MN Wetland Professional Certification Program
Basic Class- Day 2

BOARD OF WATER AND SOIL RESOURCES

Minnesota Wetland Professional Certification Program

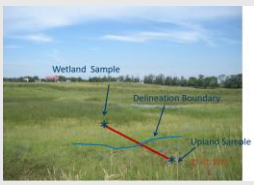
1

2

Quiz

1) Sampling transects should be?

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



Minnesota Wetland Professional Certification Program

3

2) 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

3) 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 & Regional Supplements

4

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 2 delineation is required

5

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.

6) 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

7) Which of the following can be used for determining the start of the growing season?

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

7

8) What classification system uses Systems, Sub-systems and Classes?

a) HGM
b) Eggers and Reed
c) Cowardin
d) Circular 39

9) Which of the following plant communities would be characteristic of a Circular 39 type 6 wetland?

a) Sedge meadow
b) Bog
c) Alder thicket
d) Shallow marsh

8

10) Which of the follow is not a parameter of the Hydrogeomorphic Method classification system?:

a) geomorphology
b) plant community
c) hydrology
d) hydraulics

11) A natural process in a wetland that can be scientifically assessed can also be described as a:

a) wetland value
b) routine assessment method
c) exemption
d) wetland function

9

Resources for TEP members

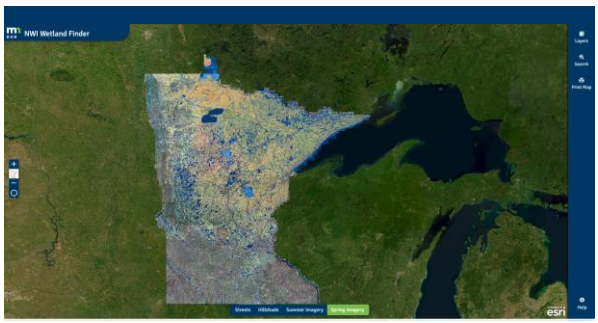
- Offsite Resources

10

Important Resources for TEP members

- National Wetland Inventory
- Web Soil Survey
- County GIS/Land Explorer
- Enviro Atlas
- MN Conservation Explorer

11



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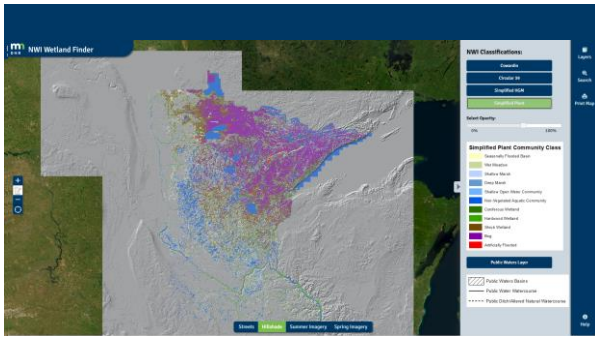
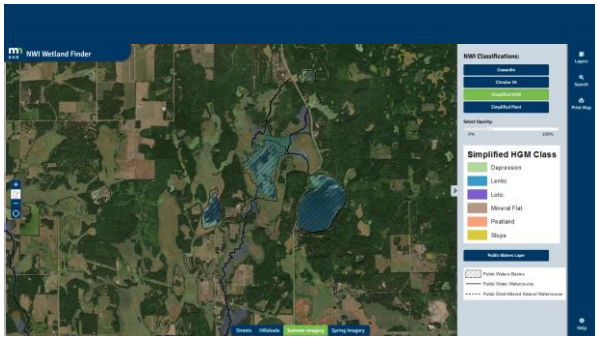
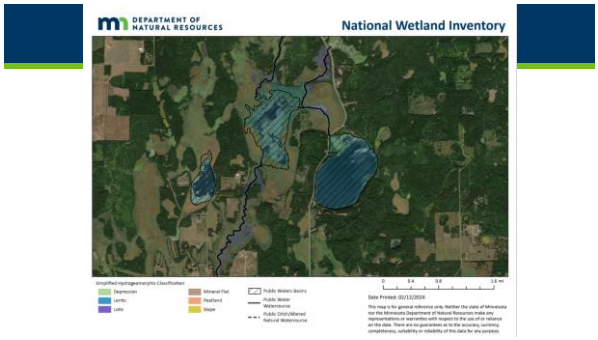

NWI Wetland Finder
NWI Classifications:
Simplified Plant Community Class
Public Waters Layer
Streets
Hillshade
Summer Imagery
Spring Imagery

13


NWI Wetland Finder
NWI Classifications:
Simplified HGM Class
Depression
Lentic
Lotic
Mineral Flat
Peatland
Slope
Public Waters Layer
Streets
Hillshade
Summer Imagery
Spring Imagery

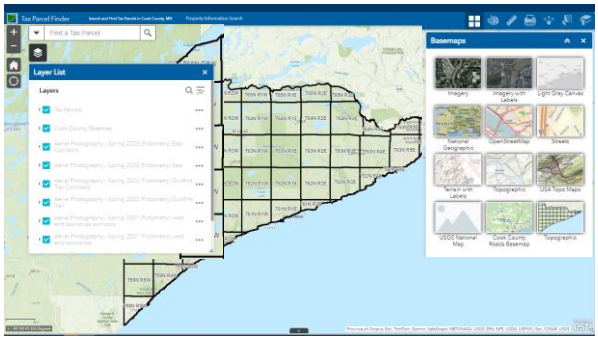
14


DEPARTMENT OF NATURAL RESOURCES
National Wetland Inventory

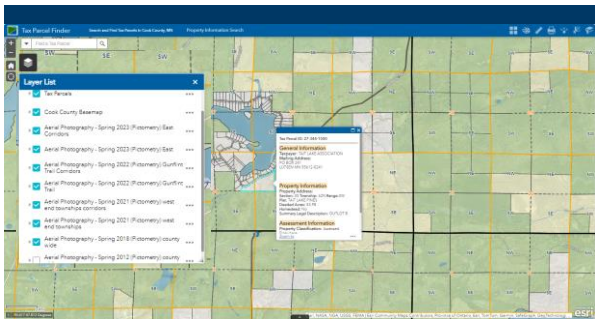
15

Soil Survey Overview

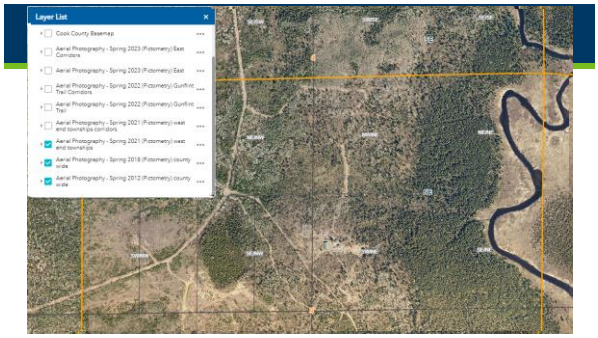
16



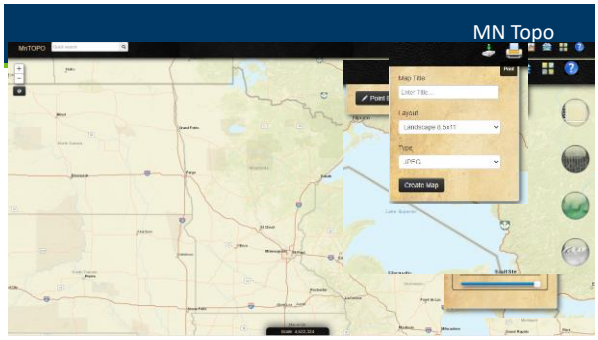
17



18


Layer List
Cook County Basemap
Aerial Photography - Spring 2023 (Pictometry) East Corridors
Aerial Photography - Spring 2023 (Pictometry) East
Aerial Photography - Spring 2022 (Pictometry) Gunflint Trail Corridors
Aerial Photography - Spring 2022 (Pictometry) Gunflint Trail
Aerial Photography - Spring 2021 (Pictometry) west and townships corridors
Aerial Photography - Spring 2021 (Pictometry) west and townships
Aerial Photography - Spring 2018 (Pictometry) county wide
Aerial Photography - Spring 2012 (Pictometry) county wide

19


MN Topo
MnTOPO
Map Title
Enter Title...
Layout
Landscape (8.5x11")
Type
JPEG
Create Map

