick Dark Surface, F1- Loamy Mucky Mineral, F3- Depleted Matrix, F6- Redox Dark Surface, S1- Sandy Mucky Mineral, S3- 2" Mucky Peat, S5- Sandy Redox



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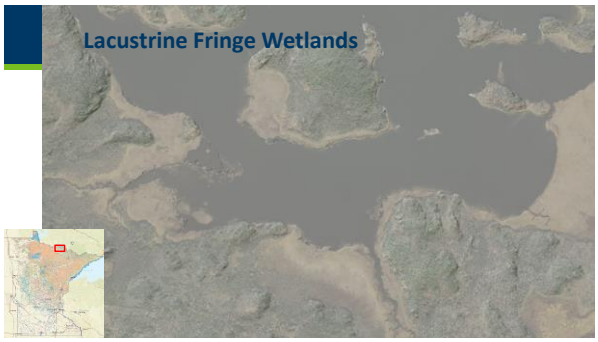
Lacustrine Fringe Wetlands



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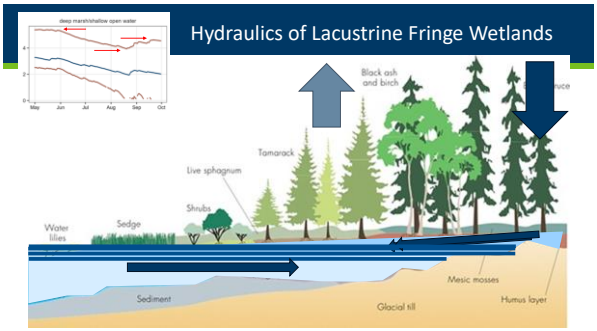
Hydraulics of Lacustrine Fringe Wetlands



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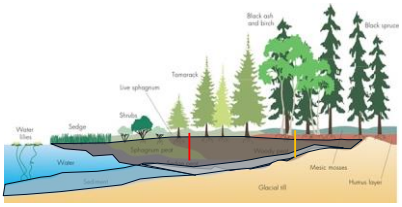
Cross Section of Hydric Soils in Lacustrine Fringe

- Histosol
- Thick Dark Surface



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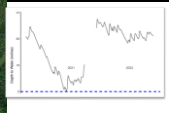
Common Indicators for Lacustrine Fringe Wetlands

HGM Class	Typical Water Regimes	Hydrology Indicators Common to Water Regime	Soil Indicators Common to Water Regime
Lacustrine Fringe	Semi permanently to permanently flooded (up to 8.2')	A1- Surface Water, A2- High Water Table, B1- Water Marks, B7- Inundation Visible on Aerial Imagery, B14- True Aquatic Plants, D9- Gauge or Well Data	A1- Histosol, A2- Histic Epipedon, A3- Black Histic, A11- Depleted Below Dark Surface, A12- Thick Dark Surface



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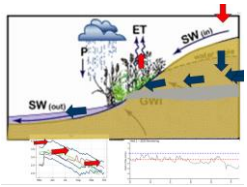
Key Takeaways

- Understand the underlying science behind HGM classes and their parameters:
  - Geomorphology
  - Hydrology
  - Hydraulics
- These parameters are drivers of function
  - And influence development of wetland indicators
- Many wetland functions change based on the water budget
- Evidence of those functions can be observed on the landscape in the form of wetland indicators



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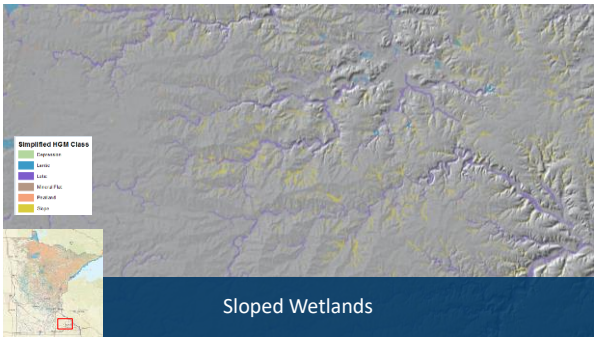

Sloped Wetlands

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Common Observations

- Open contours
- Actual slope will vary
- Will contain ephemeral drainages
- Intergrade into other HGM classes
- Organic accumulations indicate groundwater sources
- Surface sloped lack primary indicators during dry season

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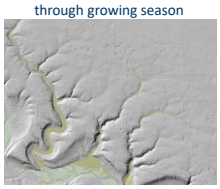
Hydrology of Sloped Wetlands

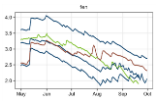
Sloped- Groundwater

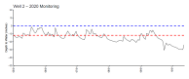
- Continuosly Saturated
- Decrease in groundwater input through growing season

