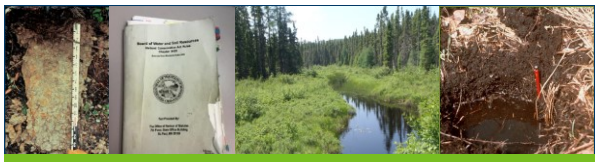
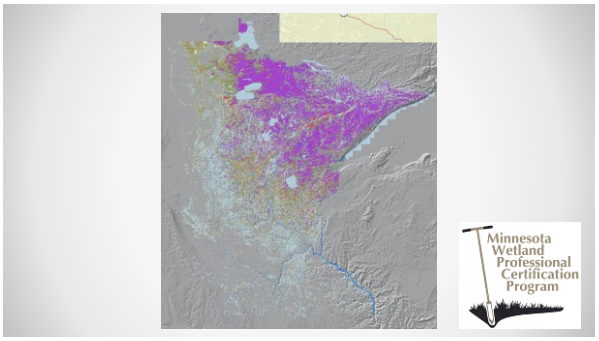


MN Wetland Professional Certification Program Tribal Training Course

BOARD OF WATER AND SOIL RESOURCES

Minnesota Wetland Professional Certification Program

1



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Basic Agenda

Day One

- 3 Parameters, Critical Definitions, Classification Systems, Functions

Day Two

- Wetland Hydrology, soil concepts, hydric soil indicators, soil texture lab, wetland vegetation, field Exercise

Day Three

- Restoration & Monitoring, Wetland Banking, Offsite Hydrology, Submitting Delineations, Course Summary

3

Science first, then apply policy

Minnesota Wetland Professional Certification Program

4

- https://bwsr.state.mn.us/wetland-training-opportunities

5

Pop Quiz

According to the 2019 Minnesota update of the National Wetland Inventory, how many acres of wetlands are in MN?

A) 6.3 million acres

B) 10.5 million acres

C) 12.2 million acres

D) 24.4 million acres

6



Three Parameters of a Wetland

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What is a Wetland?

Definition: Those areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions.


Hydrology + Vegetation + Soil = Wetland

8

3 Parameters of a Wetland

- 3 Parameters of a wetland
  - Hydrology- frequency and duration of movement of water through a landscape
  - Soil- organic and mineral surfaces which often exhibit characteristics that it has been in saturated conditions
  - Vegetation- plant community and prevalence of species that have made adaptations to live in saturated conditions

9

Hydrology

…"inundated or saturated by surface or ground water at a frequency and duration"

- Technical standard of 14 or more consecutive days of flooding or ponding;
- Water table 12 in. or less below soil surface;



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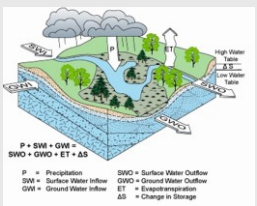
Hydrology



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

11

Hydrology Indicators

Evidence that there is continuing hydrology and confirms that an episode of inundation/saturation occurred recently.

Wetland hydrology indicators are divided into two categories:
Primary – provide stand-alone evidence of a current or recent hydrologic event; and
Secondary – provide evidence of recent hydrology when supported by one or more other hydrology indicators.

12

Soil

"…sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions"



13

Hydric Soil

- A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding **long enough** during the **growing season** to develop anaerobic conditions in the **upper part**.

14

Hydric Soil Indicators

Based on key physical properties: color & texture

And the depth & thickness where they are found


Field Indicators of Hydric Soils in the United States



15

Vegetation

"…sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions"

Wetland Indicator Status	Definition
Obligate Wetland (OBL)	Almost always occur in wetlands
Facultative Wetland (FACW)	Usually occur in wetlands, but may occur in non-wetlands
Facultative (FAC)	Occur in wetlands and non-wetlands
Facultative Upland (FACU)	Usually occur in non-wetlands, but may occur in wetlands
Obligate Upland (UPL)	Almost never occur in wetlands

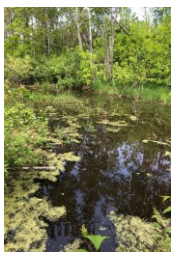
National Wetland Plant List, 2016, V3.3
http://rsgisias.crrel.usace.army.mil/NWPL/

16

Hydrophytes

Adaptations to saturated environment:

- morphological (multiple trunks, floating leaves)
- physiological (metabolic pathways)
- reproductive (floating seedlings)



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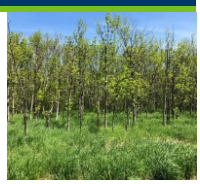
Dominance Tests

Methods to determine dominance of hydrophytic vegetation:

- Rapid test
- Dominance test (50/20)
- Prevalence Index
- Morphologic adaptations



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Rapid Test Example

Hydrophytic Vegetation?

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Quiz

- What are the three parameters that define a wetland?

Hydrology + Vegetation + Soil = Wetland

20

Other Aquatic Resources

Not every area with water is a wetland!

Wetlands are but 1 of 6 "special aquatic sites" as identified in the 87 Manual.

Mudflats
Riffle/Pool Complexes
Vegetated Shallows
Coral Reefs
Sanctuaries & Refuges

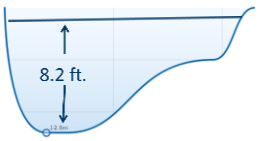
21

Other Aquatic Resources

Important Considerations for Wetlands

- Must be capable of supporting rooted, emergent vegetation.
- Must have soil.

If the water is too deep or fast flowing, cannot support rooted vegetation and soil cannot form (unconsolidated bottom).



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Basic Overview of Wetland Delineation

23

3-Parameter/ Indicator Approach

1. **Soils** –Longest term evidence, Historic conditions, may not reflect current condition.
2. **Hydrology** –Current condition, shortest term evidence but heavily influenced by recent climate conditions
3. **Vegetation** – Somewhere between

The 87 Manual requires 3 parameters because one source typically gives the answer in all situations

24

87 Manual and Regional Supplements

25

Wetland Delineation Types

Routine – Qualitative Data

- Indicator based (veg, soil, hydro)
- Representative sample points
- Estimate and interpret data
- 3-Types of delineations

Comprehensive – Quantitative Data

- Systematic sampling
- Precise measurements

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Wetland Delineation Types

ROUTINE

Level 1 - Onsite Inspection Unnecessary

Level 2 - Onsite Inspection Necessary

Level 3 - Combination of Levels 1 and 2

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Wetland Delineation Types

Routine Level 1

Use when exact wetland boundary **not necessary**

Proposed Shed

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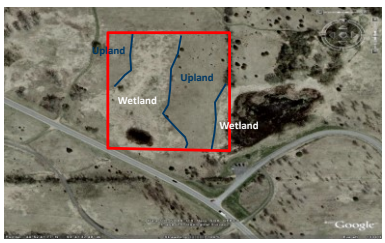
Routine Level 1

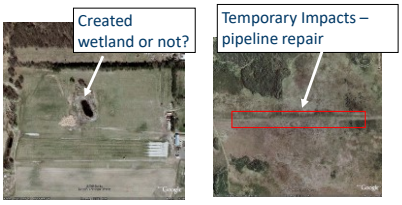
29

Routine Level 1



30

Routine Level 1 Examples



31

Wetland Delineation Types

Routine Level 2

- Use when an accurate boundary is critical
- Need a formal boundary approval
- Most used and focus of class

