



MN Wetland Professional Certification Program Wetland Delineation Methods

m BOARD OF WATER AND SOIL RESOURCES



1

Agenda

Day 1 (9-5)

- Introductions
- 3 parameters of a Wetland
- Wetland Delineation Methods
- Critical Definitions of Wetlands
- Wetland Classification systems
- Wetland Functions
- Wetland Hydrology Indicators
- Top of Data Sheet & Hydrology Indicators Field Exercise

Day 2 (9-5)

- Quiz
- Web Resources for Wetland Professionals
- Antecedent Precipitation Exercise
- Offsite Hydrology Methods
- Soil Concepts
- Hydric Soil Indicators
- Web Soil Survey Exercise
- Soil Texture Lab & Field Exercise along Landform

Day 3 (9-5)

- Wetland Vegetation
- Vegetation Sampling Plot Field Exercise
- Submitting Wetland Delineation Reports
- Wetland Delineation Field Exercise & Class summary

2

Quiz

Sampling transects should be?

- Used when conducting a routine level 1 delineation
- Representative of wetland-upland transition areas
- Located systematically using an established grid
- Randomly located throughout the evaluation area

How reliable are each of the 3-indicators in relation to time?

Soils: Long term may not reflect current conditions

Veg: Medium Term, more reflective of current conditions, and susceptible to seasonal variation

Hydrology: Shortest Term reflective of snapshot conditions




3

What is the maximum average water depth for a special aquatic site to be classified as a wetland?

- a) 1 foot below the surface
- b) 8.2 feet above the surface
- c) 1 foot above the surface
- d) 3 feet above the surface

Wetland boundaries must be delineated using:

- a) Only the US Army Corps of Engineers 1987 manual for identifying and delineating jurisdictional wetlands
- b) The hydrogeomorphic method
- c) The WCA Rulebook
- d) US Army Corps of Engineers 1987 manual for identifying and delineating jurisdictional wetlands as well as the applicable Regional Supplement to the manual



4

A seasonally flooded wetland on agricultural land is normally plowed and planted in most years. For delineation purposes, which of the following conclusions is most likely true?

- a) This is not a jurisdictional wetland
- b) Normal circumstances are not present
- c) Normal circumstances exist
- d) A level 1 delineation is required




5

Explain the concept of a Problem area

- Indicators absent to seasonal, or annual variability; or permanent due to the nature of the soils or species
- Including seasonal wetlands, prairie soils, red parent material etc...

Explain the concept of an Atypical Situation

- One or more Indicators absent due to human activity or natural events (beavers, fire, river changing course)



6

<p>Which of the following can be used for determining the start of the growing season?</p> <ul style="list-style-type: none"> a) Soil temperature at 41 inches below the surface b) Soil temperature at the soil surface c) Soil temperature at 18 inches below the surface d) Soil temperature at 12 inches below the surface 	<p>What classification system uses Systems, Sub-systems and Classes?</p> <ul style="list-style-type: none"> a)HGM b)Eggers and Reed c)Cowardin d)Circular 39
--	--



7

<p>Which of the following plant communities would be characteristic of a Circular 39 type 6 wetland?</p> <ul style="list-style-type: none"> a) Sedge meadow b) Bog c) Alder thicket d) Shallow marsh 	<p>Which of the follow is not a parameter of the Hydrogeomorphic Method classification system?:</p> <ul style="list-style-type: none"> a) geomorphology b) plant community c) hydrology d) hydraulics
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8

<p>A natural process in a wetland that can be scientifically assessed can also be described as a:</p> <ul style="list-style-type: none"> a) wetland value b) routine assessment method c) exemption d) wetland function 	
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9

Resources for TEP members

- Offsite Resources



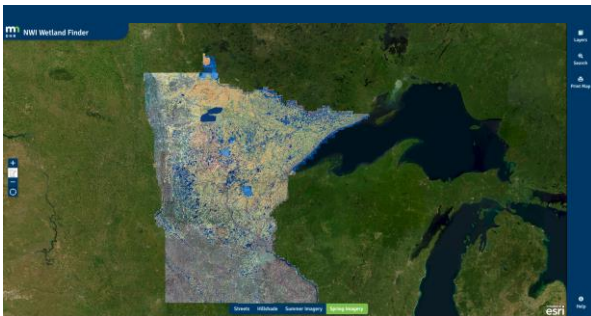
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Important Resources for TEP members

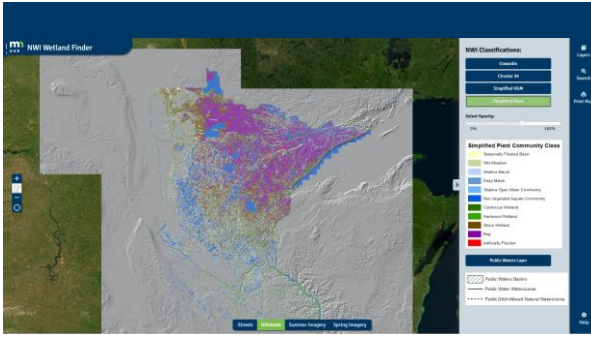
- [National Wetland Inventory](#)
- [Web Soil Survey](#)
- [County GIS/Land Explorer](#)
- [Enviro Atlas](#)
- [MN Conservation Explorer](#)



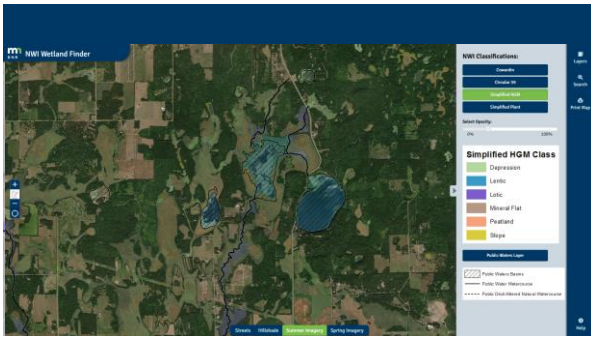
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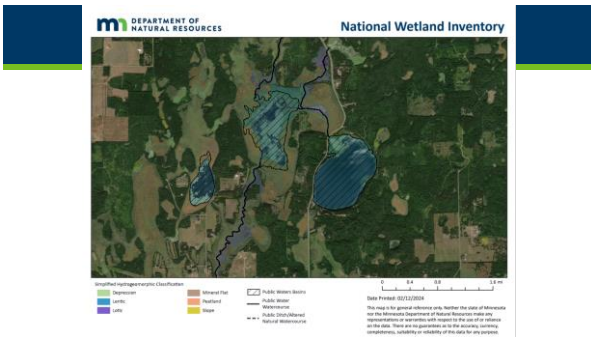
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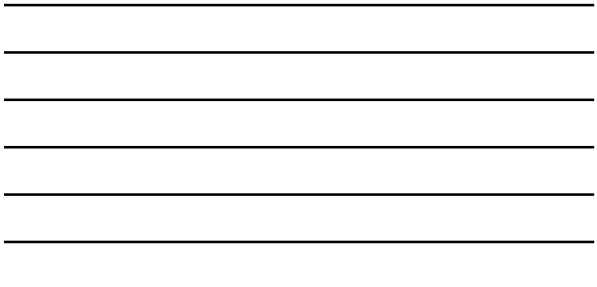
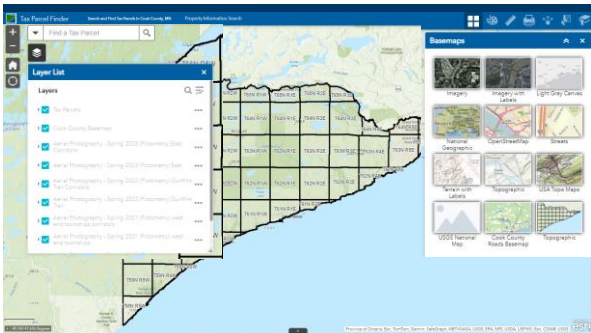


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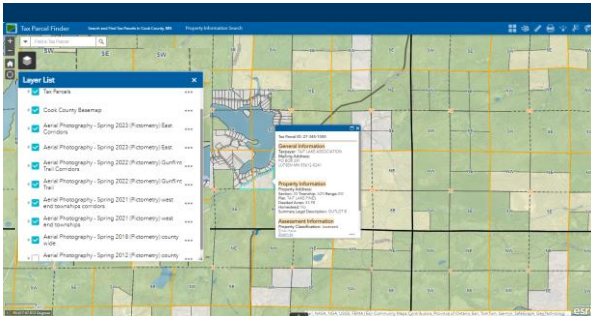
Soil Survey Overview