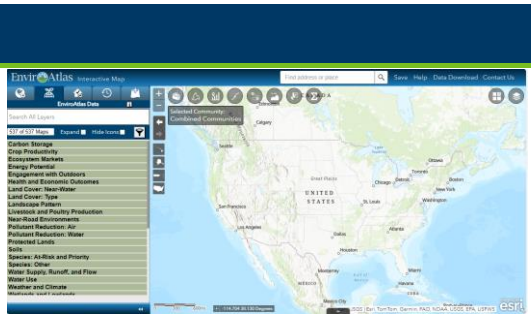
20


MnTOPO
Point Elevation
Line
Freehand Line
Elevation Profile

21

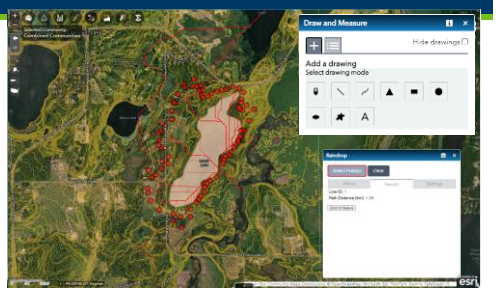
EnviroAtlas

22

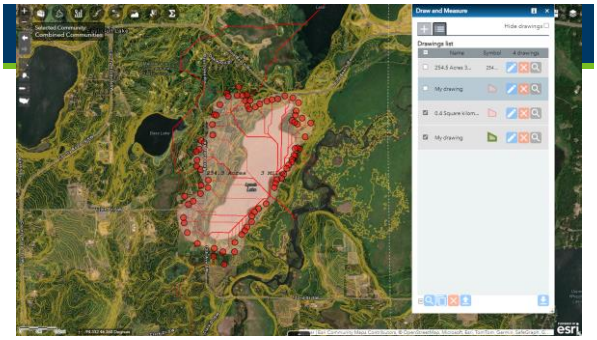


23

Defining Catchment Area



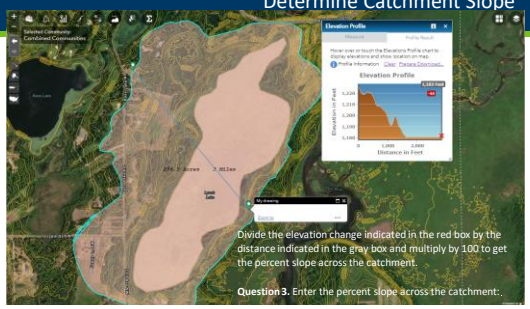
24



25

26

Determine Catchment Slope

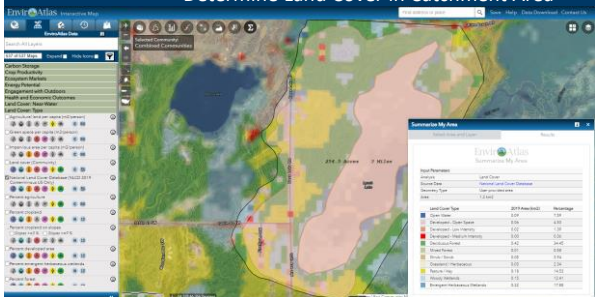


Divide the elevation change indicated in the red box by the distance indicated in the gray box and multiply by 100 to get the percent slope across the catchment.

Question 3. Enter the percent slope across the catchment:.

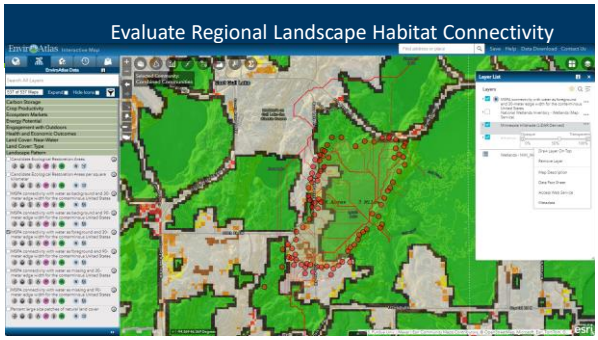
27

Determine Land Cover in Catchment Area



28

Evaluate Regional Landscape Habitat Connectivity



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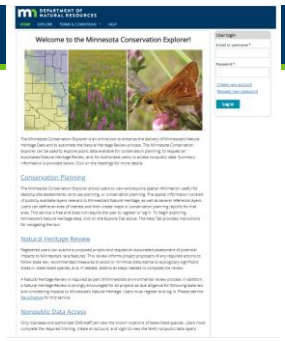
MN Conservation Explorer



30


DEPARTMENT OF NATURAL RESOURCES
HOME
EXPLORE
TERMS & CONDITIONS
HELP
Conservation Planning
The Minnesota Conservation Explorer allows all users to access conservation planning information without having to register or log in. Users will be able to view ecologically significant areas including MBS Sites of Biodiversity Significance, DNR Native Plant Communities, DNR Old Growth Stands, and Lakes of Biological Significance. In addition, users can view spatial data associated with several DNR conservation plans such as the Minnesota Prairie Conservation Plan and Audubon Minnesota Important Bird Areas. Users can also create and download maps or conservation planning reports for an area of interest.
Conservation planning reports are meant to be used as a planning tool and are not a substitute for a Natural Heritage Review. Conservation planning reports focus on ecologically significant areas and do not include information on state-listed species.
Please click on the Explore Tab above to view the conservation planning layers. The Help Tab provides instructions for navigating the tool.
User login
E-mail or username *
Password *
Create new account
Request new password
Log in

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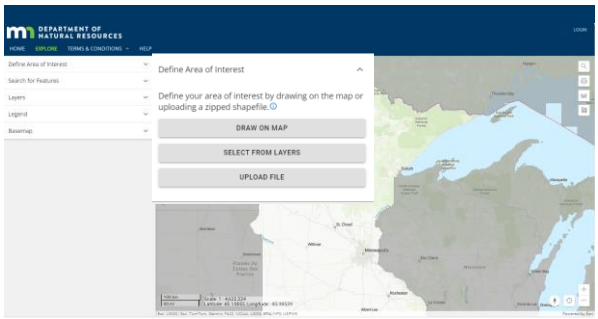
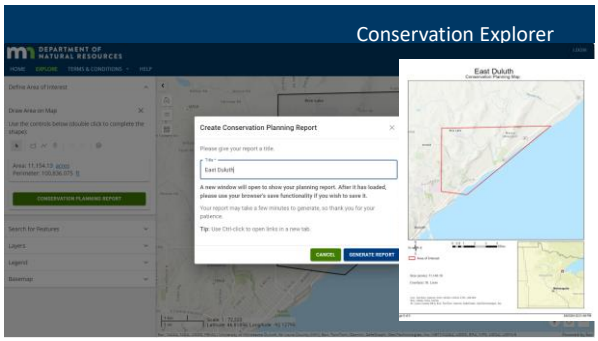
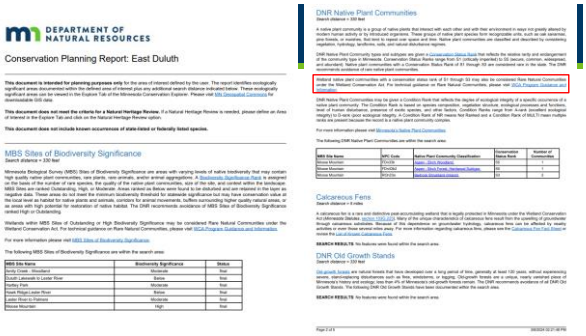

DEPARTMENT OF NATURAL RESOURCES
HOME
EXPLORE
TERMS & CONDITIONS
HELP
Define Area of Interest
Search for Features
Layers
Legend
Basemap
Define Area of Interest
Define your area of interest by drawing on the map or uploading a zipped shapefile.
DRAW ON MAP
SELECT FROM LAYERS
UPLOAD FILE

32


Conservation Explorer
DEPARTMENT OF NATURAL RESOURCES
Create Conservation Planning Report
Please give your report a title.
East Duluth
A new window will open to show your planning report. After it has loaded, please use your browser's save functionality if you wish to save it.
Your report may take a few minutes to generate, so thank you for your patience.
Tip: Use Ctrl-click to open links in a new tab.
CANCEL
GENERATE REPORT
East Duluth

33



DEPARTMENT OF NATURAL RESOURCES

Conservation Planning Report: East Duluth

This document is intended for planning purposes only for the area of interest defined by the user. The report identifies ecologically significant areas documented within the defined area of interest plus any additional search distance indicated below. These ecologically significant areas can be viewed in the Explore Tab of the Minnesota Conservation Explorer. Please visit MN Geospatial Commons for downloadable GIS data.

This document does not meet the criteria for a Natural Heritage Review. If a Natural Heritage Review is needed, please define an Area of Interest in the Explore Tab and click on the Natural Heritage Review option.

This document does not include known occurrences of state-listed or federally listed species.

MBS Sites of Biodiversity Significance

Search distance = 330 feet

Minnesota Biological Survey (MBS) Sites of Biodiversity Significance are areas with varying levels of native biodiversity that may contain high quality native plant communities, rare plants, rare animals, and/or animal aggregations. A Biodiversity Significance Rank is assigned on the basis of the number of rare species, the quality of the native plant communities, size of the site, and context within the landscape. MBS Sites are ranked Outstanding, High, or Moderate. Areas ranked as Below were found to be disturbed and are retained in the layer as they may contain rare species that meet the criteria for Outstanding or Moderate significance but may have conservation value, or the local level as habitat for native plant communities, wildlife, or humans. Sites ranked Outstanding or Moderate have the highest potential value, or as areas with high potential for restoration of native habitat. The DNR recommends avoidance of MBS Sites of Biodiversity Significance ranked High or Outstanding.

Wetlands within MBS Sites of Outstanding or High Biodiversity Significance may be considered Rare Natural Communities under the Wetland Conservation Act. For technical guidance on Rare Natural Communities, please visit WCA Program Guidance and Information.

For more information please visit MBS Sites of Biodiversity Significance.