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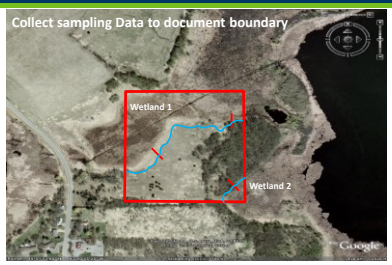
Routine 2



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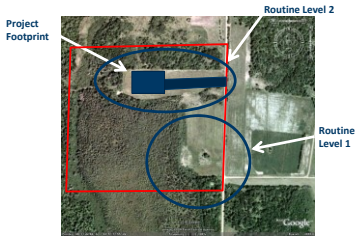
Routine Level 3

Combination of Levels 1 and 2



34

Routine Level 3

35

Wetland Delineation Types

Comprehensive Delineation Method

- Complex, requiring rigorous documentation and coordination
- Quantitative Measurements of:
  - Hydrology
  - Vegetation
  - Soils
- Combine with other methods

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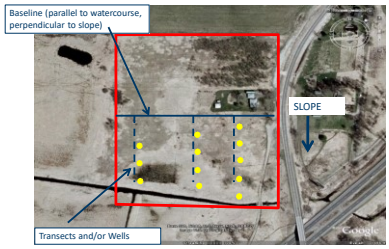
Comprehensive Delineation



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Routine Level 2 Process

1. Research data sources
   - Know site before visit
   - Saves time and effort
2. Field visit and data collection
   - Data collection
   - Preponderance of evidence
3. Delineate wetland boundary
   - Document indicators of wetland/non-wetland decision
   - Only after multiple informal observations

38

Offsite Resources = Data Sources

- Aerial Photos (current and historic)
- Soil map (Web Soil Survey)
- Topographic\LiDAR
- NWI Map (updated version in MN)
- DNR Protected Waters Map

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Routine Level 2 Process

- **Field Visit and Data Collection**
- Use preliminary map to make a plan
- Recon site and make informal observations and samples
- Make notes about general characteristics
  - Plant Communities
  - Topographic changes-Landscape position
  - Changes in soils
  - Precipitation conditions (wet-dry)
- Delineate Wetland Boundary
  - Documentation for decision

40

Field Equipment

41

Sample Points

1. Top section of data sheet
   - Documents sample location and landscape setting
   - Site conditions Wet-Dry
2. Vegetation
   - ID species to determine if plant community is hydrophytic
   - Record comments on changes in vegetation
3. Soil
   - Describe soil and determine if it is hydric
   - Record comments on changes in soil

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Sample Points

4. Topography
   - Record changes in topography
     - Abrupt
     - Gradual
     - Geomorphic position
5. Other notable remarks and observations
   - Basis for delineation line (sharp topo/veg break)
   - Hydrology inputs and outputs

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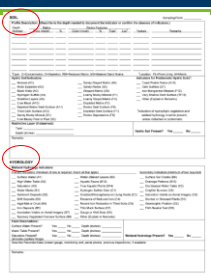
It's all about the documentation!



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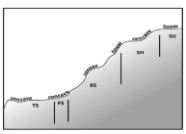
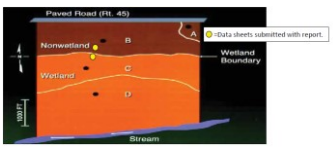
It's all about the documentation!



45

Sampling Location Should Be Representative

- Representative of soil changes (from upland to wetland)
- Representative of vegetation changes
- Representative of hydrology indicator changes
- Representative of landscape changes



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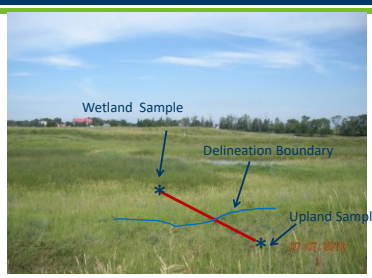
Routine Level 2 Sampling Transects



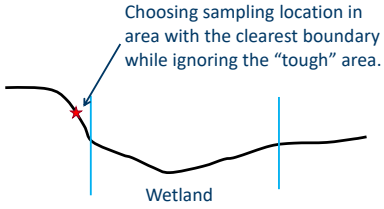
47

Sample location is important!

Good data collection cannot compensate for poor sampling location choices.

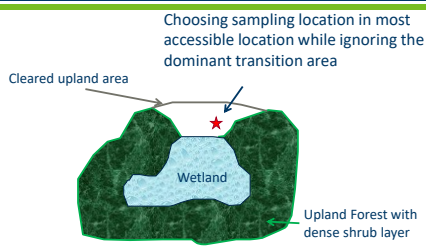
48

Common Errors – The "safe" approach



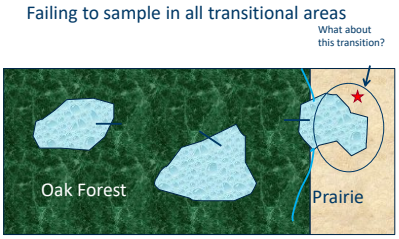
49

Common Errors – The "lazy" approach



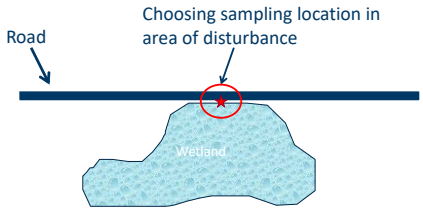
50

Common Errors – The "anti-community" approach



51

Common Errors – The "disturbed" approach



52

Make a Plan:

- Examining your offsite mapping before heading to the field.
- Do an initial site reconnaissance before settling on a sampling location.
- In tough areas, do "preliminary" sampling to help determine where you should do your "official" representative sampling (i.e. full data sheets).

53

- BWSR Wetland Delineation page

54

Critical Definitions for Wetland Delineation

55

Critical Definitions

- Wetlands
- Growing Season
- Disturbed (Atypical Situations)
- Naturally Problematic (Problem Areas)
- Normal Environmental Conditions
- Normal Circumstances

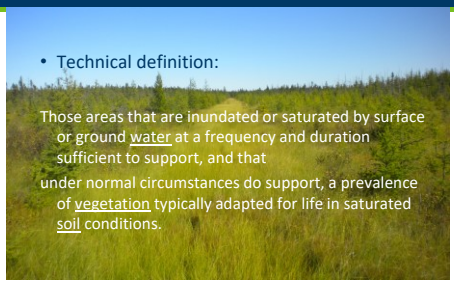
56

What is a Wetland?

"Wetlands are sometimes wet areas where people meet to argue."