Sloped- Surface

- Seasonally saturated
- Decrease in groundwater input through growing season
  - Shorter duration
  - More abrupt bounce to precip. events







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Common Indicators for Sloped Wetlands

HGM Class	Typical Water Regimes	Hydrology Indicators Common to Water Regime	Soil Indicators Common to Water Regime
Sloped	Saturated	A2- High Water Table, A3- Saturation, B10- Drainage Patterns, C7- Thin Muck Surface, D2-Geomorphic Position, D5-FAC-neutral Test	A1- Histosol, A3- Black Histic, F1- Loamy Mucky Mineral, F3- Depleted Matrix, F6- Redox Dark Surface, F21- Red Parent Material, S1- Sandy Mucky Mineral, S3- 2" Mucky Peat, S5- Sandy Redox

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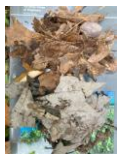
Common Hydro Indicators of Forested Sloped Wetlands

Primary:

- Saturation (A3)
- Thin Muck Surface (C7)
- Water Stained Leaves (B9)



Secondary:

- Drainage Patterns (B10)
- Geomorphic Position (D2)
- Microtopographic relief (D4)

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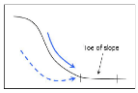
Geomorphic Position (D2)

- Immediate area is located in:
  - Depression
  - Drainageway
  - Concave position within a floodplain
  - Toe of slope
  - Fringe of water body
  - Area where groundwater discharges



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Sloped wetlands- ground or surface water?

Groundwater

- Primary hydrology indicators
- Continuosly saturated
- Organic soils
- Indicator plant species

Surfacewater

- Seasonally saturated
- Secondary indicators in dry months
- More likely mineral soils
- Ephemeral drainage patterns

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Groundwater Indicators?

- Hydrology
  - Springs or Seeps
  - Other indicators (temp, soil deposits, etc)
- Vegetation
  - Groundwater indicator plants

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Indicators of Groundwater Discharge

- Are there springs or seeps in area?

Discharge indicators:

- Cold water
- Located near headwater or watershed divide
- Iron or marl deposits in soils
- "rainbow" film on surface water

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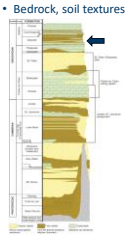
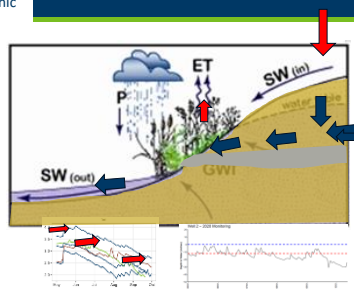
Hydraulics of Sloped Wetlands

- Often sloped- ground are stratigraphic
- Differences in permeability
  - Bedrock, soil textures





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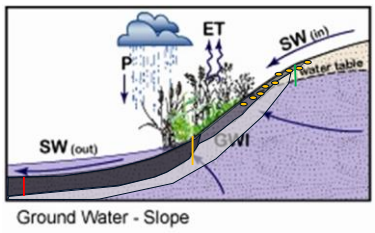
Cross Section of Hydric Soils in Sloped Wetlands

- Histosol
- Depleted below dark surface
- Redox Dark Surface



Ground Water - Slope

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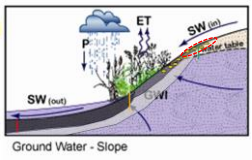
Capillary fringe of fine-grained soils

- Tension-saturated zone
- Water held at tension above water table within pores
- If pore size is small and uniform (i.e. clay or clay loam), capillary action can extend further up the soil profile
- Results in a saturated "fringe" which complicates near wetland boundary
- Esp. in forested wetlands



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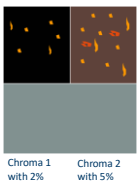
F6 Redox Dark Surface

- A layer at least 10 cm (4 inches) thick entirely within the upper 30 cm (12 inches) that has:
  a. matrix value 3 or less and chroma 1 or less and 2% or more distinct or prominent redox concentrations, or
  b. matrix value 3 or less and chroma 2 or less and 5% or more redox concentrations.



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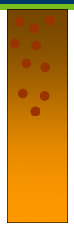
S5- Sandy Redox

- layer staring within 15 cm (6 inches) of the soil surface that is at least 10 cm (4 inches) thick, and has a matrix with 60% or more chroma 2 or less with 2% or more distinct or prominent redox concentrations



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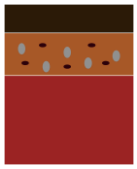
F21, Red Parent Material

- In parent material with a hue of 7.5YR or redder, a layer at least 10 cm thick with a matrix chroma of 4 or less and 2% or more redox depletions and/or redox concentrations as soft masses and/or pore linings. The layer is entirely within 30 cm of the soil surface.