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

MBS Site Name	Biodiversity Significance	Status
Amity Creek - Woodland	Moderate	Year
South Lakewalk to Lester River	Below	Year
Kelley Fen	Moderate	Year
Near Ridge/Lester River	Below	Year
Jubilo River to Flatland	Moderate	Year
Rimrock Mountain	High	Year

DNR Native Plant Communities

Search distance = 330 feet

A native plant community is a group of native plants that interact with each other and with their environment in ways not greatly altered by modern human activity or by introduced organisms. These groups of native plant species form recognizable units, such as oak savannas, aspen forests, or sedge meadows. The factors that control the distribution of native plant communities are described and described by consistency, vegetation, hydrology, landforms, soils, and natural disturbance regimes.

DNR Native Plant Community types and subtypes are given a Conservation Status Rank that reflects the relative rarity and endangerment of the community type in Minnesota. Conservation Status Ranks range from S1 (critically imperiled) to S5 (secure, common, widespread and abundant). Native plant communities with a Conservation Status Rank of S1 through S3 are considered rare in the state. The DNR recommends avoidance of rare native plant communities.

Wetland native plant communities with a conservation status rank of S1 through S3 may also be considered Rare Natural Communities under the Wetland Conservation Act. For technical guidance on Rare Natural Communities, please visit WCA Program Guidance and Information.

DNR Native Plant Communities may be given a Condition Rank that reflects the degree of ecological integrity of a specific occurrence of a native plant community. The Condition Rank is based on species composition, vegetation structure, ecological processes and functions, and the absence of disturbance-related species. Condition Ranks range from A (excellent ecological integrity) to D (poor ecological integrity) to E (very poor ecological integrity). A Condition Rank of NR means Not Ranked and a Condition Rank of MULTI means multiple ranks are present because the record is a native plant community complex.

For more information please visit Minnesota's Native Plant Communities.

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

MBS Site Name	NPC Code	Native Plant Community Classification	Conservation Status Rank	Number of Occurrences
Rimrock Mountain	FDn33c	Aspen - Birch Woodland	S5	1
Rimrock Mountain	FDn34a	Aspen - Birch Forest, Hardwood Subtype	S5	1
Rimrock Mountain	WHn31c	Seepage Woodland Complex	S4	1

Calcareous Fens

Search distance = 0 miles

A calcareous fen is a rare and distinctive peat-accumulating wetland that is legally protected in Minnesota under the Wetland Conservation Act (Minnesota Statutes, section 103G.223). Many of the unique characteristics of calcareous fens result from the upwelling of groundwater through calcareous substrates. Because of this dependence on groundwater hydrology, calcareous fens can be affected by nearby activities or even those several miles away. For more information regarding calcareous fens, please see the Calcareous Fen Fact Sheet or review the List of Known Calcareous Fens.

SEARCH RESULTS: No features were found within the search area.

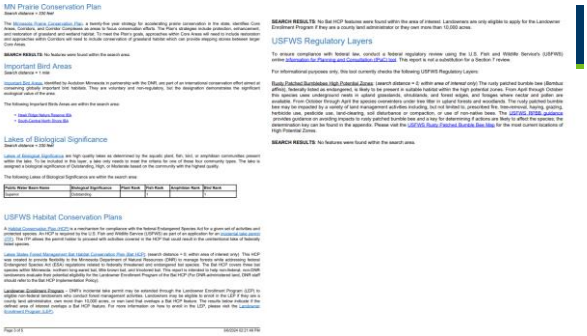
DNR Old Growth Stands

Search distance = 330 feet

Old growth forests are natural forests that have developed over a long period of time, generally at least 120 years, without experiencing significant disturbance from human activities such as logging or fire suppression. Old growth forests are rare in Minnesota, representing less than 4% of Minnesota's historic and ecologic (less than 4% of Minnesota's old-growth forests remain. The DNR recommends avoidance of all DNR Old Growth Stands. The following DNR Old Growth Stands have been documented within the search area.

SEARCH RESULTS: No features were found within the search area.

34



MN Prairie Conservation Plan

Search distance = 330 feet

The Minnesota Prairie Conservation Plan, a twenty-five year strategy for accelerating prairie conservation in the state, identifies Core Areas. Core Areas are landscapes that contain a high concentration of native prairie, grassland, and wetland habitat. Protection, enhancement, and restoration of grassland and wetland habitat. To meet the Plan's goals, approaches within Core Areas will need to include restoration and approaches within Corridors will need to include conservation of grassland habitat which can provide stepping stones between larger Core Areas.

SEARCH RESULTS: No features were found within the search area.

Important Bird Areas

Search distance = 1 mile

Important Bird Areas, identified by Audubon Minnesota in partnership with the DNR, are part of an international conservation effort aimed at conserving globally important bird habitats. They are voluntary and non-regulatory, but the designation demonstrates the significant ecological value of the area.

The following Important Birds Areas are within the search area:

- Hawk Ridge Nature Reserve IBA
- South Central Hawk Ridge IBA

Lakes of Biological Significance

Search distance = 330 feet

Lakes of Biological Significance are high quality lakes as determined by the aquatic plant, fish, bird, or amphibian communities present within the lake. To be included in this layer, a lake only needs to meet the criteria for one of these four community types. The lake is assigned a biological significance of Outstanding, High, or Moderate based on the community with the highest quality.

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

Public Water Basin Name	Biological Significance	Plant Rank	Fish Rank	Amphibian Rank	Bird Rank
Superior	Outstanding	-	1	-	1

USFWS Habitat Conservation Plans

A Habitat Conservation Plan (HCP) is a mechanism for compliance with the federal Endangered Species Act for a given set of activities and protected species. An HCP is required by the U.S. Fish and Wildlife Service (USFWS) as part of an application for an incidental take permit (ITP). An ITP allows the permit holder to proceed with activities covered in the HCP that could result in the unintentional take of federally listed species.

Lakes States Forest Management Bat Habitat Conservation Plan (Bat HCP) (search distance = 0, within area of interest only): This HCP was created to provide flexibility to the Minnesota Department of Natural Resources (DNR) to manage forests while addressing federal Endangered Species Act (ESA) regulations related to federally threatened and endangered bat species. The Bat HCP covers three bat species within Minnesota: northern long-eared bat, little brown bat, and tricolored bat. This report is intended to help non-federal ecosystem professionals evaluate their potential eligibility for the Landowner Enrollment Program of the Bat HCP (For DNR-administered land, DNR staff should refer to the Bat HCP Implementation Policy).

Landowner Enrollment Program – DNR's incidental take permit may be extended through the Landowner Enrollment Program (LEP) to non-federal landowners who implement conservation practices that benefit bat species. The LEP is open to any U.S. citizen, U.S. entity, or county land administrator, own more than 10,000 acres, or own land that overlaps a Bat HCP feature. The results below indicate if the defined area of interest overlaps a Bat HCP feature. For more information on how to enroll in the LEP, please visit the Landowner Enrollment Program (LEP).

SEARCH RESULTS: No Bat HCP features were found within the area of interest. Landowners are only eligible to apply for the Landowner Enrollment Program if they are a county land administrator or they own more than 10,000 acres.

USFWS Regulatory Layers

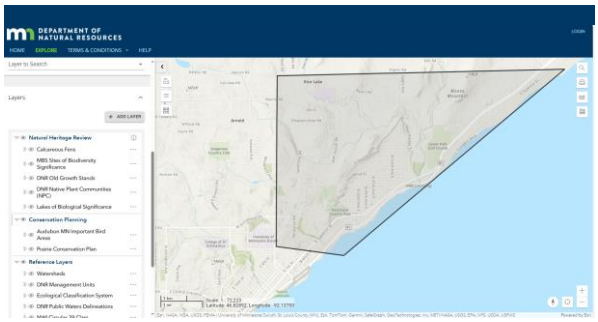
To ensure compliance with federal law, conduct a federal regulatory review using the U.S. Fish and Wildlife Service's (USFWS) online Information for Planning and Consultation (IPaC) tool. This report is not a substitution for a Section 7 review.

For informational purposes only, this tool currently checks the following USFWS Regulatory Layers:

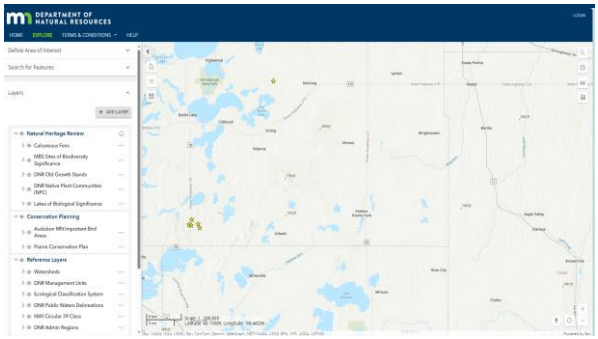
Rusty Patched Bumblebee High Potential Zones: (search distance = 0, within area of interest only): The rusty patched bumble bee (*Bombus affinis*), federally listed as endangered, is likely to be present in suitable habitat within the high potential zones. From April through October this species uses underground nests in upland grasslands, shrublands, and forest edges, and forages where nectar and pollen are available. From October through April the species overwinters under tree litter in upland forests and woodlands. The rusty patched bumble bee may be impacted by a variety of land management activities including, but not limited to, prescribed fire, mowing, grazing, pesticide use, and tree removal. The USFWS Rusty Patched Bumble Bee Consultation Technical Assistance Framework provides guidance on avoiding impacts to rusty patched bumble bee and a key for determining if actions are likely to affect the species; the determination key can be found in the appendix. Please visit the USFWS Rusty Patched Bumble Bee Map for the most current locations of High Potential Zones.