Greg Larson

57



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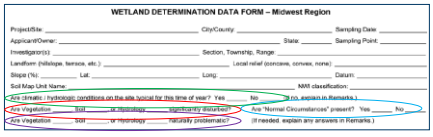
Data Sheets


WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: _____ City/County: _____ Sampling Date: _____

Applicant/Owner: _____ State: _____ Sampling Point: _____

Investigator(s): _____ Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____

Slope (%): _____ Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: _____ NWI classification: _____

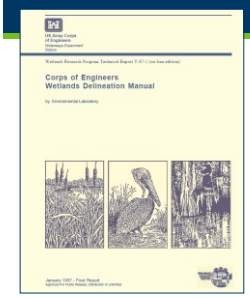
Are climatic / hydrologic conditions on the site typical for this time of year? Yes No (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes No

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

59

Definitions



60

Growing Season

Green-up indicators 2 to 3 weeks earlier than safe planting period for agricultural crops

=

Observations of inundation/saturation 2 to 3 weeks earlier in the "wet" season for wetland hydrology determinations

61

Growing Season

Regional Supplements

apply a field observation-based approach to the start (and end) of growing season

62

Why do we care about Growing Season?

Growing season dates are needed to:

- Evaluate and interpret certain wetland hydrology indicators
- Analyze recorded data to determine if wetland hydrology criterion is met

63

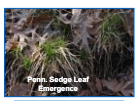
Indicators of Start of the Growing Season

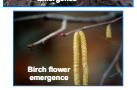
1. **"Green-up" indicator**
2. **Soil temperature at 12 inches is 41° F. or higher**
3. **In the absence of site-specific information (e.g., no site visit), use the 28° F., 5 years in 10, per WETS tables**

64

"Green-Up" Indicator for Start of Growing Season

Two or more species of non-evergreen plants show active growth in a wetland or surrounding area with similar elevation and aspect





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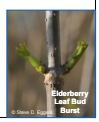
"Green-Up" Indicator (cont.)

- Record supporting information on data sheet
- Include the species observed, their abundance and location relative to the potential wetland, and type of biological activity observed
- Recommend photo documentation



66

Start of Growing Season

April site visit:

Two species of non-evergreen plants – reed canary grass and lake sedge – have new, green, aerial leaf/stem growth

Meets the "green-up" indicator for the start of the growing season

67

End of Growing Season

- woody deciduous species lose their leaves

and/or

- the last herbaceous plants cease flowering and their leaves die back

68

Disturbed (Atypical Situations)

- **One or more parameters altered or absent due to recent human activities or natural event**

Filling, artificial drainage, stream channelization, mechanized land clearing, levee construction, mowing, cropping, plowing, logging, change in river course, high-capacity groundwater well pumping, etc.

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Degree of Disturbance(s)

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Slope (%): _____ Lat: _____ Long: _____ Datum: _____

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Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

Significantly Disturbed = sufficient to remove or obscure field indicators

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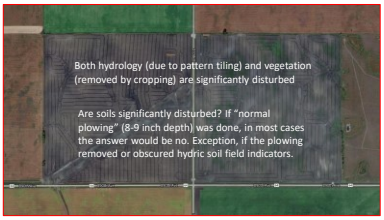
Disturbed (Atypical)

71

Disturbed (Atypical)



72

Problem Areas (Naturally Problematic)

- **One or more parameters are absent due to normal seasonal or annual variability, or permanently due to the nature of the soils or plant species**
  - Seasonal wetlands
  - Prairie potholes
  - Red clay parent materials
  - FACU-dominated wetlands
  - Inter-dunal swales

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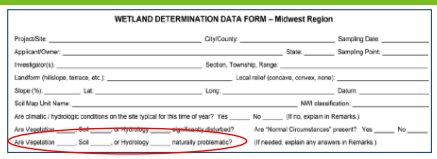
Problem Areas



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Are Vegetation _____ Soil _____ or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No _____
Are Vegetation _____ Soil _____ or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

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Seasonal Wetlands

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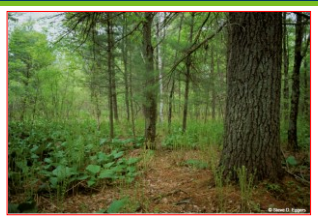
Problem Areas



Wetlands dominated by non-hydrophytic species like white pine, a Facultative Upland species

76

Wetland Definition (1977)

- Those areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions

HISTORY: In early years of implementing the Section 404 regulatory program, wetland identification was based on vegetation – there were no delineation manuals/3-parameter approach. Cases arose where wetland vegetation was removed (plowed under, burned off, herbicided, etc.) in an attempt to evade wetland regulations. Corps/EPA then adopted the approach of determining whether the area in question would support dominance by wetland vegetation under normal circumstances .

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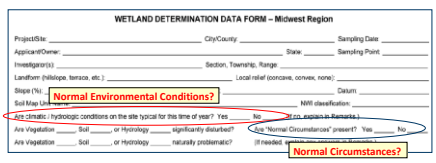
Normal Environmental Conditions vs. Normal Circumstances



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Slope (%): _____ Lat: _____ Long: _____ Datum: _____
Soil Map Unit Name: _____ NWI classification: _____
Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No _____ (If no, explain in Remarks.)
Are Vegetation _____ Soil _____ or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No _____
Are Vegetation _____ Soil _____ or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

Normal Environmental Conditions?

Normal Circumstances?

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Normal Environmental Conditions vs. Normal Circumstances

- **Short-term:** "normal environmental conditions" refers to the climatic conditions of the current year and growing season
- **Long-term:** "normal circumstances" refers to the multiple-year/decades-long condition of the site

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Normal Circumstances

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: _____ City/County: _____ Sampling Date: _____

Applicant/Owner: _____ State: _____ Sampling Point: _____

Investigator(s): _____ Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____

Slope (%): _____ Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: _____ NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

If "Yes", data collection is based on current conditions.

If "No", data collection is based on conditions that would exist in absence of recent disturbance(s).

80

Normal Circumstances Key

1. Soils, vegetation and hydrology are undisturbed.....**NC**
1. Physical alteration(s) to soils, vegetation and/or hydrology has occurred.....2

   2. Physical alteration(s) to soils, vegetation and/or hydrology is minor, i.e., insufficient to remove or obscure field indicators... .....**Normal Circumstances**

   2. Physical alteration(s) to soils, vegetation and/or hydrology is more than minor ("significantly disturbed" is checked on datasheet).....3

81

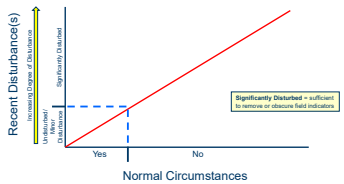
Normal Circumstances Key

3. Physical alteration(s) is legally established, maintained and represents the long-term condition of the site; OR is a newly-authorized physical alteration (e.g., a permitted fill, new concrete dam).....**Normal Circumstances**

3. Physical alteration(s) is due to:
   a. an unauthorized or illegal activity;
   b. done with intent of evading wetland regulations;
   c. total or partial clearing of vegetation, or selective removal of veg
   d. presence of a crop, tree farm, improved pasture, managed veg
   e. destruction of hydric soil field indicators by cultivation, deep ripping, etc.;
   f. irrigation or pumping of surface or groundwater for agriculture;
   g. a major natural event (e.g., a river changes course).....**NOT Normal Circumstances**

82

Relationship of Normal Circumstances and Recent Disturbance(s)