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Plant Community Relationships

- Often not a lot of discernable difference in actual species composition
- "blur" vision and look for community relationships
- "indicator" species
  - Dominants in each community that "follow" indicator status or other variables such as microtopography
- For example, large leave aster and hazelnut; or bracken fern and ostrich fern; Black ash and aspen

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Groundwater Indicator Plants

Groundwater Indicator Plants:

- Skunk cabbage- *Symplocarpos foetidus*
- Marsh Marigold-*Caltha palustris*
- Great angelica- *Anfelica atropurpurea*
- Watercress- *Nasturium officianale*

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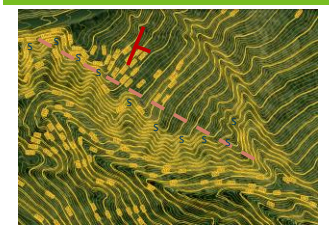
Peat Domes

- Continuous Saturation
- Slows decomposition
- Organic Accumulation
- Peat "domes" downgradient from seep
- Colonized by bryophytes



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Field Approach

- Interpreting landscape
- "Following" Hydrology
- Finding plant community relationships
- "indicator" species

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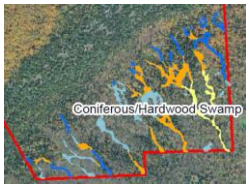
How to map sloped wetlands in the field

- Locate upslope contour
- Identify all seeps, springs or other surface/groundwater interaction
- Delineate wetland boundary
- Make use of remarks on data sheets
- Symbolize hydrology, mosaic areas, transect locations



Rob Peterson

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Mosaic Wetlands

- "…a landscape where wetland and nonwetland components are too closely associated to be easily delineated or mapped separately." – page 142 Corps NCNE Regional Supplement
- Areas of complex microtopography- "ridges" and "troughs"
- Common on the Superior lobe glacial deposits in NE MN

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Microtopographic relief

- "repeated small changes in elevation occurring over short distances"
- "Tops of ridges and hummocks are often non-wetland but are interspersed throughout a wetland matrix having clearly hydrophytic vegetation".

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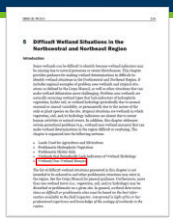
How to Map Mosaic Wetlands

- Chapter 5 of Corps manual
  - Procedure found pages 142-144 of NCNE Regional Supplement
- Follow manual procedures for vegetation, soil and hydrology

Recommended sampling approach:

- Identify all wetland areas that can be mapped
- Call other areas wetland/nonwetland mosaic"
- Establish transects across mosaic areas



5 Difficult Wetland Situations in the Northcentral and Northeast Region

2 approaches for transects outlined in Chapter 5:
1) determine total wetland distance of transect
2) **number of wetland points along transect**

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Number of points along transect method

Number of wetland points along transect

- Select transect line(s)
- At fixed number of paces determine and record wetland status
- Compile data points
- Estimate the wetland % with formula

Wetland/Non-Wetland Mosaic

Transect Number	Number of Wetland Pts.	Number of Upland Pts.	Total number of sampling pts.
T1(west)	5	5	10
T2(east)	3	6	9
Totals	8	11	19

Using the following formula, the percentage of wetlands within WNWM B is determined to be 42%

$$\% \text{ wetland} = \frac{\text{Number of wetland pts. along all transects}}{\text{Total number of pts. along all transects}}$$

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Pro tips

- "blur" your vision
  - Go with first impression and move on
- Recognize plant relationships
  - Alder and aspen
  - large leave aster
- Know your stride- especially on hummocky terrain
  - Practice equal strides on flat ground before exercise
- Use your GPS (or compass) to maintain consistent transects
- Remember that a data form is not required for every transect but document your determinations in the remarks (and field notes)

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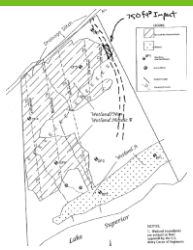
Regulatory implications of mosaics

- Calculating wetland impacts:
- Area determined to be 50% wetland
- Driveway proposes to cross 750 ft^2 of mosaic wetland
- Total wetland impact equals 375 ft^2



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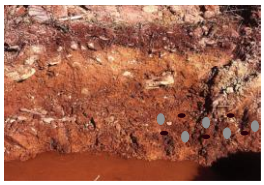
Red Parent Material

The parent material with a natural inherent reddish color attributable to the presence of iron oxides, typically hematite (Elles and Rabenhorst, 1994; Elless et al., 1996),occurring as coatings on and occluded within mineral grains. Soils that formed in red parent material have conditions that greatly retard the development and extent of the redoximorphic features that normally occur under prolonged aquic conditions.