SEARCH RESULTS: No features were found within the search area.

35



36



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Aerial Photo Interpretation

BOARD OF WATER AND SOIL RESOURCES

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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

St. Paul District REGULATORY
US Army Corps of Engineers®

Minnesota Board of Water & Soil Resources

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

US Army Corps of Engineers®
St. Paul District

Minnesota Board of Water & Soil Resources

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

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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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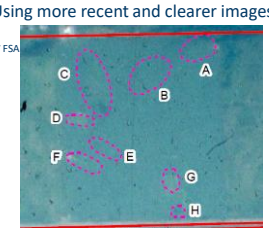
Guidance

Moving away from FSA images 1979 – 2000

Using more recent and clearer images: 5 normal years

1997 FSA



2010 MnGEO

43

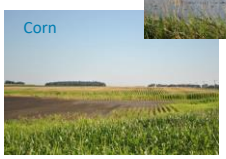
Variables

Vegetation Tolerance

Hydrophytic Veg.

Soybeans

Corn



44

Guidance

Vigor and stress responses to wetland conditions

45

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"

46

Evaluating Images

Crop Stress (CS)

47

Evaluating Images

Drowned Out (DO)

48

Evaluating Images

NC – not cropped.


49

Evaluating Images

Standing Water (SW)

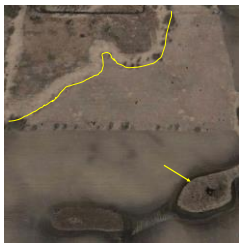

50

AP – altered pattern


51

Evaluating Images

WS – wetland signature.



52

Evaluating Images

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

53

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

54

What signature(s) do you see?

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

55

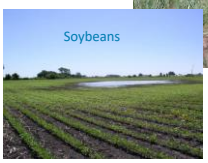
Variables

Stem Density

Alfalfa

Corn

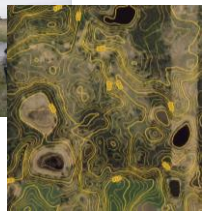
Soybeans

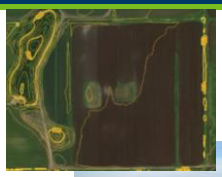


56

Variables

Topography

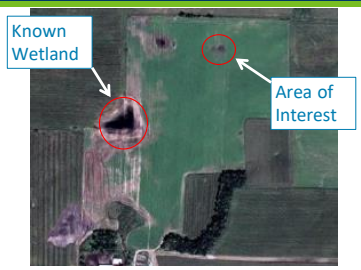




57

Variables

Reference Areas



58

Variables

Deep Peat Soils

59

Variables

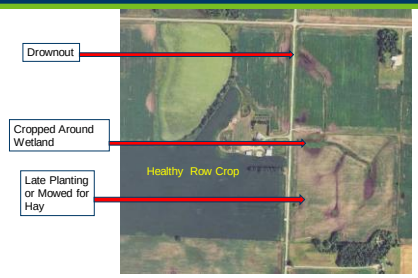
Iron Chlorosis

Winter Freeze

Business Decisions

60

Wet Signatures



61

Overview

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required, check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ~~___ Iron Deposits (B5)~~
- X Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ~~___ Crayfish Burrows (C8)~~
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ____ No ____ Depth (inches):
Water Table Present? Yes ____ No ____ Depth (inches):
Saturation Present? (includes capillary fringe) Yes ____ No ____ Depth (inches):

Wetland Hydrology Present? Yes ____ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:
June 2016 Google Image shows inundation during normal antecedent precip.

Remarks:

62

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

63

Other uses

Level 1 Delineations

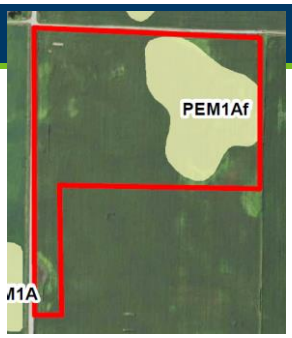
64

Incidental

2015

65

AOI NWI



66

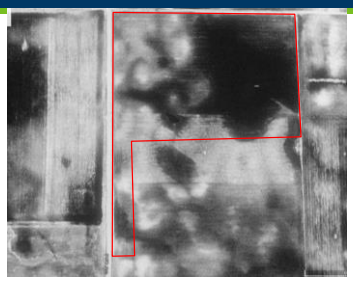
AOI Soils

67

AOI Topography

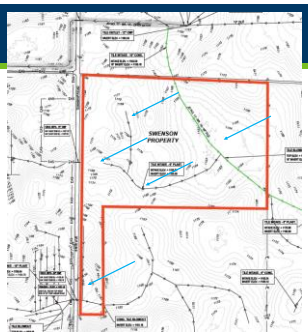
68

Pick wet or current year



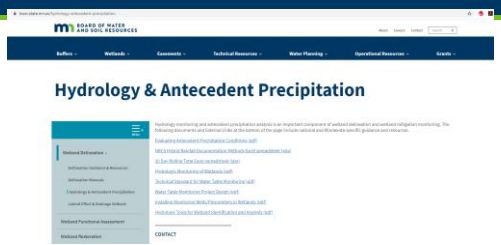
69

AOI Detailed Topo



70

Antecedent Precip



bwsr.state.mn.us/hydrology-antecedent-precipitation

71

2018-Dry

Year	Area 11	Area 12	Area 13	Area 14	Area 15
2018	SS	NV	NSS	NSS	SS
2017					
2015					
2013					
2012					
2011					
2010					
2008					
2007					
2004					
2003					

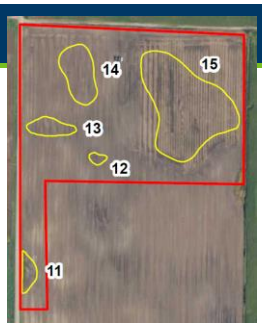
72

2017-Dry

Year	Area 11	Area 12	Area 13	Area 14	Area 15
2018	SS	NV	NSS	NSS	SS
2017	DO	NV	NV	NV	NV
2015					
2013					
2012					
2011					
2010					
2008					
2007					
2004					
2003					

73

2015-Normal



Year	Area 11	Area 12	Area 13	Area 14	Area 15
2018	SS	NV	NSS	NSS	SS
2017	DO	NV	NV	NV	NV
2015	SS	NSS	NSS	NSS	AP
2013					
2012					
2011					
2010					
2008					
2007					
2004					
2003					

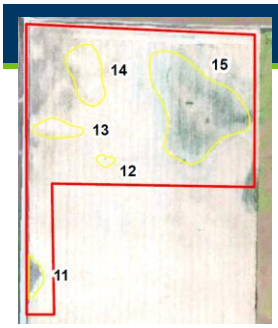
74

2013-Normal

Year	Area 11	Area 12	Area 13	Area 14	Area 15
2018	SS	NV	NSS	NSS	SS
2017	DO	NV	NV	NV	NV
2015	SS	NSS	NSS	NSS	AP
2013	CS	NV	NV	NV	CS
2012					
2011					
2010					
2008					
2007					
2004					
2003					

75

2012-Dry



Year	Area 11	Area 12	Area 13	Area 14	Area 15
2018	SS	NV	NSS	NSS	SS
2017	DO	NV	NV	NV	NV
2015	SS	NSS	NSS	NSS	AP
2013	CS	NV	NV	NV	CS
2012	DO	NSS	NV	NV	CS
2011					
2010					
2008					
2007					
2004					
2003					

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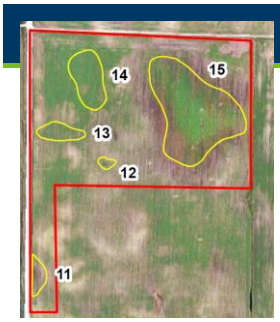
2011-Normal



Year	Area 11	Area 12	Area 13	Area 14	Area 15
2018	SS	NV	NSS	NSS	SS
2017	DO	NV	NV	NV	NV
2015	SS	NSS	NSS	NSS	AP
2013	CS	NV	NV	NV	CS
2012	DO	NSS	NV	NV	CS
2011	DO	CS	NV	NV	CS
2010					
2008					
2007					
2004					
2003					

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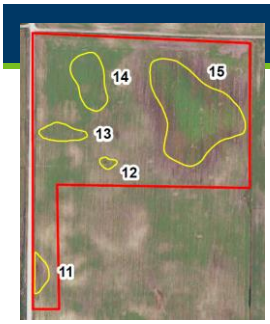
2010-Normal



Year	Area 11	Area 12	Area 13	Area 14	Area 15
2018	SS	NV	NSS	NSS	SS
2017	DO	NV	NV	NV	NV
2015	SS	NSS	NSS	NSS	AP
2013	CS	NV	NV	NV	CS
2012	DO	NSS	NV	NV	CS
2011	DO	CS	NV	NV	CS
2010	DO	CS	NV	NV	CS
2008					
2007					
2004					
2003					

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2008-Dry

Year	Area 11	Area 12	Area 13	Area 14	Area 15
2018	SS	NV	NSS	NSS	SS
2017	DO	NV	NV	NV	NV
2015	SS	NSS	NSS	NSS	AP
2013	CS	NV	NV	NV	CS
2012	DO	NSS	NV	NV	CS
2011	DO	CS	NV	NV	CS
2010	DO	CS	NV	NV	CS
2008	NV	NV	NV	NV	NV
2007					
2004					
2003					