83

Normal Circumstances

- The full range of pristine to highly disturbed conditions may constitute the normal circumstances
- The long-term condition of a site including any authorized or other legal alterations, such as highways, dams, and other relatively permanent infrastructure and development
- The extent, duration and relative permanence of the physical alteration(s) are key
- Maintenance is a factor – if a physical alteration (e.g., ditch system) is abandoned and wetlands reestablish, the NC is wetlands
- The conditions indicated by the soils and hydrology normally present on a site, in cases where the vegetation has been altered or removed

Extent and Relative Permanence Test

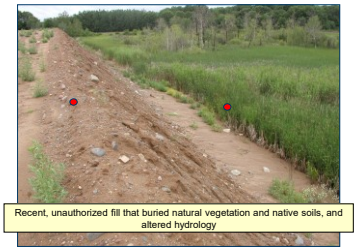
84

Normal Circumstances

- Alterations that occurred before implementation of the Clean Water Act (1972).
- Alterations that were authorized, exempt, or did not require authorization.
- Hydrologic modifications, such as functioning ditches or subsurface drains, that were installed legally, are relatively permanent, are maintained, and operate by gravity without any artificial input of energy or manpower.
- Ongoing hydrologic manipulation that is permanent and non-discretionary, such as pumping of surface or groundwater for municipal water supply, done under a court order, or required for public safety.
- A site with undisturbed conditions, including those wetlands identified as problem areas

85

Not Normal Circumstances



Recent, unauthorized fill that buried natural vegetation and native soils, and altered hydrology

86

Normal Circumstances - Hydrology

Example A: Ditch legally constructed in 1950s and maintained since = ditch is established as **Normal Circumstances**. Partially drained is the normal circumstance for hydrology.

Example B: Ditch constructed last year; unauthorized sidecasting of dredged materials in wetlands = **NOT Normal Circumstances**

87

Normal Circumstances

Authorized wetland fill meets the "extent and relative permanence test" -- establishes a new Normal Circumstance

3. Physical alteration(s) is legally established, maintained and represents the long-term condition of the site; OR is a newly-authorized physical alteration (e.g., a permitted fill, new concrete dam).....**Normal Circumstances**

88

Normal Circumstances – Soils

- **Normal plowing** (e.g., 8- to 9-inch depth) is not considered a "significant" disturbance to soils if does not remove or obscure field indicators of hydric soils
  - -- Examples: A1, A12
  - -- However, other field indictors (e.g., F8, some S indicators (sandy))
  - would be obscured or difficult to determine
- "Deep ripping" or other methods that disturb and mix soil layers at depths greater than normal plowing are **NOT Normal Circumstances**

89

Normal Circumstances - Vegetation

Removal of natural vegetation and replacement with a planted crop = NOT Normal Circumstances

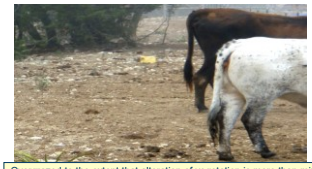
IGNORE the planted crop for purposes of the hydrophytic vegetation determination

When natural vegetation has been removed, focus on soils and hydrology. If a site has wetland hydrology and hydric soils, it would support dominance by hydrophytes under normal circumstances.

90

Normal Circumstances - Vegetation

- Removing, manicuring, planting, cropping, or other means of altering vegetation that is more than minor = NOT Normal Circumstances



Overgrazed to the extent that alteration of vegetation is more than minor – including the extreme case shown above where vegetation has been removed = NOT Normal Circumstances

91

Normal Circumstances - Vegetation

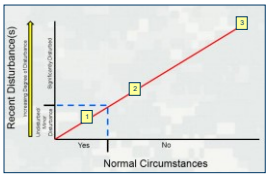
Light grazing of a sedge meadow – minor disturbance of natural vegetation = Normal Circumstances

Example of an unimproved pasture = no interseeding, planting, etc.

92

Normal Circumstances - Vegetation

What about moderate grazing sufficient to result in a shift of the plant community to species more tolerant of grazing ("increasers") at the expense of other plant species ("decreasers")[see Table 10 in Midwest Supplement for examples]. Most cases: NOT Normal Circumstances. Follow Midwest Supplement guidance.



KEY:

1 Light Grazing – Sedge Meadow
2 Moderate Grazing
3 Overgrazed – Exposed Soils

93

Normal Circumstances - Vegetation

Natural vegetation removed and replaced by manipulated/manicured vegetation (seeding, mowing, fertilizing, selective herbicide applications) = NOT Normal Circumstances

94

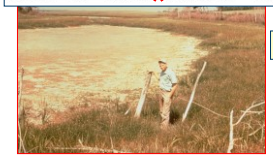
Problem Areas and Normal Circumstances

- **EXAMPLE:** Vernal pools are naturally dry outside of the first few weeks of the growing season = **Normal Circumstances**

95

Problem Areas and Normal Circumstances

Project/Site: _____ City/County: _____ Sampling Date: _____
Applicant/Owner: _____ State: _____ Sampling Point: _____
Investigator(s): _____ Section, Township, Range: _____
Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____
Slope (%): _____ Lat: _____ Long: _____ Datum: _____
Soil Map Unit Name: _____ NWI classification: _____
Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)
Are Vegetation _____ Soil _____ or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____
Are Vegetation _____ Soil _____ or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)



Prairie pothole wetland in a drought year

96

Differentiate Science from Regulation/Policy

Science of Wetland Delineation = 1987 Manual and Regional Supplements

Regulation/Policy Implications

…but farming practices are exempt
…but this site is an incidental wetland
…but this site is prior converted cropland
…but under Rapanos (or current Federal Regulation/Rule) this site wouldn't be regulated

Normal Circumstances = The vegetation adapted to the soils and hydrology of the site

97

Two-Step Process

Step 1: Delineate Wetlands, if Present, Within a Site

Every Data Sheet
- Normal Circumstances?
- Normal Environmental Conditions?
- Disturbed (Atypical Situations)?
- Problem Area (Naturally Problematic)?

Step 2: Apply regulations, policy and guidance

98

Critical Definitions

99

Wetland Classification Systems

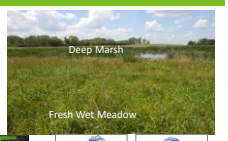
BOARD OF WATER AND SOIL RESOURCES

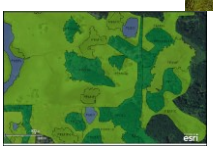
Minnesota Wetland Professional Certification Program

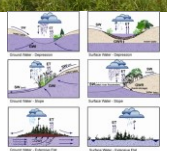
100

Wetland Classification Systems in MN

- Circular 39
- Cowardin et al.
- Eggers & Reed
- Hydrogeomorphic Method







101

Why Classify Wetlands?

- To establish a consistent organizational structure for:
  - Understanding functions
  - Inventory/mapping
  - Scientific study and tracking
  - Regulation

Most systems use
- Vegetation (emergent or forested?)
- Hydrology (standing water or saturation?)
- Water depth (6 inches or 3 feet?)

Some use
- hydrologic source (surface or groundwater fed)
- geomorphic position (position on the landscape).