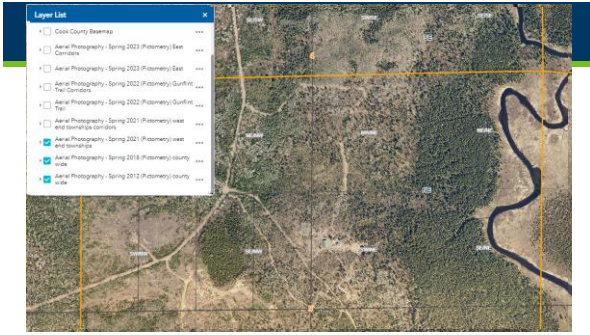
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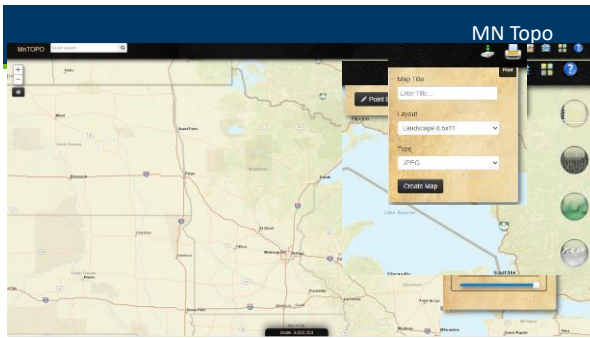
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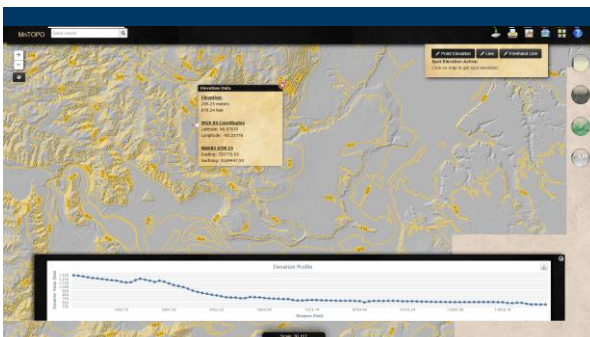
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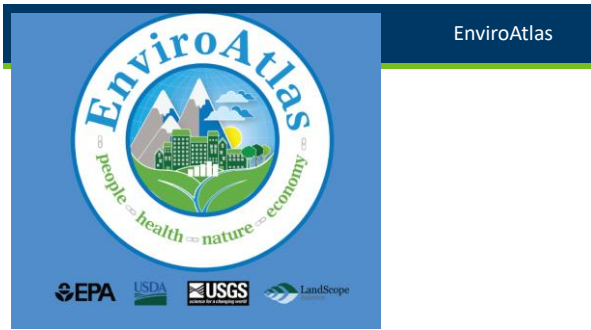
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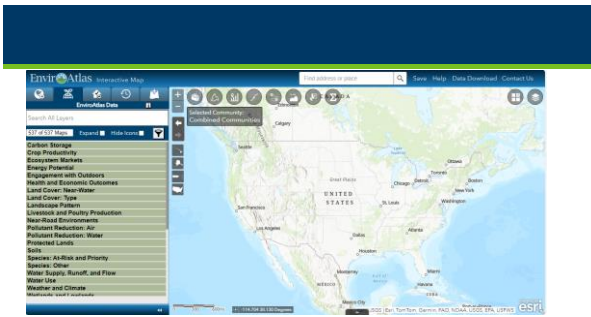


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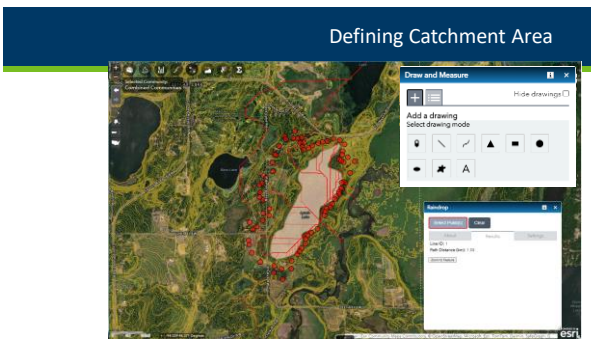


EnviroAtlas

22

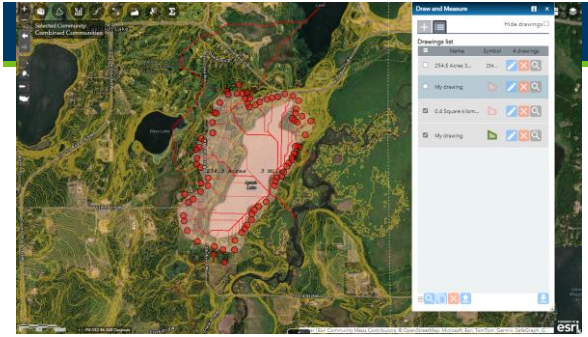


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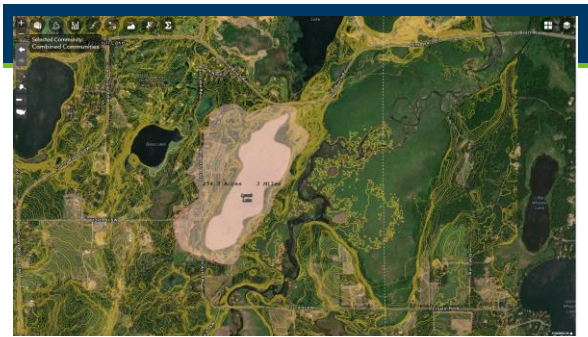


Defining Catchment Area

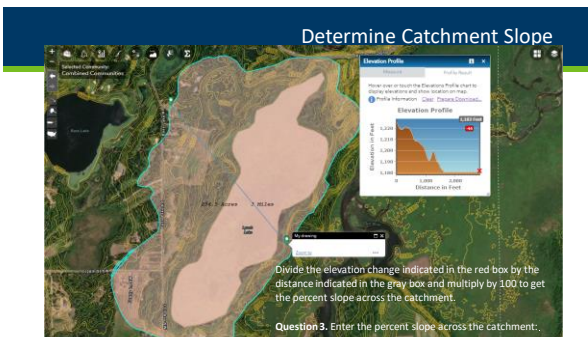
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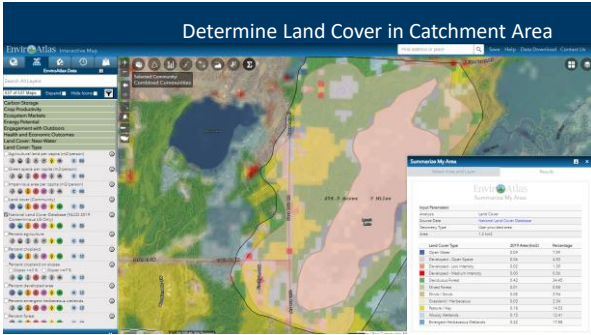
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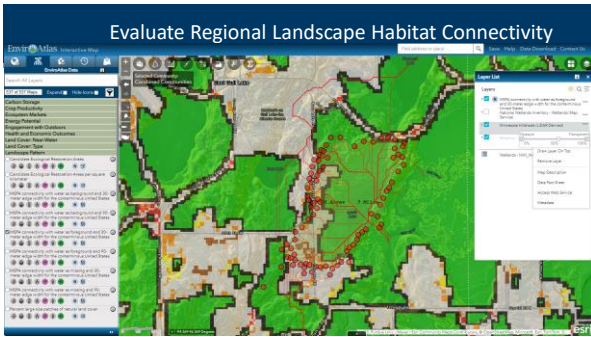
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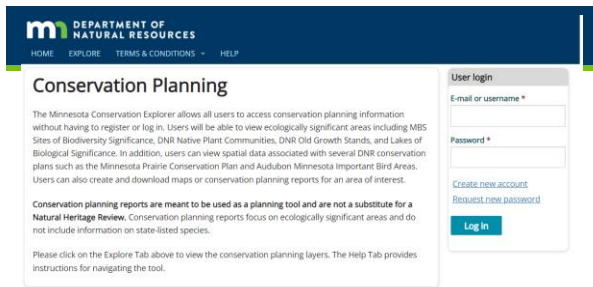
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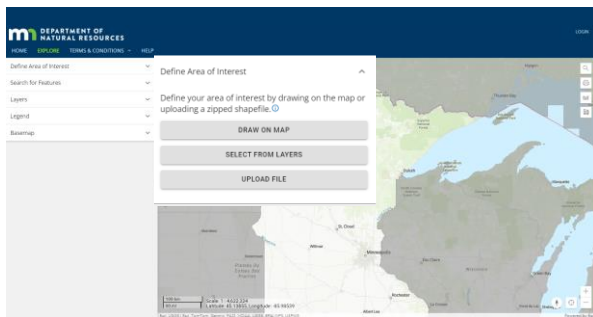
29

MN Conservation Explorer

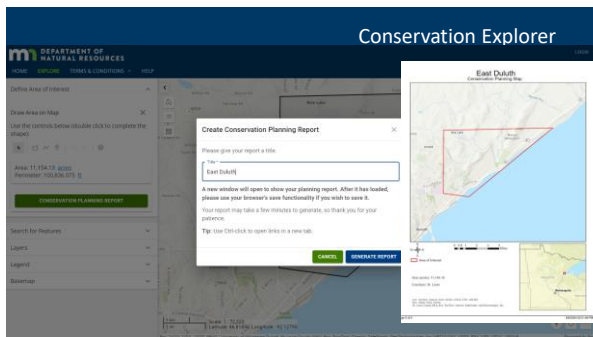
30



31



32



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Conservation Planning Report: East Duluth

This document is intended for planning purposes only for the area identified defined by the user. The report identifies ecologically important areas and resources that are important to the area. It is not intended to be used as a regulatory tool. Please refer to the Minnesota Department of Natural Resources website for more information.