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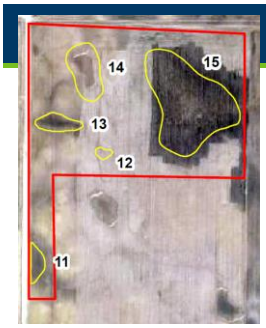
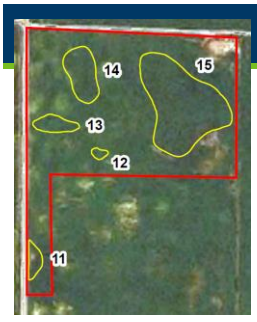
2007-Wet



Year	Area 11	Area 12	Area 13	Area 14	Area 15
2018	SS	NV	NSS	NSS	SS
2017	DO	NV	NV	NV	NV
2015	SS	NSS	NSS	NSS	AP
2013	CS	NV	NV	NV	CS
2012	DO	NSS	NV	NV	CS
2011	DO	CS	NV	NV	CS
2010	DO	CS	NV	NV	CS
2008	NV	NV	NV	NV	NV
2007	SS	NV	SS	SS	DO
2004					
2003					

80

2004-Normal



Year	Area 11	Area 12	Area 13	Area 14	Area 15
2018	SS	NV	NSS	NSS	SS
2017	DO	NV	NV	NV	NV
2015	SS	NSS	NSS	NSS	AP
2013	CS	NV	NV	NV	CS
2012	DO	NSS	NV	NV	CS
2011	DO	CS	NV	NV	CS
2010	DO	CS	NV	NV	CS
2008	NV	NV	NV	NV	NV
2007	SS	NV	SS	SS	DO
2004	CS	NV	NV	NV	NV
2003					

81

2003-Wet

Year	Area 11	Area 12	Area 13	Area 14	Area 15
2018	SS	NV	NSS	NSS	SS
2017	DO	NV	NV	NV	NV
2015	SS	NSS	NSS	NSS	AP
2013	CS	NV	NV	NV	CS
2012	DO	NSS	NV	NV	CS
2011	DO	CS	NV	NV	CS
2010	DO	CS	NV	NV	CS
2008	NV	NV	NV	NV	NV
2007	SS	NV	SS	SS	DO
2004	CS	NV	NV	NV	NV
2003	NV	NV	NV	NV	CS

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Let's do the math.

Review Summary Table

Image Date MM/YYYY	Image Source	Climate Condition	Image Interpretation Areas(s) 11	12	14	15
5/31/2018	County	Dry	SS	NV	NSS	NSS	SS
7/1/2017	FSA	Dry	DO	NV	NV	NV	NV
7/1/2015	FSA	Normal	SS	NSS	NSS	NSS	AP
7/1/2013	FSA	Normal	CS	NV	NV	NV	CS
9/10/2012	County	Dry	DO	NSS	NV	NV	CS
7/1/2011	County	Normal	DO	CS	NV	NV	CS
7/1/2010	FSA	Normal	DO	CS	NV	NV	CS
7/1/2009	FSA	Dry	NV	NV	NV	NV	CS
7/1/2008	FSA	Dry	NV	NV	NV	NV	NV
10/1/2007	County	Wet	SS	NV	SS	SS	DO
7/1/2006	County	Dry	NV	NV	NV	NV	CS
8/1/2004	County	Normal	CS	NV	NV	NV	NV
7/1/2003	FSA	Wet	NV	NV	NV	NV	CS
		Number of Normal Years	5	5	5	5	5
		Normal Years with Wet Signature	5	2	0	0	4
		Percent Normal with Wet Signature	100	40	0	0	80

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Document

Hydric Soils present[1]	Identified on NWI or other wetland map[2]	Percent with wet signatures from Exhibit 1	Field verification required[3]	Wetland?
Yes	Yes	>50%	No	Yes
Yes	Yes	30-50%	No	Yes
Yes	Yes	<30%	Yes	Yes, if other hydrology indicators present
Yes	No	>50%	No	Yes
Yes	No	30-50%	Yes	Yes, if other hydrology indicators present
Yes	No	<30%	No	No
No	Yes	>50%	No	Yes
No	Yes	30-50%	No	Yes
No	Yes	<30%	No	No
No	No	>50%	Yes	Yes, if other hydrology indicators present
No	No	30-50%	Yes	Yes, if other hydrology indicators present
No	No	<30%	No	No

Area	Hydric Soils Present	Identified on NWI or other wetland map	Percent with wet signatures from Exhibit 1	Other hydrology indicators present	Wetland?
11	Yes	No	100	NA	Yes
12	Yes	No	40	NA	No
13	Yes	No	0	NA	No
14	Yes	No	0	NA	No
15	Yes	Yes	80	NA	Yes

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Document

Hydric Soils present[1]	Identified on NWI or other wetland map[2]	Percent with wet signatures from Exhibit 1	Field verification required[3]	Wetland?
Yes	Yes	>50%	No	Yes
Yes	Yes	30-50%	No	Yes
Yes	Yes	<30%	Yes	Yes, if other hydrology indicators present
Yes	No	>50%	No	Yes
Yes	No	30-50%	Yes	Yes, if other hydrology indicators present
Yes	No	<30%	No	No
No	Yes	>50%	No	Yes
No	Yes	30-50%	No	Yes
No	Yes	<30%	No	No
No	No	>50%	Yes	Yes, if other hydrology indicators present
No	No	30-50%	Yes	Yes, if other hydrology indicators present
No	No	<30%	No	No

Area	Hydric Soils Present	Identified on NWI or other wetland map	Percent with wet signatures from Exhibit 1	Other hydrology indicators present:	Wetland?
11	Yes	No	100	NA	Yes
12	Yes	No	40	NA	No
13	Yes	No	0	NA	No
14	Yes	No	0	NA	No
15	Yes	Yes	80	NA	Yes

85

Document

Hydric Soils present[1]	Identified on NWI or other wetland map[2]	Percent with wet signatures from Exhibit 1	Field verification required[3]	Wetland?
Yes	Yes	>50%	No	Yes
Yes	Yes	30-50%	No	Yes
Yes	Yes	<30%	Yes	Yes, if other hydrology indicators present
Yes	No	>50%	No	Yes
Yes	No	30-50%	Yes	Yes, if other hydrology indicators present
Yes	No	<30%	No	No
No	Yes	>50%	No	Yes
No	Yes	30-50%	No	Yes
No	Yes	<30%	No	No
No	No	>50%	Yes	Yes, if other hydrology indicators present
No	No	30-50%	Yes	Yes, if other hydrology indicators present
No	No	<30%	No	No

Area	Hydric Soils Present	Identified on NWI or other wetland map	Percent with wet signatures from Exhibit 1	Other hydrology indicators present:	Wetland?
11	Yes	No	100	NA	Yes
12	Yes	No	40	NA	No
13	Yes	No	0	NA	No
14	Yes	No	0	NA	No
15	Yes	Yes	80	NA	Yes

86

Document

Hydric Soils present[1]	Identified on NWI or other wetland map[2]	Percent with wet signatures from Exhibit 1	Field verification required[3]	Wetland?
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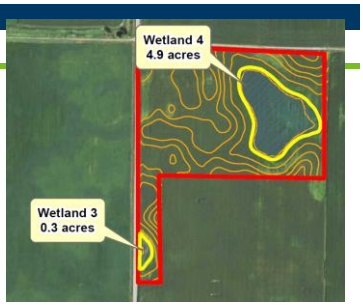
Yes	Yes	30-50%	No	Yes
Yes	Yes	<30%	Yes	Yes, if other hydrology indicators present
Yes	No	>50%	No	Yes
Yes	No	30-50%	Yes	Yes, if other hydrology indicators present
Yes	No	<30%	No	No
No	Yes	>50%	No	Yes
No	Yes	30-50%	No	Yes
No	Yes	<30%	No	No
No	No	>50%	Yes	Yes, if other hydrology indicators present
No	No	30-50%	Yes	Yes, if other hydrology indicators present
No	No	<30%	No	No

Area	Hydric Soils Present	Identified on NWI or other wetland map	Percent with wet signatures from Exhibit 1	Other hydrology indicators present:	Wetland?
11	Yes	No	100	NA	Yes
12	Yes	No	40	NA	No
13	Yes	No	0	NA	No
14	Yes	No	0	NA	No
15	Yes	Yes	80	NA	Yes

87

Conclusion: Final Determination



88

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
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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

89

Other uses

Level 1 Delineations

90

Incidental

91

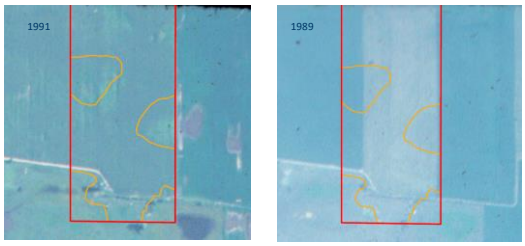
Incidental

92

Incidental

93

Incidental



94

Incidental

95

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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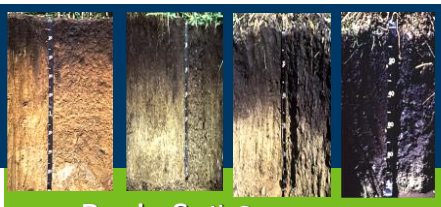

Basic Soil Concepts

BOARD OF WATER AND SOIL RESOURCES

Minnesota Wetland Professional Certification Program

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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

98

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

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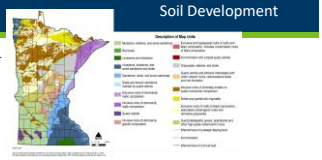
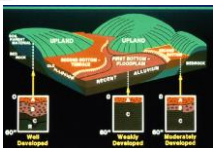
Factors That Influence Soil Development

- 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.