102

Wetland Classification Systems

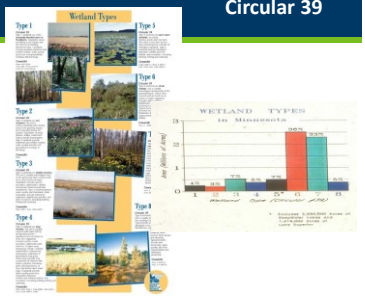
103

Circular 39

Developed in 1956 for wildlife habitat (waterfowl)

Used in Minnesota Wetland Conservation Act

Based on hydrology and vegetation
let's also apply landscape position



104

Type 1

Seasonally flooded basins

Landscape position: depressional basins, floodplains

Hydrology: Seasonally Flooded, dry for much of growing season

Vegetation: Highly Variable plant communities

105

Type 2

Inland fresh meadow

Landscape position: depressions, lake fringes

Hydrology: saturated, without standing water for most of the growing season

Vegetation: grasses, sedges, rushes, or broadleaf plants

106

Type 3

Inland shallow marshes

Landscape position: lake fringe, seep areas of on irrigated land

Hydrology: flooded up to 6" in depth

Vegetation: Grasses, bulrushes, cattails, arrowhead

107

Type 4

Deep marsh

Landscape position: shallow basins, lake fringe

Hydrology: 6" to 3' of near permanent surface water with open water components

Vegetation: Cattails, reeds, spike rush, bulrushes, pondweeds, duckweeds, water lilies, wild rice

108

Type 5

Inland open water

Landscape position: shallow basins, lake fringe

Hydrology: <6' deep

Vegetation: pondweeds, water milfoils, fringed by emergent vegetation

109

Type 6

Shrub swamps

Landscape position: sloped, along river and lake fringes

Hydrology: Saturation with seasonal shallow inundation

Vegetation: Shrub swamps dominated with willow, dogwood and alder as well as grasses/forbs.

110

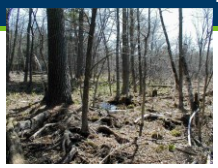
Type 7

Wooded swamps

Landscape position: mineral flats, sloped

Hydrology: saturated with seasonal inundation for short periods

Vegetation: Forested, often dominated with tamarack, black ash, spruce, red maple, balsam fir, cedar



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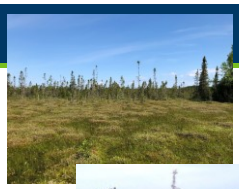
Type 8

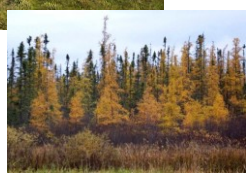


Bogs

Landscape Position: organic flats, lake fringe

Hydrology: permanently saturated

Vegetation: Herbaceous strata dominated by sphagnum moss, leatherleaf, Labrador tea, sedges, black spruce and tamarack trees



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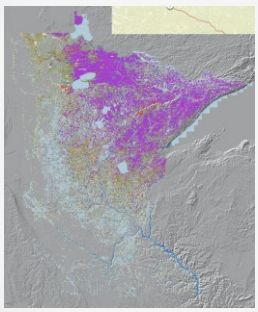
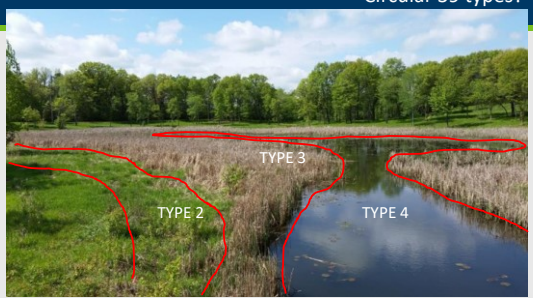


113

Circular 39 types?



114

Cowardin Classification System

- Created in 1979
- Includes wetlands and other aquatic habitats (streams, lakes, etc.)
- Used for NWI maps
- Nationwide system

115

Cowardin System

Hierarchy uses symbols to describe System, Class, plant community, hydrology and modifiers

Examples of common symbols:

Systems:
P = Palustrine, L= Lacustrine, R = Riverine

Palustrine Classes:
EM = Emergent, SS = Scrub shrub, FO = Forested

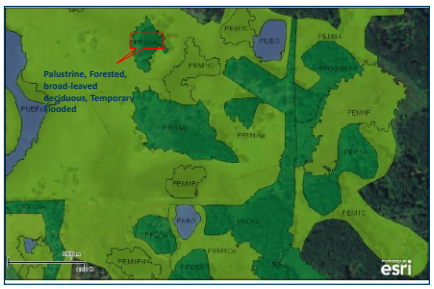
Plant Community:
EM: Persistent=1, Non persistent=2
SS & FO: Broad-leaved deciduous=1, Needle-leave deciduous= 2, Broad-leaved evergreen=3, Needle-leaved evergreen=4

Water regime modifiers:
C = Seasonally flooded, B = Saturated, A = Temporarily Flooded, F=semi-permanently flooded, H=permanently flooded

Special Modifiers:
b = Beaver, d = Partially Drained/Ditched, f = Farmed, x = Excavated

116

Cowardin System - NWI



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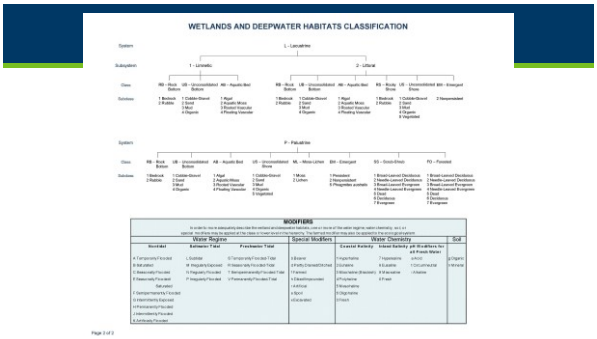

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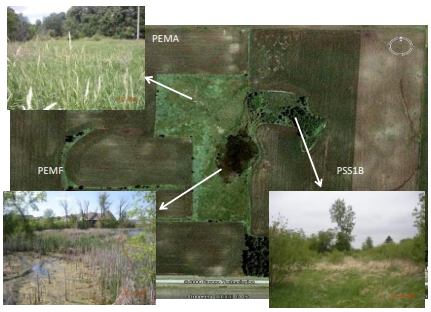

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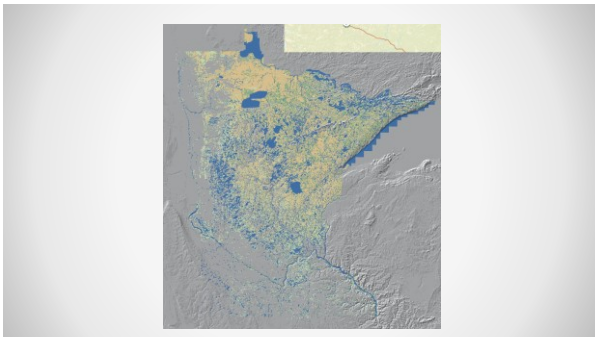
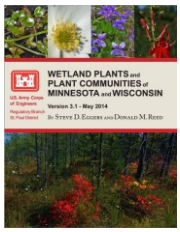


120

Eggers & Reed Classification System

Primarily based on plant communities, but includes "typical" associated hydrologic regimes