MBL Sites of Biodiversity Significance

Minnesota Biological Survey (MBS) Sites of Biodiversity Significance are areas with varying levels of value biodiversity that may contain high levels of native plant and animal species, and other rare or unusual species. It is important to identify and protect these areas to maintain the state's natural resources. Please refer to the Minnesota Department of Natural Resources website for more information.

The following MBL Sites of Biodiversity Significance are within the search area:

Table with 4 columns: Site Name, MBL Site, MBL Category, and Status. Rows include sites like 'Duluth Marsh' and 'Duluth Park'.

DNR Native Plant Communities

A native plant community is a group of native plants that occur together and which are associated with a particular soil type and climate. They are found in a variety of habitats, including wetlands, forests, and prairies. Please refer to the Minnesota Department of Natural Resources website for more information.

The following DNR Native Plant Communities are within the search area:

Table with 4 columns: Site Name, DNR Native Plant Community, DNR Native Plant Community, and Status. Rows include sites like 'Duluth Marsh' and 'Duluth Park'.

Calcarius Fens are a type of wetland that are characterized by their shallow water and dense vegetation. They are found in a variety of habitats, including wetlands, forests, and prairies. Please refer to the Minnesota Department of Natural Resources website for more information.

DNR Old Growth Stands are areas with old-growth forests that have been preserved for their scientific and historical value. They are found in a variety of habitats, including wetlands, forests, and prairies. Please refer to the Minnesota Department of Natural Resources website for more information.

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MN Prairie Conservation Plan

The Minnesota Prairie Conservation Plan is a multi-year plan for identifying, protecting, and restoring prairie habitats in the state. It is a key component of the state's conservation strategy. Please refer to the Minnesota Department of Natural Resources website for more information.

Important Bird Areas are areas that are important for the conservation of birds. They are found in a variety of habitats, including wetlands, forests, and prairies. Please refer to the Minnesota Department of Natural Resources website for more information.

States of Biological Significance are areas that are important for the conservation of biological resources. They are found in a variety of habitats, including wetlands, forests, and prairies. Please refer to the Minnesota Department of Natural Resources website for more information.

The following States of Biological Significance are within the search area:

Table with 4 columns: State Name, State of Biological Significance, State of Biological Significance, and Status. Rows include sites like 'Duluth Marsh' and 'Duluth Park'.

USFWS Habitat Conservation Plans are a requirement for developers who have a proposed project in an area of critical habitat. They are found in a variety of habitats, including wetlands, forests, and prairies. Please refer to the Minnesota Department of Natural Resources website for more information.

SEARCH RESULTS: No USFWS Habitat Conservation Plans were found within the search area.

USFWS Regulatory Layers are areas that are important for the conservation of wildlife. They are found in a variety of habitats, including wetlands, forests, and prairies. Please refer to the Minnesota Department of Natural Resources website for more information.

The following USFWS Regulatory Layers are within the search area:

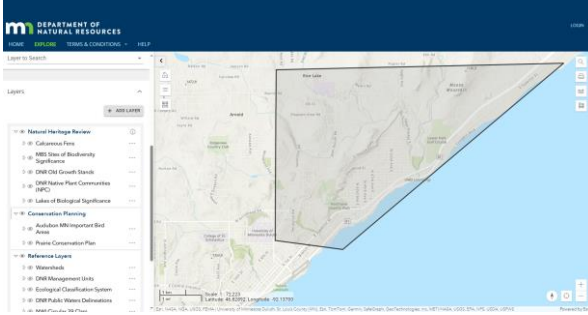
SEARCH RESULTS: No USFWS Regulatory Layers were found within the search area.

SEARCH RESULTS: No USFWS Regulatory Layers were found within the search area.

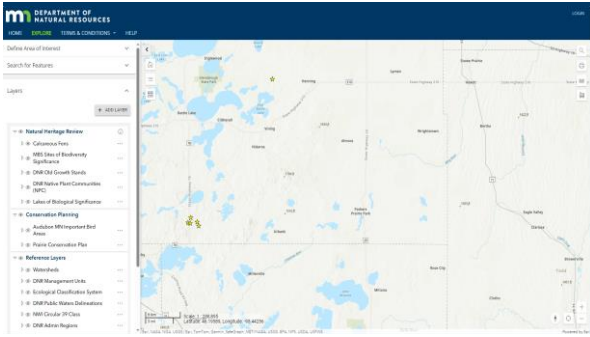
SEARCH RESULTS: No USFWS Regulatory Layers were found within the search area.

Page 1/1

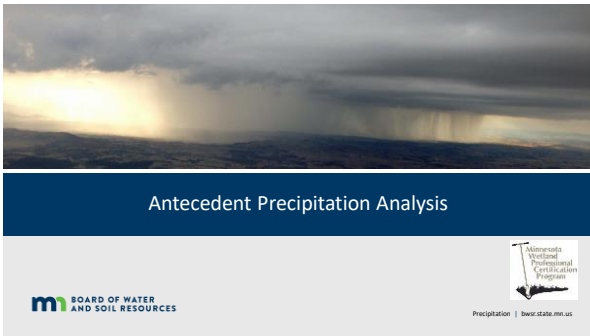
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37



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- [Hydrology and Antecedent Precipitation](#)

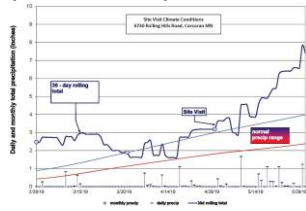


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Precip.

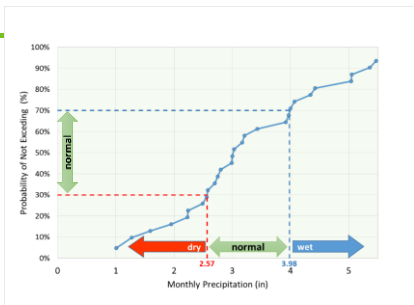
What do we mean by Antecedent Precipitation?

The prior or preceding precipitation events or conditions, leading up to the site visit or when aerial photography was taken.



40

What does NORMAL mean? What does WET or DRY mean?



41

When in the process is it needed?

Off-site/Level 1 wetland delineation

On-site/Level 2

- Recommend this be done prior to site visit if possible
- Puts better perspective on site data collection

Other Observations Types

- For interpreting Well or Stage Gauge Data
- Establish baseline conditions for a potential wetland bank/monitoring post construction
- Further defining a wetland boundary/questionable wetland area in difficult/are cases
- May not be needed in advance but will be when interpreting data set.



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How to do it...

- **Three-Prior Month Method**
 - Using State Climatology Tool
 - Manual Completion
- **Thirty Day Rolling Total**
 - Summing the prior 30-day precipitation totals for each day and plotting this “rolling total” on a daily basis
- **Hybrid Method**
 - Essentially combines above methods



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With the State Climatology Tool

Minnesota State Climatology Office
State Climatology Office — 304 Division of Ecological and Water Resources
University of Minnesota

Present Climate Conditions

Retrieve Past Climate Data

Latest Developments

- June Hydrology
- Warm Streak Ends
- May 17 Tornadoes
- May 16 Wisconsin Tornado
- Lake Ice Out
- Spring Phenology
- March 6 Tornadoes

Other Topics

- Kuykendall Lecture Series
- Climate Change
- Heat Island Study

Precipitation Worksheet Using Gridded Database

Precipitation data for target watershed location:
 State Climatology Office
 latitude/longitude: 45.9100 -93.0000
 longitude/latitude: 45.9100 -93.0000
 April precipitation in this unit state:
 Wednesday, April 03, 2013

Score using 1981-2010 normal period:

value over the center	1981-2010 normal	antecedent month	1981-2010 normal
minimum precipitation total for this location	1.00	2.16	2.00
mean 100 days before the target and reference day	1.00	1.00	1.00
mean in 100 days the number of days more than	0.0	1.00	0.0
total number of days more than	0	19	0
monthly score	1.143	2.244	1.143
total month score	1.143	1.143	1.143
total month score	1.143	1.143	1.143

<http://climate.umn.edu/>

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Hybrid Method

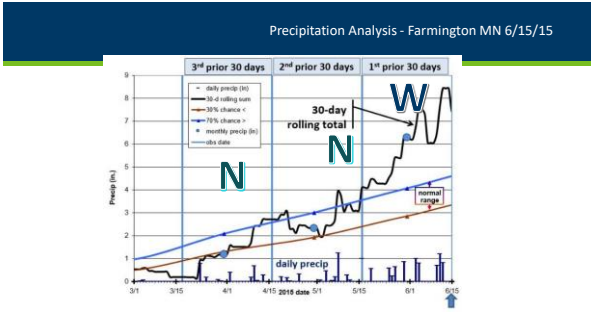
30-day rolling total
with
3-prior-month method

45

Precip.


"Hybrid" method - ERDC/EL TR - WRAP 00 - 01					
Date	15-Jun-2014		Project WDCP		
Location	Farmington, MN		State MN		
County	Dakota		Growing Season		
Soil Name	15-Jun-2015				
Photo/obs date:					
	Prior Period	Condition Dry, Wet, Normal	Condition Value	Period Weight Value	Product of Previous 2 Columns
1st prior 30 days	W		3	3	9
2nd prior 30 days	N		2	2	4
3rd prior 30 days	N		2	1	2
				Sum	15
Note: If sum is					
6 - 9	prior period has been drier than normal		Condition value:		
10 - 14	prior period has been normal		Dry = 1		
15 - 18	prior period has been wetter than normal		Normal = 2		
			Wet = 3		

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Corps Antecedent Precipitation Tool



The Antecedent Precipitation Tool (APT)

What is the APT?