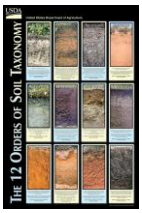




100

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

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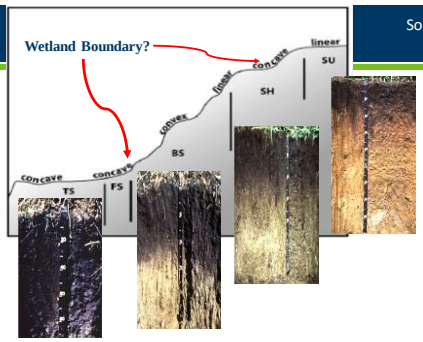
Soil Catena



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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 visibl (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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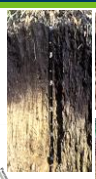
Key Soil Properties

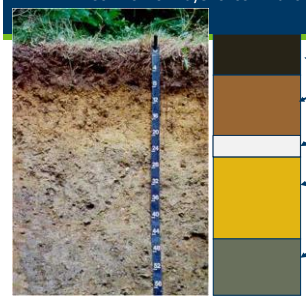
Properties that are important to hydric soil development and recognition:

- 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



105

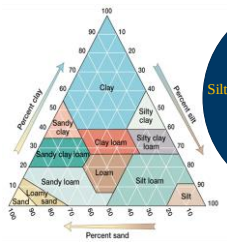
Soil Horizon- layer of soil with similar physical, chemical, and biologic properties

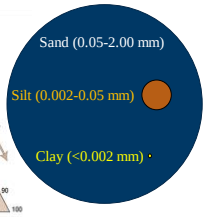


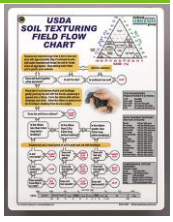
- O horizon- Organic horizon, thickness varies
- A Horizon- Organic accumulation (typically ~10%), ideally granular structure
- E Horizon- Coloring agents (Fe, Organics) removed
- B Horizon- Subsoil accumulation of minerals, organics, and sometimes chemicals, blocky structure
- C Horizon - Similar to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

106

Soil Texture- Relative proportion of soil particles







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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

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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 an estimated property
- Larger grain sizes= higher permeability

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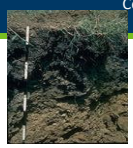
Capillary Fringe

- 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

110

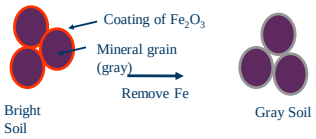
Coloring Agents in Soil

- 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)



111

Soil Color

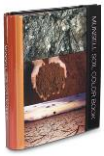


"Bright-colored" soil is bright because the gray-colored mineral grains are coated with a thin layer of "paint" formed by Fe oxides. Stripping the paint off the particles leaves the mineral grains exposed.

112

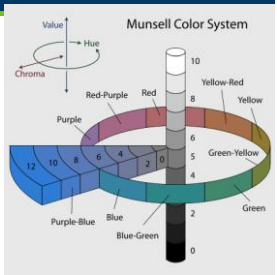
Color

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



Hue Value Chroma

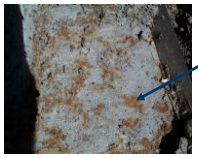
10YR 2/1



113

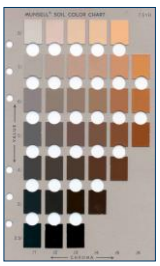
Color

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



What is the percent of redox?

30%



114

Reading Soil Color

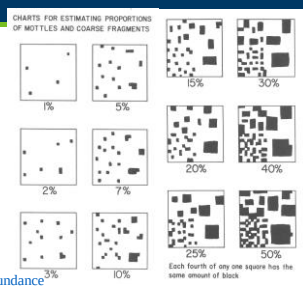
- Optimum conditions
  - Natural light
  - Clear, sunny day
  - Midday
  - Light at right angles
  - Soil moist

115

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

116

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	Code	Difference in Color Between Matrix and RMF (Δ means "difference between")			
		Hue (h)	Value (v)		*Chroma (c)*
Faint [1]	F	Δh = 0;	Δv ≤ 2	and	Δc ≤ 1
		Δh = 1;	Δv ≤ 1	and	Δc ≤ 1
		Δh = 2;	Δv = 0	and	Δc = 0
Distinct [1]	D	Δh = 0;	Δv ≤ 2	and	Δc > 1 to < 4
			or Δv > 2 to < 4	and	Δc < 4
		Δh = 1;	Δv ≤1	and	Δc > 1 to < 3
			or Δv > 1 to < 3	and	Δc < 3
		Δh = 2;	Δv = 0	and	Δc > 0 to < 2
			or Δv > 0 to < 2	and	Δc < 2
Prominent [1]	P	Δh = 0;	Δv ≥ 4	or	Δc ≥ 4
		Δh = 1;	Δv ≥ 3	or	Δc ≥ 3
		Δh = 2;	Δv ≥ 2	or	Δc ≥ 2
		Δh ≥ 3;			

[1] If compared colors have both a value ≤3 and a chroma of ≤2, 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**.



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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

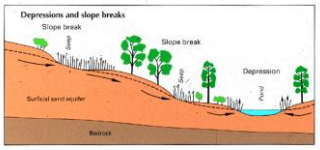
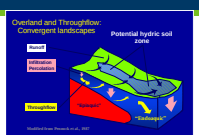


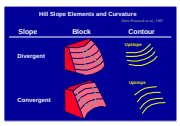
Figure D1. Precipitation analysis for a growing season showing daily precipitation, monthly precipitation, the 30-day rolling sum, and the range of normal conditions.

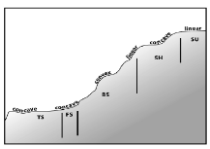
119

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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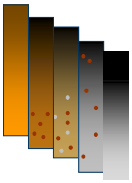
Hydric Soil Development

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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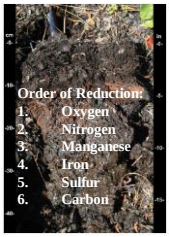
Hydric Soil Development

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



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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

Think old car left in the elements- chemical reactions leave "rust in the soil"

123

Change in the state of iron

- Available O_2, NO_3, and Mn depleted
- $Fe^{3+} \longrightarrow Fe^{2+}$ (Mobile)
- **Bluish Grey** when **reduced**
- **Grey** when **depleted** from soil
- **Orange** or **Red** when **oxidized**

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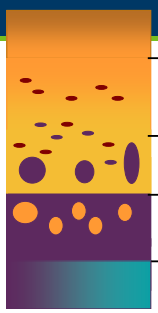
Anaerobic process



Never Saturated
Oxidized Matrix

Infrequently Saturated
Oxidized Matrix with few concentrations

Frequently Saturated
Oxidized Matrix with depletions And concentrations

Very Frequently Saturated
Depleted or Reduced Matrix With concentrations

Permanently Saturated - depleted Or reduced matrix

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Depleted Matrix

Iron removed or re-organized in profile leaving Grey matrix

- **Value 4 or More**
- **Chroma 2 or Less**

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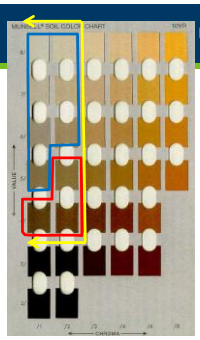
Depleted Matrix Requirement



Do Not Need Concentrations

Need Concentrations (2%)

High Value (4 or more)

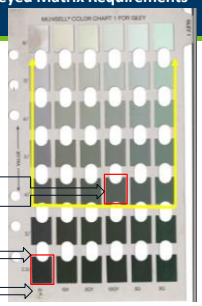
Low Chroma (2 or Less)

127

Gleyed Matrix Requirements

Gleyed Matrix

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



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Hydric Soil Indicators

BOARD OF WATER AND SOIL RESOURCES

Minnesota Wetland Professional Certification Program

129

Field Indicators of Hydric Soils

Natural Resources Conservation Service

- National Technical Committee for Hydric Soils

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

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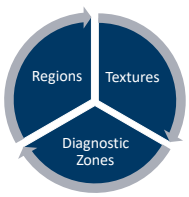
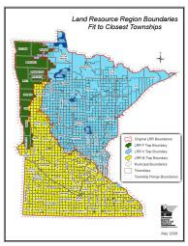
Field Indicator Organization- Regions





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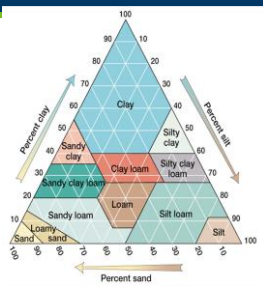
Field Indicator Organization- Texture

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



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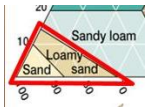
Soil Indicator Groups- Texture

Sandy Soil Indicators (S):

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



Fine Grained Soil Indicators (F):

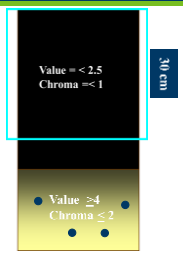
- Use when texture is:
  - Loamy Very Fine Sand or finer

A group- all textures

133

Diagnostic Zones

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



134

Diagnostic Zones for S and F indicator groups

Sandy (S)

Upper 15 cm (6")

Loamy / Clayey (F)

Upper 30 cm (12")

135

Key terms to help interpret indicators:

Credit: 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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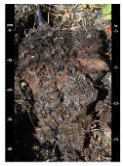
Format of Indicator Descriptions

A1.—Histosol *(for use in all LRRs)* or **Histel** *(for use in LRRs with permafrost)*. Classifies as a Histosol (except Folist) or as a Histel (except Folistel).
User Notes: In a Histosol, typically 40 cm (16 inches) or more of the upper 80 cm (32 inches) is organic soil material (fig. 7). Organic soil materials have organic carbon contents (by weight) of 12 to 18 percent or more, depending on the clay content of the soil. These materials include muck (sapric soil material), mucky peat (hemic soil material), and peat (fibric soil material). See *Keys to Soil Taxonomy* (Soil Survey Staff, 2014) for a complete definition.