- **Shallow, Open Water**
- **Deep Marsh**
- **Shallow Marsh**
- **Sedge Meadow**
- **Fresh (Wet) Meadow**
- **Wet/Wet-Mesic Prairie**
- **Calcareous Fen**
- **Open Bog/Coniferous Bog**
- **Shrub-Carr/Alder Thicket**
- **Hardwood Swamp/Coniferous Swamp**
- **Floodplain Forest**
- **Seasonally Flooded Basin**



121

Eggers & Reed Classification System

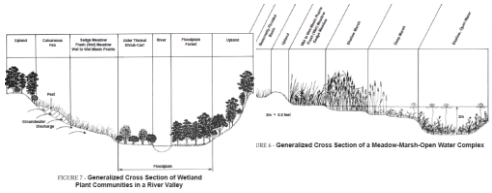


FIGURE 6 - Generalized Cross Section of a Meadow-Marsh-Open Water Complex

FIGURE 7 - Generalized Cross Section of Wetland Plant Communities in a River Valley

122

Shallow, Open Water

Hydrology: permanently inundated, Water depths less than 8.2 feet (2.5 meters)

Vegetation: Dominated by submergent, floating and floating-leaved species

123

Deep Marshes

Hydrology: semi-permanently inundated by 6 inches to 3 feet or more of water during the growing season

Vegetation: Dominated by herbaceous emergent, submergent, floating and floating-leaved species

124

Shallow Marshes

Hydrology: Soils saturated to the surface to inundated up to 6 inches of water for a significant portion of most growing seasons

Vegetation: Wild rice, reed canary grass and bur reed

125

Fresh (Wet) Meadows

Hydrology: Water table often drop below 12 inches after early portion of growing season

Vegetation: Dominated by grasses, such as reed canary grass and redtop, and/or forbs such as giant goldenrod and marsh aster

126

Sedge Meadows

Hydrology: Saturated soils most of the growing season.

Vegetation: Dominated by sedges, primarily *Carex,* but also woolgrass and other sedge family members, Canada blue-joint grass may be subdominant, can have floating mat (Sedge Mat) when fringing deeper hydrologic regimes

127

Wet to Wet-Mesic Prairies

- Hydrology: Saturated soils most of the growing season
- Vegetation: Dominated by native prairie grasses, often with a rich diversity of hydrophytic prairie forbs such as Prairie cord-grass, big bluestem, gayfeather, green bulrush, mountain mint, sawtooth sunflower, New England aster, white lady-slipper, etc.

128

Seasonally Flooded Basins

Hydrology: seasonally flooded, Typically ponded for a few weeks early in the growing season then drying out

Vegetation: Mudflats left by receding water are colonized by annuals such as smartweeds

Condition shown is in May -- cropped corn field. By mid- to late growing season, annual species such as wild millet (FACW) and smartweeds (FACW-OBL) would dominate

129

Shrub-Carr and Alder Thickets

Hydrology: saturated to seasonally flooded

Vegetation: Native willows, dogwoods and/or alders dominate. Disturbed sites may have non-native buckthorns.

130

Hardwood and Coniferous Swamps

Hydrology: saturated, may be seasonally inundated

Vegetation: Black Ash, Tamarack/Black Spruce, no continuous sphagnum moss

131

Calcareous Fens

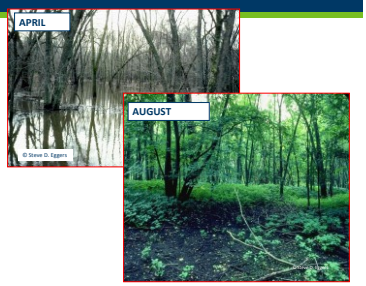
- Hydrology: upwelling groundwater discharge continuously saturates organic soils, Specific soil and water chemistry (CaCo)
- Vegetation: Rarest wetland type in MN. Supports disproportionate number of T & E species: sterile sedge, beaked spikerush, hardstem bulrush, Grass of Parnassus, Kalm's lobelia, white lady-slipper, Riddell's goldenrod

132

Floodplain Forests

Hydrology: seasonally inundated, relatively well-drained for most of the growing season

Vegetation: silver maple, American elm, river birch, green ash, black willow, box elder, eastern cottonwood



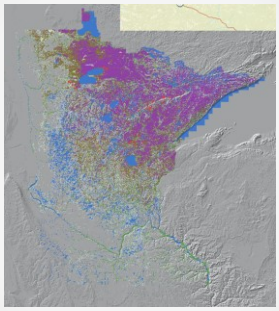
133

Open and Coniferous Bogs

Hydrology: saturated, with acidic, peat soils low in nutrients

Vegetation: tamarack, black spruce, continuous mat of *Sphagnum* moss, bog sedge, wire-grass sedge, cottongrass, leatherleaf, labrador tea and unique flora not found in any other habitat. Many orchid species.

134



135

Eggers & Reed?

136

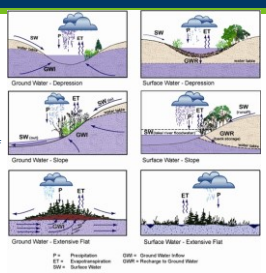
Hydrogeomorphic Method

Assesses functional conditions of a specific wetland referenced to data collected from wetlands across a range of physical conditions

- Developed by Brinson (1993), modified by Smith et al. (1995)
- Hydrogeomorphic Wetland Classification System: An Overview and Modification to Better Meet the Needs of the NRCS (2008 NRCS Technical Note No. 190-8-76)

Established Classes based on geomorphic, hydrology and hydraulic functions of palustrine wetlands

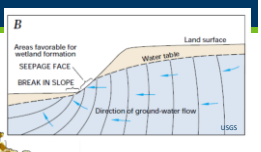
- RIVERINE, DEPRESSIONAL, SLOPE, MINERAL SOIL FLATS, ORGANIC SOIL FLATS, ESTUARINE FRINGE, LACUSTRINE FRINGE

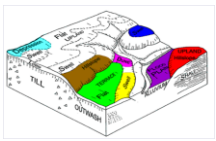


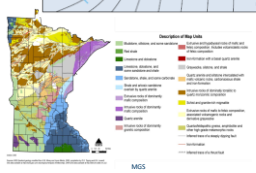
137

Parameters of HGM

- Geomorphology- landscape position
- Hydrology- water source and output
- Hydraulics- hydrodynamics



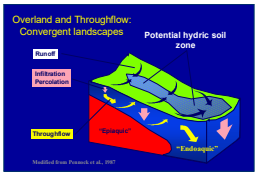


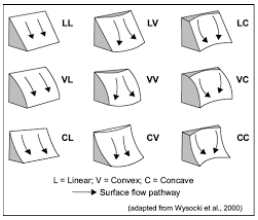


138

Landscape Position- surface shape

- Convex- surface curves outward
- Concave- surface curves inward
- Linear- flat, one dimensional surface



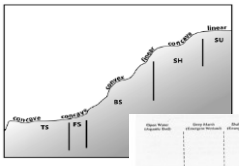


139

Landscape Position- slope processes

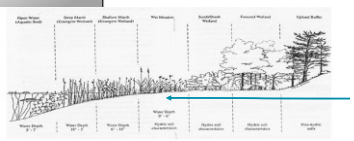
Landscape position:

- Summit
- Shoulder
- Backslope
- Foot slope
- Toe slope



Slope processes:

- Erosional- summit, shoulder, backslope
- Depositional- foot slope, toe slope



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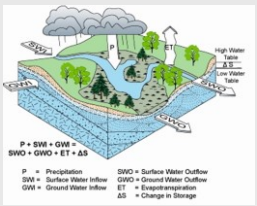
Hydrology



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

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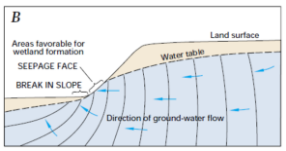
Hydraulics- how water moves



- Uni-directional
- Bi-directional
  - Estuarine and lacustrine fringe

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HGM Classes

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

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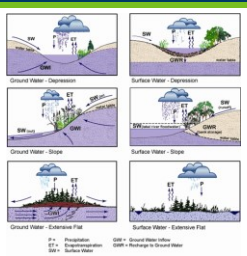
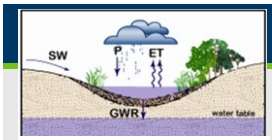
HGM Subclasses

- Influenced by:
  - Groundwater input
  - Surface water input
  - Hydrology Outputs
    - Surface
    - Ground



144

Depressional- surface



- Landscape position- concave, foot slope/toe slope, closed contours
- Hydraulics- unidirectional
- Water source- surface flow and precipitation, seasonal
- Outputs- Evapotranspiration, groundwater recharge

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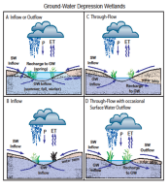
Depressional- groundwater



- Landscape position- concave, foot and toe slopes, closed contours
- Hydraulics- unidirectional
- Water source- groundwater and precipitation, *seasonal*
- Outputs- Evapotranspiration, groundwater recharge, intermittent overland flow

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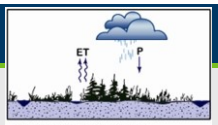
Mineral Soil Flats

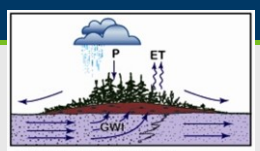


Surface Water - Extensive Flat

- Landscape position- relic land bottoms and floodplains, intergrades to multiple other classes (sloped, riverine, lacustrine)
- Hydraulics- vertical groundwater fluctuations
- Water source- precipitation, no groundwater interaction
- Outputs- evapotranspiration, saturated "seepage" flow

147

Organic Soil Flats



Ground Water - Extensive Flat

- Landscape position- summit (interfluves- broad "plateau" between drainage systems, depressions filled with organics, vertical accretion of organics
- Hydraulics- precipitation, unidirectional groundwater
- Water source- precipitation, groundwater
- Outputs- saturated overland seepage, evapotranspiration

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Riverine

- Landscape position- floodplains and riparian corridors, often intergrade to sloped or depressional
- Hydraulics- unidirectional, surface overbank flow, groundwater, interflow (both surface and ground) from adjacent uplands
- Water source- precipitation, groundwater
- Outputs- overland surface flow (perennial flow not required), evapotranspiration

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Lacustrine Fringe

- Landscape position- adjacent to lakes, toe slope, often intergrade to sloped
- Hydraulics- bidirectional (inflow from adjacent uplands and lake)
- Water source- precipitation, groundwater
- Outputs- return flow to lake, saturated surface seepage, evapotranspiration

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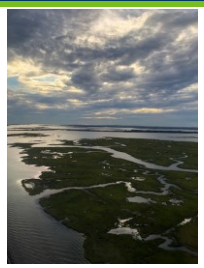
Estuarine Fringe

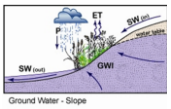
- Landscape position- along coasts and estuaries, often intergrade to riverine
- Hydraulics- bidirectional (tidal flow)
- Water source- surface via frequent tidal flooding, precipitation
- Outputs- tidal exchange, saturated overland flow, evapotranspiration



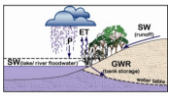
151

Sloped

- Landscape position- linear or convex, predominately found at foot and toe slope, can be found on back slope and shoulder slope, often intergrades to other classes (mineral flat, riverine, depression)
- Hydraulics- unidirectional
- Water source- groundwater, surface runoff, precipitation
Outputs-



Ground Water - Slope



Surface Water - Slope

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HGM Class (subclass)	Hydrology Inputs	Hydrology Outputs	Hydraulics
RIVERINE	surface flow precipitation groundwater	surface flow evapotranspiration	bidirectional (both surface and ground)
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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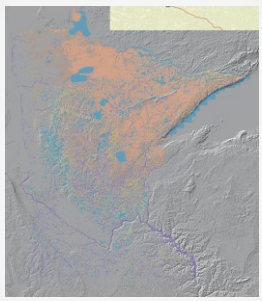

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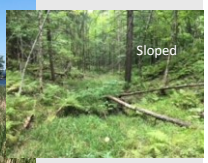
HGM?


Mineral flat


Lacustrine Fringe


Sloped

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Wetland Classification Systems in Minnesota

Circular 39
- Based on hydrology and vegetation

Cowardin
- Based on hierarchy system, class, veg, water regime, special modifiers

Eggers & Reed
- Based on plant communities & "typical" associated hydrologic regimes

Hydrogeomorphic Method
- Based on landscape position, water source, hydraulics


Type 3, PEM1F, shallow marsh, DEPRESSION-surface

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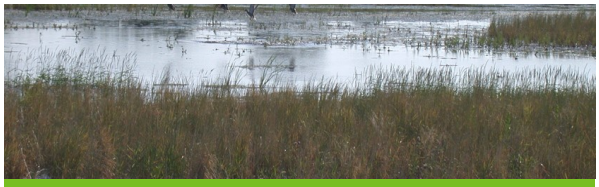

Wetland Functions

BOARD OF WATER AND SOIL RESOURCES

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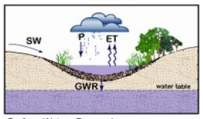
Overview

- Wetland Functions
- Wetland Values
- Hydrogeomorphic Method
- Functional Assessments
  - MN Routine Assessment Method (MNRAM)
  - Floristic Quality Assessment (FQA)



Surface Water - Depression

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Wetland Functions & Values

Wetland Functions: in scientific assessments means natural processes

Wetland Value: wetland goods and services providing monetary or social welfare benefit.

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Values

Food Production

Wild Rice

Cranberries

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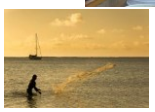
Values

More than a billion people make a living from wetlands across the world.