What is the APT used for?

<https://www.epa.gov/wotus/antecedent-precipitation-tool-apt>

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Enter Lat-Long, Date and Calculate

Antecedent Precipitation Tool (APT)
 Version 1.0: Technical and User Guide
 By Robert Simpson and Adam E. Sims

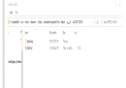
1. The purpose of this application is to provide the user with the ability to calculate the antecedent precipitation index (API) for a specific location and date. The API is a measure of the moisture content of the soil at a specific location and date. It is calculated based on the precipitation data for the location and the date of interest. The API is used to determine the likelihood of soil saturation and the potential for waterlogging.

Note: Decimal Degrees format = '46.79032'
 And include the '-' in Longitude

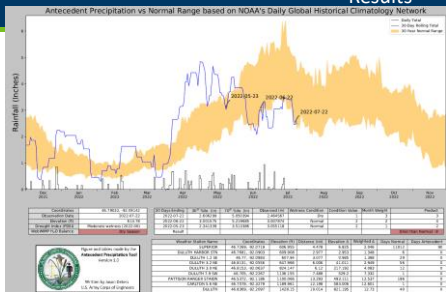
49

Results

- Tool opens pdf in a temporary folder on desktop



- Open pdf to view results:



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Aerial Photo Interpretation

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Overview



- '87 Manual Definitions:
- Normal Circumstances
 - Atypical area
 - Problem area



Midwest and NC/NE require aerial review per Chapter 5:

- "Agricultural lands"
- "Wetlands that periodically lack indicators of wetland hydrology"

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Guidance

March 4, 2015

Guidance for Submittal of Delineation Reports to the St. Paul District Army Corps of Engineers and Wetland Conservation Act Local Governmental Units in Minnesota, Version 2.0

3.7.6 Using Aerial Imagery to Assess Wetland Hydrology
 Procedures have been updated and improved for the assessment of wetland hydrology based on aerial imagery. The interagency approach to off-site wetland determinations on agricultural lands (also referred to as the state "Mapping Conventions") is required for CWA and WCA purposes. Refer to the guidance

Guidance for Offsite Hydrology

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Guidance



July 1, 2016

Guidance for Offsite Hydrology/Wetland Determinations

This document replaces all previous Minnesota Board of Water and Soil Resources (BWSR) and St Paul District Corps of Engineers (District) published guidance of guidance concerning wetland mapping conventions.

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Guidance

- Always use all* imagery in putting the pieces together, and place greatest reliance on more recent years; they tend to best reflect current conditions.

*Use only high quality/good resolution slides. Much better to focus on image quality than normalcy of antecedent conditions.

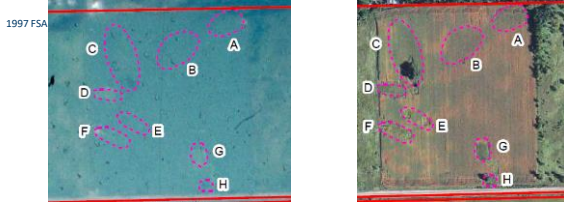


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Guidance

Moving away from FSA images 1979 – 2000

Using more recent and clearer images: 5 normal years



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Variables

Vegetation Tolerance

Hydrophytic Veg.



Corn



Soybeans



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Guidance

Vigor and stress responses to wetland conditions



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Evaluating Images

Signatures:

- CS: Crop stress
- DO: Drowned Out
- NC: Not cropped
- SW: Standing water
- NV: Normal vegetative cover
- NSS: No soil wetness
- AP: Altered pattern
- SS: Soil wetness signature
- CS/DO... (can have multiple, use the /)

Wetland Signatures are a positive "hit"

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Evaluating Images

Crop Stress (CS)



60

Evaluating Images

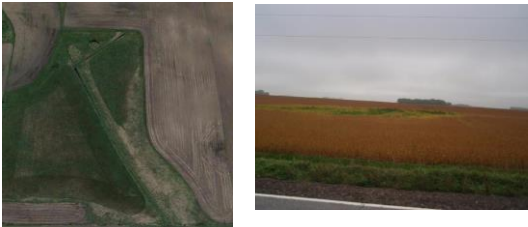
Drowned Out (DO)



61

Evaluating Images

NC – not cropped.



62

Evaluating Images

Standing Water (SW)



63

AP – altered pattern



64

Evaluating Images

WS – wetland signature.



65

Evaluating Images

Normal Vegetative Cover (NV) or No Soil Wetness (NSS)



66

Evaluating Images

Soil Wetness Signature-SS

- In Bare soil images, dark, or wet-appearing photo tone from early growing season
- May even include some standing water
- Note the drift lines around the edge of the basin



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What signature(s) do you see?

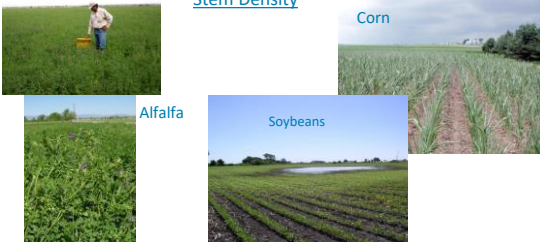


Crop Stress (CS)	
Drowned Out (DO)	
Not Cropped (NC)	
Standing Water (SW)	
Altered Pattern (AP)	
Wetland Signature (WS)	

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Variables

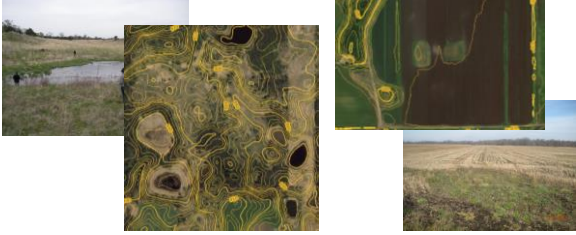
Stem Density



69

Variables

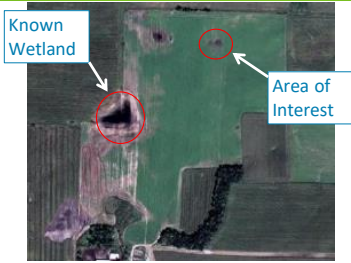
Topography



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Variables

Reference Areas



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Variables

Deep Peat Soils



72

Variables

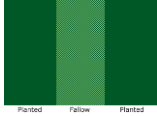
Iron Chlorosis



Winter Freeze

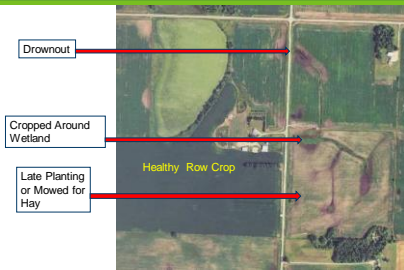


Business Decisions



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Wet Signatures



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Overview

HYDROLOGY		Secondary Indicators (minimum of two required)
Wetland Hydrology Indicators:		
<small>Prerequisites: Indicators (minimum of one is required; check all that apply)</small>		
<input type="checkbox"/> Surface Water (A1)	<input type="checkbox"/> Water-Stained Leaves (B9)	<input type="checkbox"/> Surface Soil Cracks (B8)
<input type="checkbox"/> High Water Table (A2)	<input type="checkbox"/> Aquatic Fauna (B13)	<input type="checkbox"/> Drainage Patterns (B10)
<input type="checkbox"/> Saturation (A3)	<input type="checkbox"/> Mire Deposits (B15)	<input type="checkbox"/> Moss Trim Lines (B19)
<input type="checkbox"/> Water Marks (B1)	<input type="checkbox"/> Hydrogen Sulfide Odor (C1)	<input type="checkbox"/> Dry-Season Water Table (C2)
<input type="checkbox"/> Sediment Deposits (B2)	<input type="checkbox"/> Oxidized Rhizospheres on Living Roots (C3)	<input type="checkbox"/> Clayfish Burrows (C8)
<input type="checkbox"/> DR Deposits (B3)	<input type="checkbox"/> Presence of Reduced Iron (D4)	<input type="checkbox"/> Saturation Visible on Aerial Imagery (C9)
<input type="checkbox"/> Algal Mat or Crust (B4)	<input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6)	<input type="checkbox"/> Mottled or Stippled Matrix (D1)
<input type="checkbox"/> Iron Deposits (B6)	<input type="checkbox"/> Thin Muck Surface (C7)	<input type="checkbox"/> Geomorphic Position (D2)
<input type="checkbox"/> Inundation Visible on Aerial Imagery (B7)	<input type="checkbox"/> Other (Explain in Remarks)	<input type="checkbox"/> Shallow Aquifer (D3)
<input type="checkbox"/> Secondary Vegetative/Concrete Surface (B5)		<input type="checkbox"/> Monographic Relief (D4)
<input type="checkbox"/> FAC-Neutral Test (D5)		
Field Observations:		
Surface Water Present? Yes <input type="checkbox"/> No <input type="checkbox"/> Depth (inches): _____		
Water Table Present? Yes <input type="checkbox"/> No <input type="checkbox"/> Depth (inches): _____		
Saturation Present? Yes <input type="checkbox"/> No <input type="checkbox"/> Depth (inches): _____	Wetland Hydrology Present? Yes <input type="checkbox"/> No <input type="checkbox"/>	
<small>Excludes capillary fringe</small>		
<small>Excludes flowlines (use stream gauge monitoring wetland photos; previous inspections, if available)</small>		
<small>June 2016 Google Image shows inundation during normal antecedent precip.</small>		
Remarks:		