- 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

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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)* or **Histel** *(for use in LRRs with permafrost)*. Classifies as a Histosol (except Folist) or as a Histel (except Folistel).
User Notes: In a Histosol, typically 40 cm (16 inches) or more of the upper 80 cm (32 inches) is organic soil material (fig. 7). Organic soil materials have organic carbon contents (by weight) of 12 to 18 percent or more, depending on the clay content of the soil. These materials include muck (sapric soil material), mucky peat (hemic soil material), and peat (fibric soil material). See *Keys to Soil Taxonomy* (Soil Survey Staff, 2014) for a complete definition.

Figure 7.—Indicator A1 (Histosol or Histel). This soil has more than 40 cm (16 inches) of organic material, starting at the soil surface

138

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.

User Notes: Most histic epipedons are surface horizons 20 cm (8 inches) or more thick of organic soil material (fig. 8). Aquic conditions or artificial drainage is required. See *Keys to Soil Taxonomy* (Soil Survey Staff, 2014) for a complete definition.

Figure 8.—Indicators A2 (Histic Epipedon) and A3 (Black Histic). This soil meets the depth criterion of A2 and the color and depth criteria of A3. The black color, a requirement of A3, results from the accumulation of organic matter when the soil is saturated and anaerobic.

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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 20 cm (8 inches) or more thick that starts at a depth of ≤15 cm (6 inches) 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.

User Notes: Unlike indicator A2, this indicator does not require proof of aquic conditions or artificial drainage (fig. 8).

Figure 8.—Indicators A2 (Histic Epipedon) and A3 (Black Histic). This soil meets the depth criterion of A2 and the color and depth criteria of A3. The black color, a requirement of A3, results from the accumulation of organic matter when the soil is saturated and anaerobic.

140

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 ≥30 cm (12 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 fragmental soil material.

Organic, loamy, or clayey layer(s) above the depleted or gleyed matrix must have 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 sandy material above the depleted or gleyed matrix must have value of 3 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.

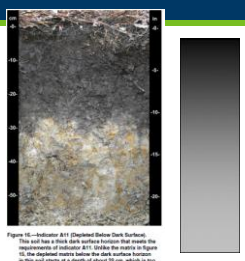

Figure 10.—Indicator A11 (Depleted Below Dark Surface). This soil has a thick dark surface horizon that meets the requirements of indicator A11. Unlike the matrix in figure 10, the depleted matrix below the dark surface horizon in this soil starts at a depth of about 29 cm, which is too deep to meet the requirements of indicator F3 (Depleted Matrix). Indicator A11 allows a deeper depleted matrix than indicator F3.

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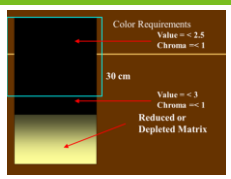
A12- Thick Dark Surface

- 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 layer(s) above the depleted or gleyed matrix and starting at a depth <15 cm (6 inches) from the soil surface must have value of 2.5 or less and chroma of 1 or less to a depth of at least 30 cm (12 inches) and 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 soil particles must be masked with organic material, viewed through a 10x or 15x hand lens. Observed without a hand lens, the particles appear to be close to 100 percent masked.

142

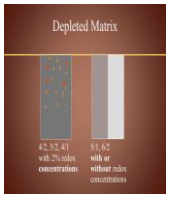
F3- Depleted Matrix

- 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.



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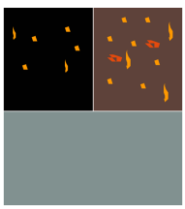
F6- Redox Dark Surface

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

F6.—Redox Dark Surface. *For use in all LRRs, except W, X, and Y; for testing in LRRs W, X, and Y.* A layer that is at least 10 cm (4 inches) thick, starting at a depth ≤20 cm (8 inches) from the mineral soil surface, and has:

a. Matrix value of 3 or less and chroma of 1 or less and 2 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings, or

b. Matrix value of 3 or less and chroma of 2 or less and 5 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings.



144

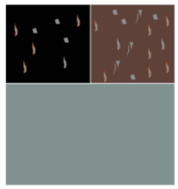
F7- Depleted Dark Surface

- Applicable land resource regions (LRR)
  - Use in all LRRs
- User notes
  - Careful to not mistake an E horizon for depletions!

F7.—Depleted Dark Surface. *For use in all LRRs, except W, X, and Y; for testing in LRRs W, X, and Y.* Redox depletions with value of 5 or more and chroma of 2 or less in a layer that is at least 10 cm (4 inches) thick, starting at a depth ≤20 cm (8 inches) from the mineral soil surface, and has:

a. Matrix value of 3 or less and chroma of 1 or less and 10 percent or more redox depletions, or
b. Matrix value of 3 or less and chroma of 2 or less and 20 percent or more redox depletions.

Figure 31.—Indicators F6 (Redox Dark Surface) and F7 (Depleted Dark Surface). A soil that meets the requirements of indicator F7 commonly also meets the requirements of indicator F6. If the dark surface layer has depletions, it most likely also has concentrations.



145

S5- Sandy Redox

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

S5.—Sandy Redox. *For use in all LRRs, except for Q, V, W, X, and Y.* A layer starting at a depth ≤15 cm (6 inches) from the soil surface that is at least 10 cm (4 inches) thick and has a matrix with 60 percent or more chroma of 2 or less and 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings.

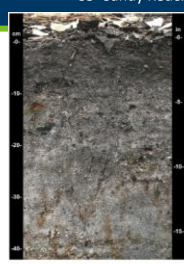


Figure 22.—Indicator S5 (Sandy Redox). This soil meets the requirements of indicator S5, having a matrix chroma of 2 or less and at least 2 percent redox concentrations starting at a depth of about 10 cm.

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Data Sheet

SOIL — Sampling Point: W1-DP2W

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

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-3	10yr 2/1	100					Clay Loam	
3-22	10yr 5/2	80	7.5yr 5/6	20	C	M	Loamy clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ 2 cm Muck (A10)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ 5 cm Mucky Peat or Peat (S3)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☒ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ Coast Prairie Redox (A16)
- ☐ Iron-Manganese Masses (F12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):
Type: ____
Depth (inches): ____

Hydric Soil Present? Yes ☒ No ☐

Remarks:

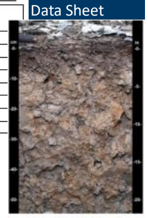

Figure 29.—Indicator F3 (Depleted Matrix). This soil has value of 4 or more and chroma of 2 or less and redox concentrations starting at a depth of 8 cm. Since the depleted matrix starts at a depth of ≤15 cm from the soil surface, the minimum thickness requirement is only 5 cm.

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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
- Sandy soils

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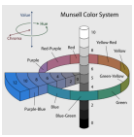
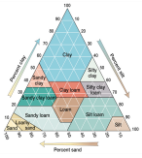
Review

- 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

- Hydric soil indicators
  - All, Fine, Sandy
- Common soil indicators
  - Organic Indicators (A1, A2, A3)
  - Depleted Matrix (A11, A12, F3)
  - Redoximorphic features (F6, S3)





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Soil Survey Overview

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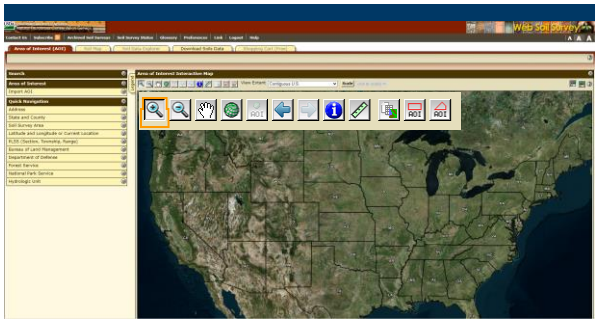