They typically have a Color Change Propensity Index (CCPI) of <30 (Rabenhorst and Parikh, 2000).

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Naturally Problematic

- Do not develop Fe-depleted matrix colors
- Mineralogy resistant to color change
  - Specific geologic formations
    - hemantite
  - In MN, lacustrine sediments
- One of most common problematic soil situation in US
- Guidance started to be developed in 1996- now included in regional supplements

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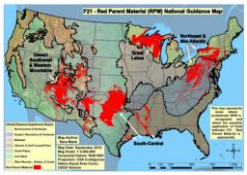

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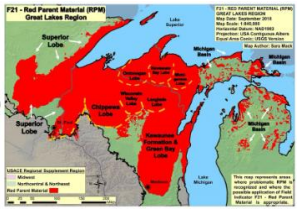
Superior Lobe Deposits

- Regions across US with problematic red parent material
  - North east-Mid-Atlantic, Great Lakes, South-Central, Desert Southwest and Western Mountains
- In MN, problematic RPM associated with glacio-lacustrine deposits from Superior Lobe deposits
- Deposits originated red sedimentary rocks of Superior basin



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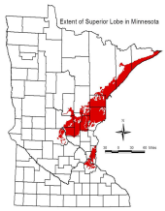
Soils Series with Known Problematic RPM



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F21- Red Parent Material

- **F21.—Red Parent Material.** A layer derived from red parent materials (see Glossary) that is at least 10 cm (4 inches) thick, starting at a depth ≤25 cm (10 Inches) from the soil surface with a hue of 7.5YR or redder. The matrix has a value and chroma greater than 2 and less than or equal to 4.
- The layer must contain 10 percent or more depletions and/or distinct redox should differ in color by having:
- a. A minimum difference of one value higher and
- one chroma lower than the matrix, or
- b. Value of 4 or more and chroma of 2 or less

Figure 41.—Indicator F21, Red Parent Material. This indicator should be used only in areas of red parent material that are resistant to reduction. Not all red soils formed in red parent material.

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Chapter 5 Procedures for Red Parent Material

- Verify that hydrophytic vegetation and hydrology indicators are present
  - Still proceed if atypical or problematic
- Describe landscape setting
- Describe soil profile and determine whether hydric soil is present
  - Note color 30 minutes after exposure to oxygen

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Lab exercise describing red parent material

- Work in Field Groups to describe soil profile
- Focus on identifying redox features
  - Both depletions and concentrations
- Be as accurate as possible with percentage redox
- Determine whether F21 is met

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Source of Hydrology / Origin of the Sloped Wetland

- Capillary Fringe - causes saturated soils from precipitation (rain and snow melt) to wick upslope.
  - Loamy soil indicators – Redox Dark Surface (F6), Depleted Matrix (F3), Red Parent Material (F21)

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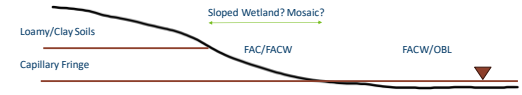
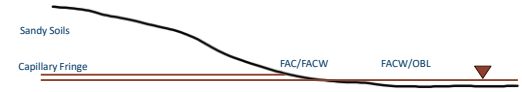


- Capillary fringe is greater in loamy/clayey soils and has longer water retention resulting in the possible formation of sloped wetlands and mosaics along the wetland edge where capillary fringe is the primary source of hydrology.



- Capillary fringe is less in sandy soils and has shorter water retention resulting in more abrupt wetland boundaries, less sloped wetlands, and mosaics.

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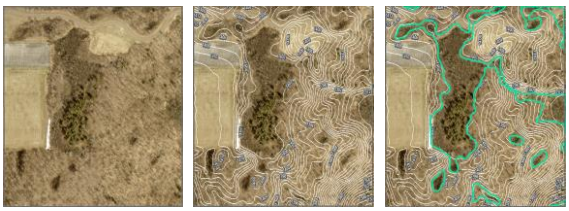

Source of Hydrology / Origin of the Sloped Wetland
- Ephemeral Drainage - Response to Precipitation (rain and snow melt)
- Seepage – Shallow Groundwater
  - Formation of muck as a result of frequency and duration of saturation (water is moving from the higher landscape positions to the lower positions over an extended period of time).

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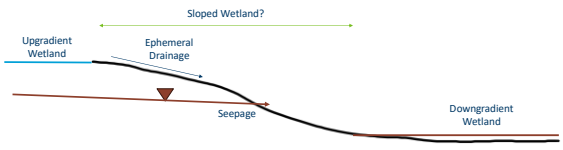

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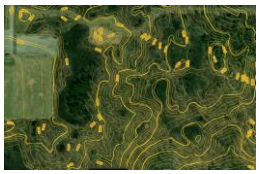
Field map and directions



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