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Other uses

Level 1 Delineations

Delineation Method	Review of offsite mapping resources	Site Visit	Sampling Approach	Complete Field Data Forms	Field Staking of Wetland Boundaries
Routine Level 1	Yes	Sometimes	Offsite	No	No
Routine Level 2	Yes	Yes	Onsite, qualitative	Yes	Yes
Comprehensive	Yes	Yes	Onsite, quantitative	Yes	Yes

WCA Application Type Examples	Commonly Used Delineation Method
Temporary impact under No-Loss	Routine Level 1
Banking application: pre-application scoping	Routine Level 1
Banking application: full application	Routine Level 2
Road Program Wetland Impact Documentation—Road project through a large continuous wetland	Routine Level 1
Road Program Wetland Impact Documentation—Scattered wetlands within construction corridor	Routine Level 2
Replacement plan	Routine Level 2
Enforcement actions	Routine Level 2 or Comprehensive
Wetland boundary approval (no project application)	Routine Level 2
Agricultural exemption determination (8420.0420, Subpart 2A)	Routine Level 1

76

Other uses



Level 1 Delineations

77

Incidental



78

Final Point

- Except for Level 1 delineations, the results of aerial imagery review are not necessarily the final determination.
- Other data to support conclusions.
- Results do not override site specific data (Level 2, etc).

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5/28/2024

WDGP Training | bwrs.state.mn.us

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Basic Soil Concepts

m BOARD OF WATER AND SOIL RESOURCES



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Overview

- Basics of Soil
 - Soil formation
 - Landscape position
- Soil Properties
 - Texture
 - Color
- Hydric soil development
- Web Soil Survey
 - Interpreting soil reports
- Hydric soil indicators
 - All
 - Fine
 - Sandy
- Common soil indicators



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What is Soil?

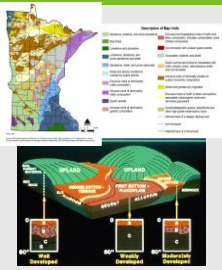
- Natural body that occurs on the land surface, occupies space, and is characterized by one or both of the following:
 - Horizons or layers, or
 - The ability to support rooted plants in a natural environment
 - Upper limit is air or shallow (>2.5 m) water
 - Lower limit is either bedrock or the limit of biological activity
 - Lower limit for classification set at an arbitrary 2 m



82

Factors That Influence Soil Development

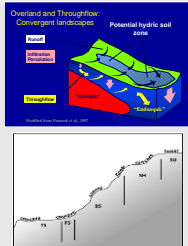
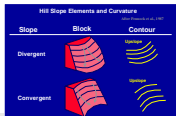
- Climate- weather conditions prevailing over long period of time
- Parent material- geologic material from which soils form
- Topography- landscape position and slope processes
- Organisms- essential role of microbes in the soil, includes humans
- Time- soil doesn't "age", it develops. vegetation, organisms and climate "act on" parent material and topography to develop soil.



83

Landscape Position

- Location relative to other landforms
- Critically influences water flow and soil formation
- Most wetlands, even groundwater seeps, are on some sort of concave surface



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Soil Taxonomy

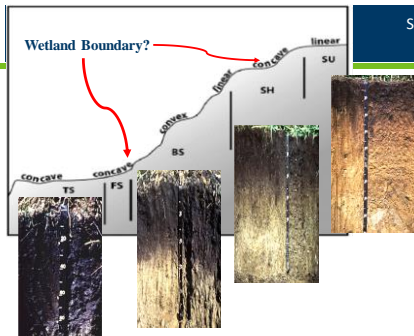
- 12 orders of soil taxonomy
- Which ones are common in MN



- **Alfisols:** wide range of climate, forest soils, clay in subsoil
- **Andisols:** volcanic, high nutrient
- **Aridisols:** desert soils
- **Entisols:** recent deposition, dunes, slopes, floodplains, sandy
- **Gelisols:** permafrost, high latitudes and/or elevation
- **Histosols:** high organic, most saturated year round
- **Inceptisols:** wide range of climate, moderate weathering
- **Mollisols:** "prairie soils", dark colored, high organic
- **Oxisols:** highly weathered tropical, stable, low fertility
- **Spodosols:** coarse-textured, acidic, conifer forests
- **Ultisols:** humid climate, weathered, clay-rich
- **Vertisols:** high content of expanding clays, Red River Valley

85

Soil Catena



86

Two Categories of Soil Material
- Mineral Soil/Horizons

- Mineral horizons**
 - Primarily sand, silt, and clay, with varying amounts of organic matter
- Organic horizon**
 - consists of mostly decomposed organic material



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Organic Matter Decomposition

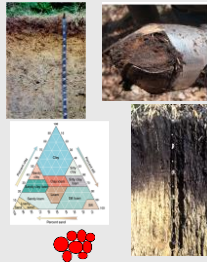
- **Fibric (peat)**
 - Least decomposed
 - Plant fibers identifiable
 - After rub -> >40% of fibers still visible (2/3)
- **Hemic (mucky peat)**
 - Intermediate decomposition
- **Sapric (muck)**
 - Most decomposed, <1/3 ID of plant fibers
 - <1/6 of fibers visible after rubbing



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Key Soil Properties

- Properties that are important to hydric soil development and recognition:
- **Horizons**- layer of soil with similar physical, chemical, and biologic properties
 - **Texture**- relative proportion of soil particles (sand, silt, clay)
 - **Structure**- arrangement of solid parts and of the pore spaces located between them
 - **Permeability**- ability of water to move through a material
 - **Color**- hue, value, chroma
 - **Organic matter**- percent, thickness, and level of organic decomposition
 - **Drainage**- presence of natural and human drainage on a landscape



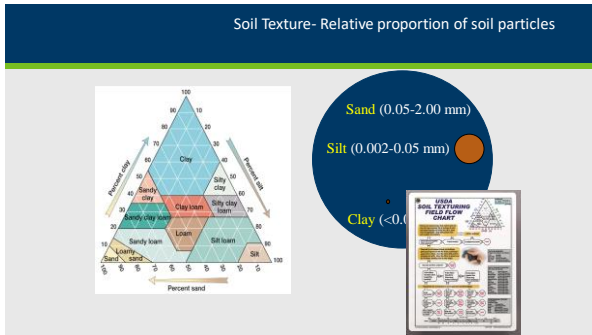
89

Soil Horizon- layer of soil with similar physical, chemical, and biologic properties



- **O horizon**- Organic horizon, thickness varies
- **A Horizon**- Organic accumulation (typically ~10%), ideally granular structure
- **E Horizon**- Coloring agents (Fe, Organics) removed
- **B Horizon**- Subsoil accumulation of minerals, organics, and sometimes chemicals, blocky structure
- **C Horizon**- Similar to parent material, often less developed with little structure
- **R Horizon**- Parent material

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91

Soil Structure

- Soil Structure- arrangement of solid parts and of the pore spaces located between them
- Aggregation- interaction and arrangement of soil particles
- Precipitation of oxides, carbonates and silicates
 - Cementation
- Can decline under cultivation & irrigation

Examples of Soil Structure Types		
Granular (oil aggregates)	Blocky (Subangular)	Blocky (Angular)
Lenticular	Platy	
Wedge	Prismatic	Columnar
Structureless Types		
Single Grain (Loose mineral/rock grains)	Massive (Continuous, unconsolidated mass)	

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Permeability- ability of water or air to move through the soil profile

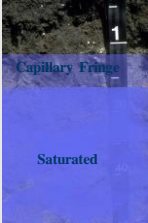
- Variables in permeability:
 - Structure- arrangement of soil characterized by size, shape (blocky, columnar, platy, etc.) and grade (weak, strong)
 - Texture- pore space of different particle sizes
- Permeability is "measured" in inches per hour
 - Permeability is actually an estimated property
 - Larger grain sizes= higher permeability

The diagram shows a cluster of brown circular particles of varying sizes. The spaces between these particles represent pore spaces, which are larger for larger grain sizes.

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Capillary Fringe


- Based upon permeability
- The zone above the free water table that is effectively saturated
 - Water held at tension
 - Theoretical values much higher than "real life"
 - Difficult to measure



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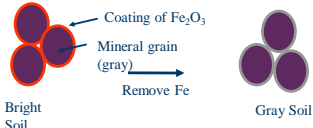
Coloring Agents in Soil

- Organic matter
 - OM will mask all other coloring agents.
- Iron (Fe)
 - brown colors are the result of Fe oxide stains coating individual particles
- Manganese (Mn)
 - resulting in a very dark black or purplish black color
- Calcium
- Lack of coatings
 - Color of the mineral soil grains (stripped)



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Soil Color




“Bright-colored” soil is bright because the gray-colored mineral grains are coated with a thin layer of “paint” formed by Fe oxides. Stripping the paint off the particles leaves the mineral grains exposed.