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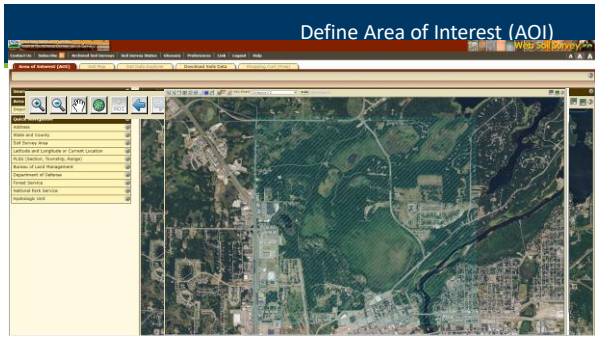
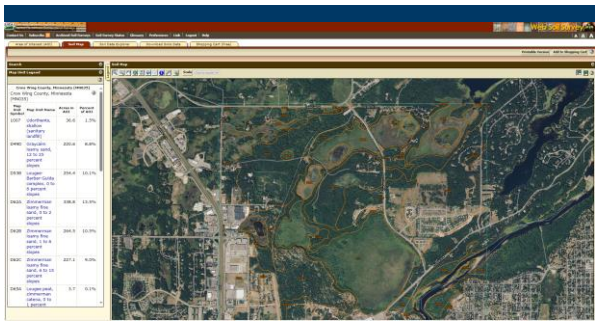


152



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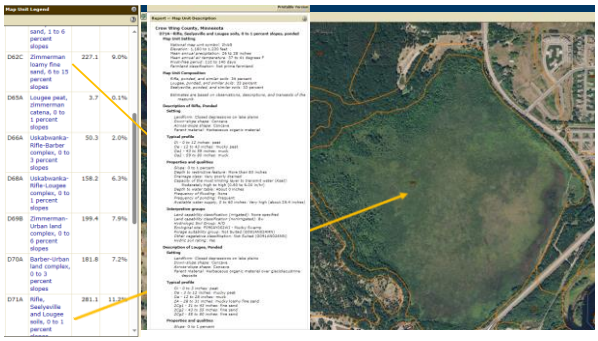

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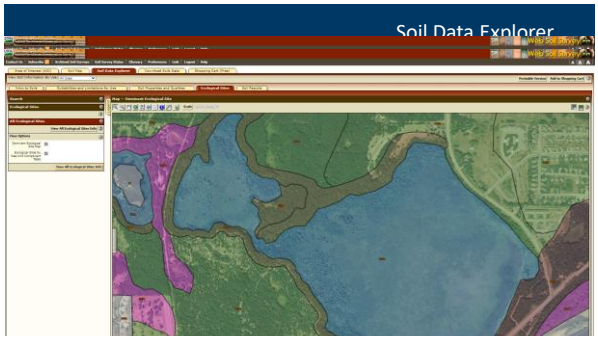
Soil Data Explorer

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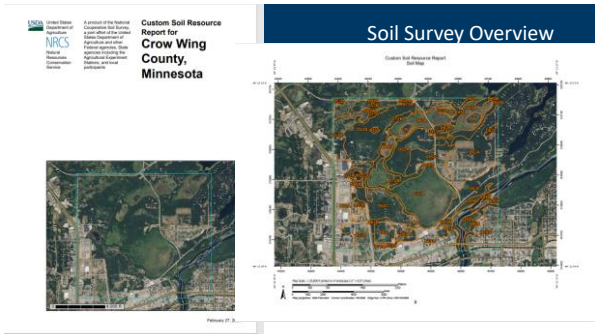
Custom Soil Resource Report for Crow Wing County, Minnesota
Soil Survey Overview

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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 45 inches: gravelly sandy loam
2Bw,BC,2BC - 45 to 48 inches: gravelly sandy loam
2BCd - 48 to 80 inches: gravelly sandy loam

Properties and qualities
Slope: 1 to 8 percent
Depth to restrictive feature: 30 to 60 inches to densic 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 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

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Antecedent Precipitation Analysis

BOARD OF WATER AND SOIL RESOURCES

Minnesota Wetland Professional Certification Program

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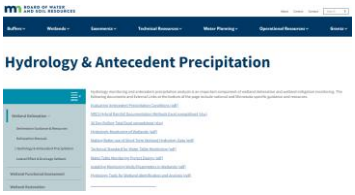
Precip

- Hydrology and Antecedent Precipitation



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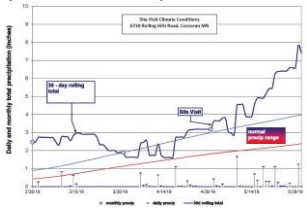
Precip.

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.



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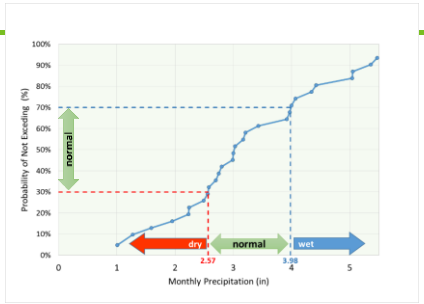
What does NORMAL mean? What does WET or DRY mean?



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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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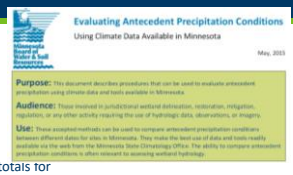
How to do it…


Evaluating Antecedent Precipitation Conditions
Using Climate Data Available in Minnesota
May, 2013
Purpose: This document describes procedures that can be used to evaluate antecedent precipitation using climate data and tools available in Minnesota.
Audience: Those involved in jurisdictional wetland delineation, restoration, mitigation, regulation, or any other activity requiring the use of hydrologic data, observations, or imagery.
Use: These accepted methods can be used to compare antecedent precipitation conditions between different dates for sites in Minnesota. They make the best use of data and tools readily available via the web from the Minnesota State Climatology Office. The ability to compare antecedent precipitation conditions is often relevant to assessing wetland hydrology.

- **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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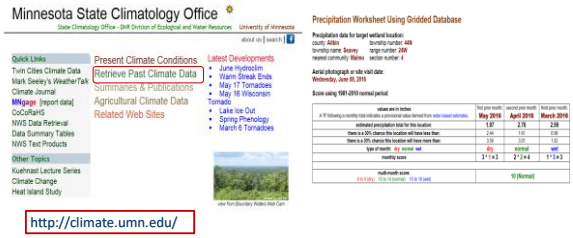
With the State Climatology Tool


Minnesota State Climatology Office
State Climatology Office - DNR Division of Ecological and Water Resources, University of Minnesota
about us | search
Quick Links
Twin Cities Climate Data
Mark Seeley's WeatherTalk
Climate Journal
MNgage [report data]
CoCoRaHS
NWS Data Retrieval
Data Summary Tables
NWS Text Products
Other Topics
Kuehnast Lecture Series
Climate Change
Heat Island Study
Present Climate Conditions
Retrieve Past Climate Data
Summaries & Publications
Agricultural Climate Data
Related Web Sites
Latest Developments
June Hydroclim
Warm Streak Ends
May 17 Tornadoes
May 16 Wisconsin Tornado
Lake Ice Out
Spring Phenology
March 6 Tornadoes
Precipitation Worksheet Using Gridded Database

http://climate.umn.edu/

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Hybrid Method

30-day rolling total

with

3-prior-month method

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Precip.

"Hybrid" method - ERDC/EL TR - WRAP 00 - 01

Date	15-Jun-2014		
Location	Farmington, MN	Project	WDCP
County	Dakota	State	MN
Soil Name		Growing Season	
Photo/obs date	15-Jun-2015		

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
10 - 14	prior period has been normal
15 - 18	prior period has been wetter than normal

Condition value:
Dry =1
Normal =2
Wet =3

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Precipitation Analysis - Farmington MN 6/15/15

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Corps Antecedent Precipitation Tool

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

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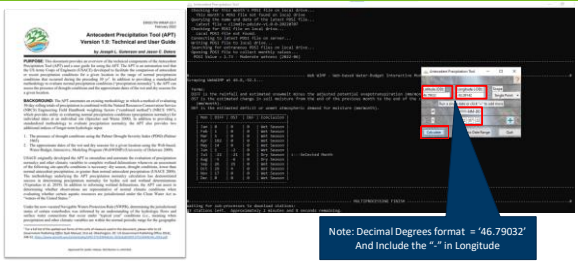
Enter Lat-Long, Date and Calculate



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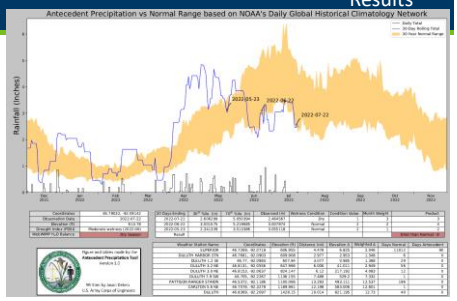
Results

- Tool opens pdf in a temporary folder on desktop

- Open pdf to view results:



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Antecedent Precipitation Evaluation Review

- Important for accurate interpretations/observations
- Done by the delineator
- Included in the report
- Should support your conclusion.
- Not always clear…Best Professional Judgement needed.
- Several methods available, each with certain strengths/weaknesses…
- Discussed in detail via BWSR and other Guidance Documents.

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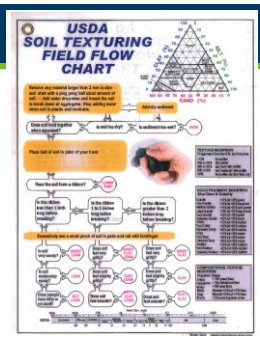
Texture by Feel



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