- Fishing
- Eco-tourism
- Farming
- Drinking water



Source: www.worldwildlife.org
Photos: www.ramsar.org

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Values

Recreation, Aesthetics, Education

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Values

Hunting, Fishing, Bird watching, photography

www.nps.org

Mud Duck Boats

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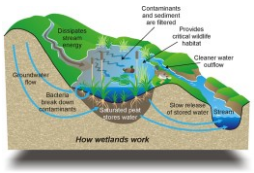
Wetland Functions

- Act as a natural "filter" to maintain water quality
- Facilitates infiltration recharging groundwater
- Stabilize base flow
- Decreases fluid velocity during high flow events which decreases turbidity
- Storm water retention (i.e. storage)
- Provides habitat
- Shoreline protection



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Functions

Water Quality

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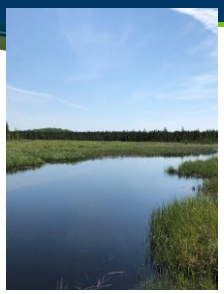
Functions

Floodwater Retention



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Functions

Habitat

- Many insects, reptiles and amphibians rely on wetlands to complete their life cycle.
- Some mammals are semi-aquatic: beavers, muskrat, mink, otters.
- Many birds feed and nest in wetlands.
- Fish rely on wetlands for breeding, feeding and shelter.

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Functions

Sediment Trap

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Functions

Groundwater Recharge

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Functions

Carbon Storage

Although wetlands only account for 5-8% of earths terrestrial landscape they may provide carbon sinks of about 300 to 700 billion tons of carbon. Peatland wetlands make up the majority of carbon sinks.

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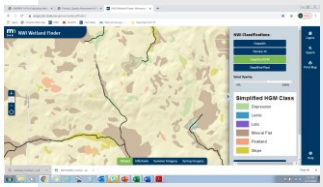
National Wetland Inventory

- NWI now has simplified HGM Classes
  - Depression
  - Lentic (lake system)
  - Lotic (riverine)
  - Mineral Flat
  - Peatland
  - Slope



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Functional Assessment Methods

- MN Routine Assessment Method (MNRAM)
  - Numeric model for assessing wetland functions and some values

Comprehensive General Guidance

for

Minnesota Routine Assessment Method (MnRAM) Evaluating Wetland Function, Version 3.4 (beta)

9/15/2010

- Floristic Quality Assessment
  - Vegetation based ecological condition assessment method

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MnRAM (MN Routine Assessment Method)

- Developed by interagency work group shortly after WCA passed.
  - Refined in 2010
- Assessment tool that uses numeric model to rank both Functions and values

- BWSR no longer supports Access database version
- Excel version 3.2 and text version using the Comprehensive Guidance Document for explanations, definitions and ranking formulas for each function

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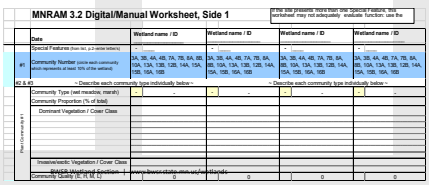
Method

Determine vegetative diversity and integrity:

- List plant communities of each wetland
  - Dominant vegetation
  - Cover class



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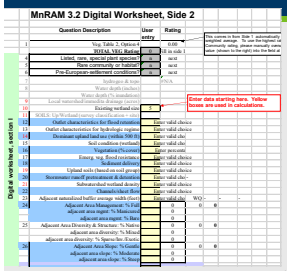
Method


MnRAM 3.2 Digital Worksheet, Side 2

Assign rating based on series of questions for each wetland using Comprehensive Guidance

MnRAM Comprehensive General Guidance

MnRAM Guidance on Selected Questions

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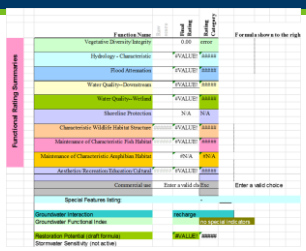
Method

Functional index score

Outcome Numeric ranking:

- Exceptional
- High
- Medium
- Low


Functional Rating Summaries

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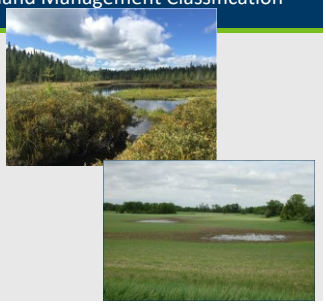
Wetland Management Classification

Functional index score can then be used to classify management

- Wetland Management Classification System

Results are **classification recommendations:**

- Preserve, Manage 1, Manage 2, Manage 3



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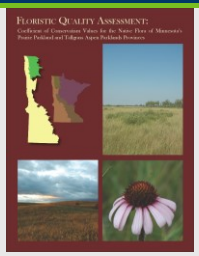
Floristic Quality Assessment

- Vegetation condition assessment to measure the quality of a native plant community
- Developed by the MN Pollution Control Agency
  - 2007, Statewide C-values
  - Efforts to regionalize C-values underway
- Intended to compliment functional assessments such as MNRAM



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FQA Key Concepts

- Key concepts:
  - Species conservatism- tolerance to degradation
    - Coefficients of Conservatism (C-value)
  - Floristic Quality Index
    - Species richness and mean C-values
- Sampling methods
  - Rapid FQA
  - Full Method

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FQA Key Concepts

- Coefficients of Conservatism
  - Numeric rating of an individual species fidelity in relationship to disturbance
  - C-values range from 0-10
    - 0= most tolerant, found in wide variety of plant communities
    - 10= least tolerant, found in narrow range of plant communities
    - Non-native species = 0
      - Reed Canary Grass (introduced) C=0
      - Ostrich Fern (FAC, NCNE) C=5
      - Showy lady slipper C=9

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Sampling Methods Overview

- FQA Sampling Protocol:
  - Map Assessment Area
  - Determine Plant community types
  - Conduct timed meander (rapid) or plot-based sampling
  - Conduct shoreland sampling (if necessary)
  - Make Areal cover estimations
  - Calculations

- Full FQA -Plot-based sampling
- Rapid FQA- Timed meander rules
  - Areal cover in cover classes for each species

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- Determining the Assessment Area
- Define plant communities
  - Eggers & Reed
  - MN DNR Native Plant Communities Classification Guide
    - Laurentian Mixed Forest, Eastern Broadleaf Forest, Prairie Parkland and Tallgrass Aspen Parklands

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Metrics

Variables:

- Number of species = Species Richness
- Mean C-value
- Mean C-value (weighted) (wC)
  - $wC = \sum pC$

- Floristic Quality Index
  - Integral measurement of FQA
  - $FQI = \bar{C}\sqrt{S}$
    - mean C value
    - S= number of species (i.e. species richness)
  - Both stand alone indices
- Greater the FQI, the closer the condition is to a natural state

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Review

- Functions- natural processes
  - Water quality, flood retention, habitat, groundwater recharge, carbon storage
- Values- provide monetary or social welfare benefit
  - Wild rice, recreation, education, aesthetics, fishing

- HGM- landscape position, hydrology, hydraulics
  - Depressional, sloped, riverine, mineral flats, organic flats, lacustrine and estuarine fringe
- MNRAM- Numeric model for assessing wetland functions and some values
- FQA- Vegetation based ecological condition assessment method

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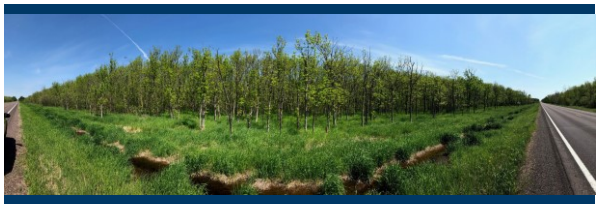

Wetland Functional Assessment

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