96

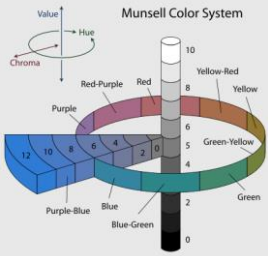
Color

- Hue- the spectrum color
- Value- lightness or darkness
- Chroma- "purity" or grayness of color



Hue Value Chroma


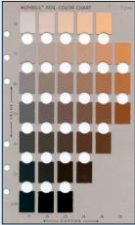
10YR 2/1



97

Color

- Matrix (predominant) color
- Color of redoximorphic features
 - Contrast, abundance, location, and size of redox features





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Reading Soil Color

- Optimum conditions
 - Natural light
 - Clear, sunny day
 - Midday
 - Light at right angles
 - Soil moist





Increasing strength of color →

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Abundance and Size of Redox

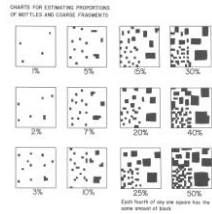
Abundance

- Few -- less than 2%
- Common -- 2 to 20%
- Many -- more than 20%

Size

- Fine -- < 5 mm
- Medium -- 5 to 15 mm
- Coarse -- > 15 mm

Several indicators require at least 2% abundance



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Contrast

- Contrast refers to the degree of visual distinction between associated colors
- Faint -- evident only on close examination
- Distinct -- readily seen at arms length
- Prominent -- contrast strongly

Contrast Class	Hue (h) (S)	Value (v) (L)	Chroma (C) (C)
Faint +	$\Delta h = 0$	$\Delta v \leq 2$	and $\Delta c \leq 1$
	$\Delta h = 1$	$\Delta v \leq 1$	and $\Delta c \leq 1$
	$\Delta h = 2$	$\Delta v = 0$	and $\Delta c = 0$
Distinct +	$\Delta h = 0$	$\Delta v \leq 2$	and $\Delta c > 1$ to ≤ 4
		or $\Delta v = 2$ to ≤ 4	and $\Delta c \leq 4$
	$\Delta h = 1$	$\Delta v \leq 1$	and $\Delta c > 1$ to ≤ 3
	or $\Delta v = 1$ to ≤ 3	and $\Delta c \leq 3$	
	$\Delta h = 2$	$\Delta v = 0$	and $\Delta c > 0$ to ≤ 2
	or $\Delta v = 0$ to ≤ 2	and $\Delta c \leq 2$	
Prominent +	$\Delta h = 0$	$\Delta v \geq 4$	or $\Delta c \geq 6$
	$\Delta h = 1$	$\Delta v \geq 3$	or $\Delta c \geq 3$
	$\Delta h = 2$	$\Delta v \geq 2$	or $\Delta c \geq 2$
	$\Delta h \geq 3$		

* If compared colors have both a value (S) and a chroma (C), the contrast is Faint, regardless of hue differences.

Several indicators require distinct or prominent contrast!

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Definition of a Hydric Soil

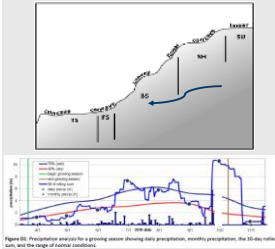
• A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.



102

Landscape and formation of hydric soils

- Landscape position
 - Surface shape (linear, concave, convex)
 - Erosional or depositional
- Hydraulics
 - How water moves
- Hydroperiod- seasonal pattern of water table depth in a wetland
 - Long term- organic
 - Seasonal inundation- thick O, dark A
 - Seasonal saturation- thin O
 - Floodplain- thin, stratified layers



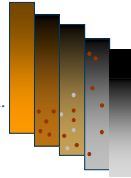
103

Hydric Soil Development

Hydric soils indicators develop in **anaerobic** conditions by the process of :

1. **Reduction** and Re-oxidation of Iron
2. **Organic Matter** Accumulation

Foundation of the Field Indicator Manual.



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Conceptual overview of aquic conditions

- Here's what happens when water moves into a soil profile:
 - Downward movement
 - Lateral movement
 - Lose some things
 - Changes in chemical state in others
- Old car example

BRIS Wetland Section | www.bris.state.nv.us/wetlands

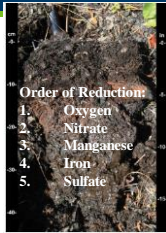
105

Hydric Soil Development

Soil microbes that drive reduction require:

1. Anaerobic conditions i.e. (saturated soil)
2. Organic matter (energy source)
3. Soil temperature warm enough for microbial respiration (>41F)
4. Duration of conditions (Time)

In anaerobic conditions decomposition slows and leads to organic accumulation

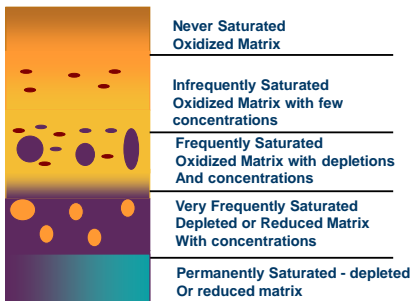


106

Change in the state of iron

- Find slide from old slides
- Iron is still there, just changed state

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108

Depleted Matrix

Iron removed or re-organized in profile leaving Grey matrix

- Value 4 or More
- Chroma 2 or Less

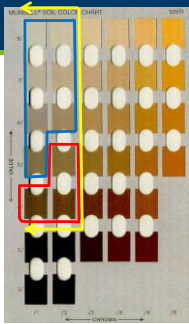


109

Depleted Matrix Requirement

Do Not Need Concentrations

Need Concentrations (2%)



Depleted Matrix Requirement

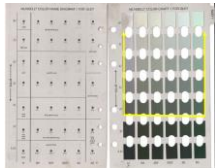
High Value (4 or more)
Low Chroma (2 or Less)

110

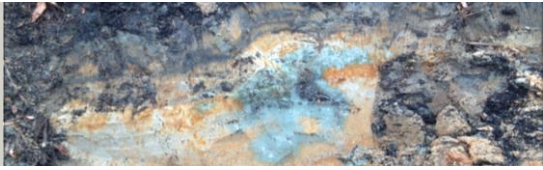
Gleyed Matrix Requirements

Gleyed Matrix

- Iron Present, but in reduced state (Fe²⁺) Gleyed color with value >= 4



111



Hydric Soil Indicators



112

Field Indicators of Hydric Soils

Natural Resources Conservation Service

- National Technical Committee for Hydric Soils

Used for **on-site verification** of hydric soils

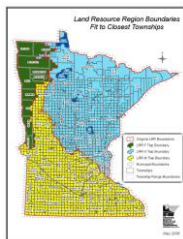
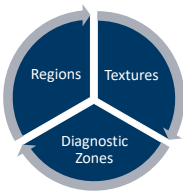


Field Indicators of Hydric Soils in the United States



113

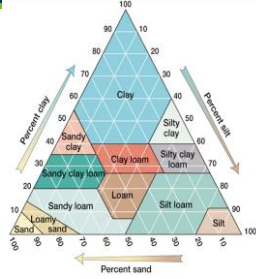
Field Indicator Organization



114

All Soils

- Use regardless of texture(s)
 - All Mineral
 - All Organic
- Typically organic matter influences near the surface
- Includes smell
- Rotten egg

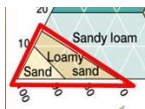


115

Soil Indicator Groups

Sandy Soil Indicators (S):

- Use when texture is:
 - Loamy Fine Sand or coarser



Fine Grained Soil Indicators (F):

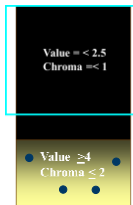
- Use when texture is:
 - Loamy Very Fine Sand or finer



116

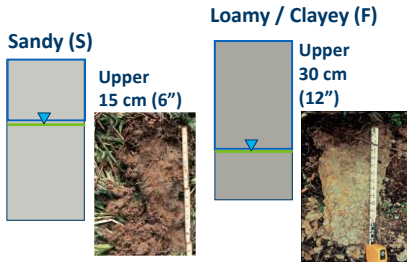
Diagnostic Zones

- Layers with :
 - Certain **Colors**
 - high value and low chroma
 - redoximorphic features
 - organic matter accumulations
 - Specific **Depths** from Surface
 - **Thickness** requirements



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Diagnostic Zones for S and F indicator groups



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Couple of key terms to help interpret indicators:



Credits: USDA & NRCS for following pictures

- Aquic- moisture regime, reducing regime virtually free of dissolved oxygen
- Histic- saturated organic horizon
- Epipedon-horizon near the surface
- Depletions- areas of low chroma where oxides have been stripped away
- Concentrations-zones where oxides have accumulated

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Format of Indicator Descriptions

- Alpha-numeric designation
 - A1
- Short name
- Histosol
- Applicable land resource regions (LRR)
 - Use in all LRRs
- Description of the indicator
- User notes
 - Additional information, explanation and guidance
- Supplement adds regional likelihood, locations

A1—Histosol (to use as A1, 2B1) or Hemic (to use as C1B) with permafrost. Classifies as a Histosol (Group 1) only if a Hemic (Group 1) is present. In a Histosol, typically 40 cm (16 inches) or more of the upper 80 cm (32 inches) is organic soil meeting Eq. 7. Organic soil materials have organic matter contents (by weight) of 12 to 18 percent of mass, depending on the clay content of the soil. These materials include much (upper soil horizons), highly (and Hemic not necessary), and some (Hemic not necessary) that meet the histosol (and Group 1) criteria. Use when an LRR is applicable. (Soil Science Society, 2014) Use as a descriptive definition.



Figure 1. Histosol A1 (Soil) or Hemic (Soil). This indicator is used when the criteria of applicable indicator is met in the soil profile.

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A1- Histosol

- A1. Histosol:** Classifies as a Histosol. A Histosol has a layer of organic matter accumulation of ≥ 16 inches in the upper 32 inches of soil material.
- Use in all LRRs

A1—Histosol. For use in all LRRs in the United States and in the United States Virgin Islands. This soil is a Histosol (Oxisol) that has a surface horizon (A1) that is 16 inches or more thick (32 inches or more) and is composed of peat or muck (A1). The soil is a Histosol because the surface horizon contains 65 percent or more of organic matter by weight (A1) and is underlain by mineral soil material (A2). The soil is a Histosol because the surface horizon contains 65 percent or more of organic matter by weight (A1) and is underlain by mineral soil material (A2). See also the National Engineering Survey Staff, 2014 for a complete definition.

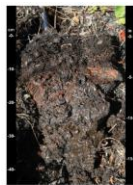


Figure 1—Indicator A1 (Histosol Epipedon) and A1 (Dark Histic). The soil meets the depth criterion of A1 and the color and depth criterion of A1. The black color is a requirement of A1, results from the accumulation of organic matter when the soil is saturated and anaerobic.



121

A2- Histic Epipedon

Histic epipedon- saturated, organic horizons 8 inches or more thick in the upper part

- Applicable land resource regions (LRR)
- Use in all LRRs

A2—Histic Epipedon. For use in all LRRs. A histic epipedon underlain by mineral soil material with chroma of 2 or less.

Soil Notes: Most Histic epipedons are surface horizons 30 cm (12 inches) or more thick of organic soil material (A). An Aquic condition or artificial drainage is required. See also the National Engineering Survey Staff, 2014 for a complete definition.

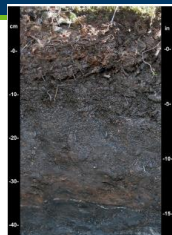


Figure 2—Indicator A2 (Histic Epipedon) and A1 (Dark Histic). The soil meets the depth criterion of A2 and the color and depth criterion of A1. The black color is a requirement of A1, results from the accumulation of organic matter when the soil is saturated and anaerobic.



122

A3- Black Histic

- A layer of peat, mucky peat, or muck 8 in or more thick that starts at a depth of ≤ 6 in from the soil surface; has hue of 10YR or yellower, value of 3 or less, and chroma of 1 or less; and is underlain by mineral soil material with chroma of 2 or less.

- Applicable land resource regions (LRR)
- Use in all LRRs

A3—Black Histic. For use in all LRRs. A layer of peat, mucky peat, or muck (A3) that is 8 inches or more thick (A3) and starts at a depth of ≤ 6 inches from the soil surface. The soil is a Histic because the surface horizon contains 65 percent or more of organic matter by weight (A3) and is underlain by mineral soil material with chroma of 2 or less.

Soil Notes: Unlike indicator A2, this indicator does not require proof of aquic conditions or artificial drainage (A3). See also the National Engineering Survey Staff, 2014 for a complete definition.

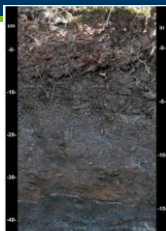
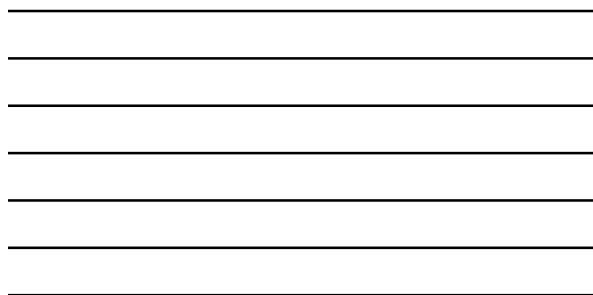


Figure 3—Indicator A3 (Histic Epipedon) and A1 (Dark Histic). The soil meets the depth criterion of A3 and the color and depth criterion of A1. The black color is a requirement of A1, results from the accumulation of organic matter when the soil is saturated and anaerobic.



123

A11- Depleted Below Dark Surface

- Applicable land resource regions (LRR)
- Use in all MN LRRs

A11—Depleted Below Dark Surface. For use in all LRRs, except for W, X, and Y, for testing in LRRs W, X, and Y. A layer with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less, starting at a depth ≥ 25 cm (10 inches) from the soil surface, and having a minimum thickness of either:

- a. 15 cm (6 inches), or
- b. 5 cm (2 inches) if the 5 cm consists of regenerative soil included.

Organic, bony, or clayey horizons above the depleted or gleyed matrix must have a value of 3 or less and chroma of 2 or less starting at a depth ≤ 15 cm (6 inches) from the soil surface and extend to the depleted or gleyed matrix. Any such material above the depleted or gleyed matrix must have a value of 2 or less and chroma of 1 or less starting at a depth ≤ 15 cm (6 inches) from the soil surface and extend to the depleted or gleyed matrix. Viewed through a 10x or 15x hand lens, at least 70 percent of the visible sand particles must be masked with organic material. Observed without a hand lens, the sand particles appear to be close to 100 percent masked.

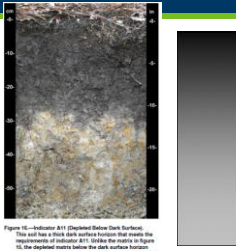
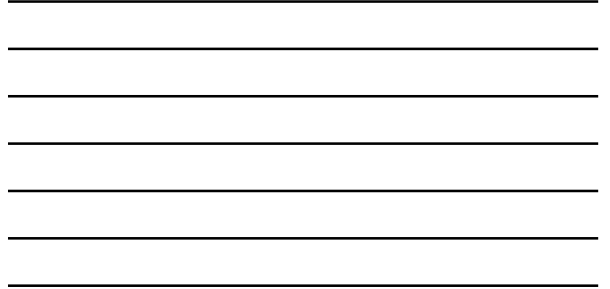


Figure 16.—Indicator A11 (Depleted Below Dark Surface). This soil has a thick dark surface horizon that meets the requirements of indicator A11. Unlike the matrix in figure 16, the depleted matrix below the dark surface horizon in this soil starts at a depth of about 33 cm, which is too deep to meet the requirements of indicator 70 (Depleted Matrix). Indicator A11 allows a deeper depleted matrix than indicator 70.

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A12- Thick Dark Surface

- Applicable land resource regions (LRR)
- Use in all LRRs
- User notes
 - Most often associated with overthickened soils in concave landscape positions.

A12—Thick Dark Surface. For use in all LRRs. A layer at least 15 cm (6 inches) thick with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less starting below 30 cm (12 inches) of the surface. The horizon above the depleted or gleyed matrix must have a value of 2 or less and chroma of 1 or less to a depth of at least 30 cm (12 inches) and a value of 3 or less and chroma of 1 or less in any remaining layers above the depleted or gleyed matrix. In any sandy material above the depleted or gleyed matrix, at least 70 percent of the visible sand particles must be masked with organic material. Viewed through a 10x or 15x hand lens, the particles appear to be close to 100 percent masked.

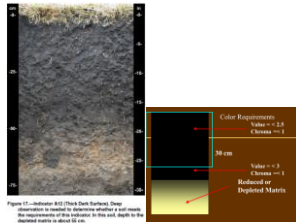
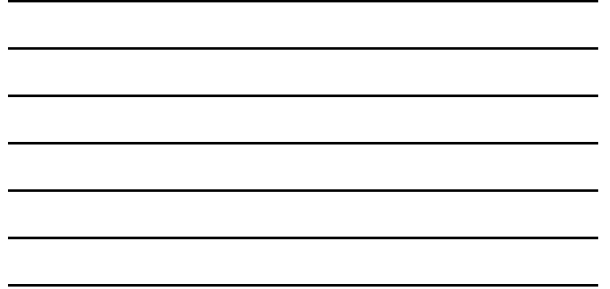


Figure 17.—Indicator A12 (Thick Dark Surface). Deep observation made in the presence of water and some desiccation of the soil. In this soil, depth to the depleted matrix is about 30 cm.

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F3- Depleted Matrix

- Applicable land resource regions (LRR)
- Use in all LRRs

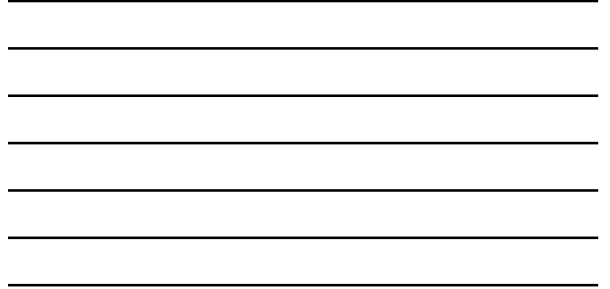
F3.—Depleted Matrix. For use in all LRRs, except W, X, and Y, for testing in LRRs W, X, and Y. A layer that has a depleted matrix with 60 percent or more chroma of 2 or less and that has a minimum thickness of either:

- a. 5 cm (2 inches) if the 5 cm starts at a depth ≤ 10 cm (4 inches) from the soil surface, or
- b. 15 cm (6 inches), starting at a depth ≤ 25 cm (10 inches) from the soil surface.



Figure 18.—Indicator F3 (Depleted Matrix). This soil has a thin layer of soil with a value of 4 or more and chroma of 2 or less and a minimum thickness of 5 cm. Below the depleted matrix there is a 10 cm (4 inch) layer of soil with a value of 3 or less and chroma of 1 or less. The minimum thickness required is only 5 cm.

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Data Sheet

6-200 Sampling Point

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Strata	Hydr. Indicator	Color (Munsell)	%	Color (Munsell)	%	Texture	Remarks

Type: C=Concentration, L=Location, M=Muscular Matrix, CC=Covered or Cracked Sand Grains, T=Texture, H=Hydrophobicity, K=Kinkiness

Hydric Soil Indicators:

<input type="checkbox"/> Munsell A1 <input type="checkbox"/> Munsell A2 <input type="checkbox"/> Munsell A3 <input type="checkbox"/> Strongly Depleted (A2) <input type="checkbox"/> Depleted Matrix (A3) <input type="checkbox"/> Dark Mucky (A2) <input type="checkbox"/> Thin Dark Surface (A1) <input type="checkbox"/> Dark Mucky (A2) <input type="checkbox"/> Thin Mucky Peel or Peel (A3)	<input type="checkbox"/> Sandy Slightly Mucky (S4) <input type="checkbox"/> Sandy Mucky (S5) <input type="checkbox"/> Clayey Mucky (S6) <input type="checkbox"/> Loamy Mucky (S7) <input type="checkbox"/> Very Dark Surface (F5) <input type="checkbox"/> Depleted Dark Surface (F7) <input type="checkbox"/> Thin Dark Surface (F6)	<input type="checkbox"/> Indicators for Problematic Hydric Soils: <input type="checkbox"/> Control Feature (A1-A3) <input type="checkbox"/> Non-Anagomphic Muckiness (F12) <input type="checkbox"/> Other (Specify in Remarks)
--	--	---

Remarks: _____

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Problematic Hydric Soils

- Covered in Chapter 5 of the regional supplements
- Problematic hydric soils are the norm in some landscapes
 - **Red Parent Material** (*inhibited, or difficult to see redox features*)
 - **Active floodplains** (*deposition of new material*)
 - **Drained systems** (*relict hydric indicators*)
 - **High Value** (*bright*) / **Low Chroma** (*grey*),
 - **Thick prairie** soils



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Review

- **Soil formation**
 - Parent material, landscape position, horizons
- **Soil Properties**
 - Texture
 - Sand, silt, clay
 - Color
 - Hue, value, chroma
- **Hydric soil development**
 - Anaerobic conditions, reduction, organic accumulation
- **Web Soil Survey**
 - Interpreting soil reports

- **Hydric soil indicators**
 - All, Fine, Sandy
 - Common soil indicators
 - Organic Indicators (A1, A2, A3)
 - Depleted Matrix (F3, F7)
 - Redoximorphic features (F6, S3)

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Web Soil Survey

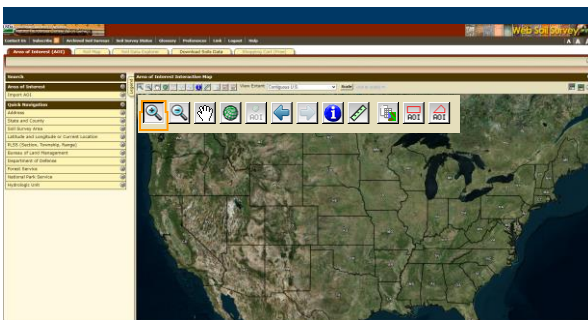


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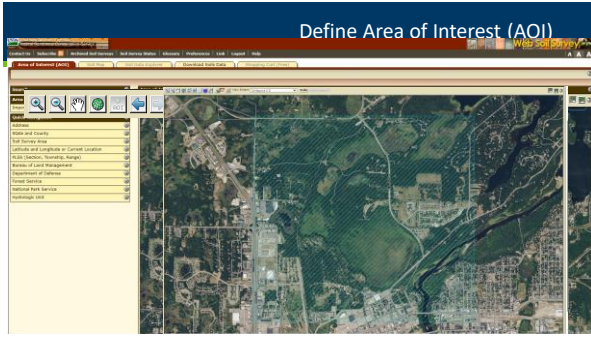
Soil Survey Overview



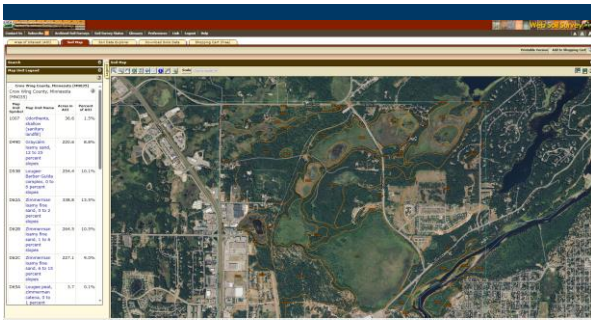
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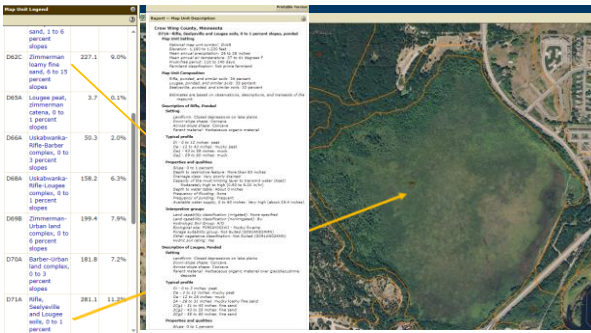
135



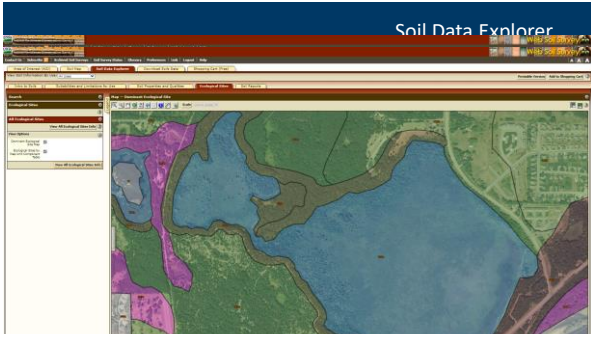
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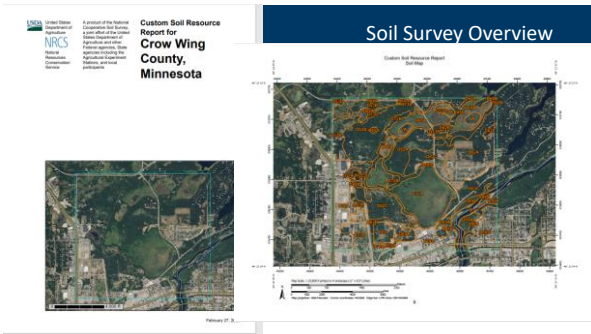
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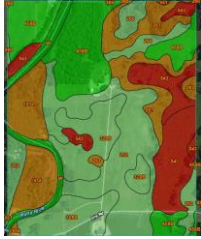


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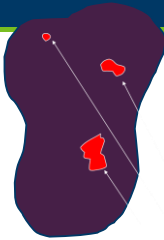
Hydric Soil Rating Map



- 100% Hydric ■
- 66-99% Hydric ■
- 33-66% Hydric ■
- 1-32% Hydric ■
- Non-Hydric ■

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Predominately Hydric

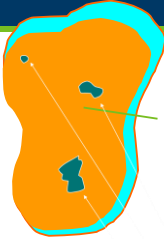


- 66-99% Hydric
- Small areas of non-hydric components on higher or convex landscape positions
- FACW

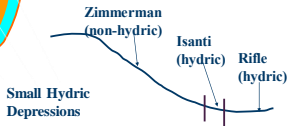
Non-Hydric Inclusions

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Partially Hydric Soils



- 33-66% Hydric
- Hydric Soils as inclusions along map unit boundary or Small Depressions
- FAC



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Attributes from Soil Survey to help understand Functions

- Geomorphic description
 - Landform
 - Slope shape
 - Parent material
- Typical profile
 - Textures
 - Depths
- Properties and qualities
 - Slope
 - Restrictive layer
 - Drainage class
 - Depth to water table
 - Frequency of flooding/ponding

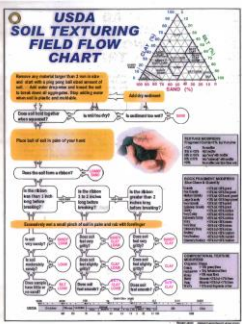
Description of Normanna

Setting
Landform: Moraines
Landform position (two-dimensional): Summit, backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy material over dense loamy till

Typical profile
A- 0 to 4 inches: loam
Bw- 4 to 43 inches: gravelly sandy loam
2Bw,BC,2BC- 45 to 48 inches: gravelly sandy loam
2BCL- 48 to 80 inches: gravelly sandy loam

Properties and qualities
Slope: 3 to 8 percent
Depth to restrictive feature: 30 to 60 inches to dense material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 33 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

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