Hydric Soils of Minnesota

BOARD OF WATER AND SOIL RESOURCES

Minnesota Wetland Professional Certification Program

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Introductions

- Ben Meyer- CMWP- MN Board of Water & Soil Resources
  - Co-Coordinator-MN Wetland Professional Certification Program
  - Wetland Specialist- North Metro Counties
- David Demmer- CMWP- MN Board of Water & Soil Resources
  - Co-Coordinator-MN Wetland Professional Certification Program
  - Wetland Specialist- NE MN Counties

Minnesota Wetland Professional Certification Program

MN Association of Professional Soil Scientists

- Luke Lunde- Professional Soil Scientist- WSB LLC
- Steve Lawler- Professional Soil Scientist- Mower SWCD
- David Bauer- Professional Soil Scientist- CMWP- Alliant Engineering

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Upcoming MAPSS Events

The SPRUCE (Spruce and Peatland Responses Under Climatic and Environmental Change Experiment)

- July or August 2024
- Grand Rapids
- histosol hydrology, histosol restoration, ecology, etc.

MAPSS Winter Technical Event

- December 6, 2024

We promote the understanding and wise use of Minnesota's soil resources.

www.mnsoilscientist.org

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2024 MWPCP Training Courses

Introduction to Wetland Delineation and Regulations

- Introduction to Wetland Delineation and Regulations: Arden Hills- June 10-14
- Introduction to Wetland Delineation and Regulations: Brainerd - September 9-13
- Introduction to Wetland Delineation and Regulations: Arden Hills- September 30-October 4

Regulatory Training

- Wetland Conservation Act (WCA) 101 Virtual Training- February 5-6 (3 online CEC per day)
- TEP Academy- St Cloud MNDOT Training Facility- April 9 (6 CEC)

Regional Training

- Redwood Falls– August 27-28 (6 CEC per day)

Professional Exams

MWPCP Exams will be offered at 1pm on:

- June 14 in Arden Hills
- September 13 in Brainerd
- October 4 in Arden Hills.

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2024 MWPCP Training Courses

Technical Training

- Hydric Soils- Albany City Hall and Two Rivers County Park, Stearns County- April 30 & May 1 (6 CEC per day)
- Wetland Restoration-McLeod County Fairgrounds- May 15-16 (12 CEC)
- Wetland Delineation Methods- Prairie Woods Environmental Learning Center- Spicer- May 29-31 (18 CEC)
- Floristic Quality Assessment (FQA) Method- MNDOT Shoreview Training Center – June 17 or 18 (6 CEC per day)
- Wetland Plant ID- Lino Lakes (July 16) or Cloquet Forestry Center (July 18) (6 CEC per day)
- Antecedent Precipitation Tool- St Cloud MNDOT Training Center- October 22 (2 sessions) (3 CEC per session)

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Registration Information

Staggered registration:

- April- July classes will open the week of March 11th.
- August-October classes will open the week of July 1st.

Email will go out to our contact lists a couple of weeks prior

- Email bwsr.mwpcp@state.mn.us to be added to list

MWPCP maintains a waitlist for all full classes

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Certification Updates

- COVID-related continuing policies lapsed
- Need 18 continuing education hours (6 online)
- Current renewal period ends on December 31, 2024 for individuals who passed exams in 2021.
- Do not need to report MWPCP classes
- Use Credit Reporting Form
- List of approved classes on MWPCP page
- If not listed, use Credit Determination Form
- Notify us if you change jobs or email

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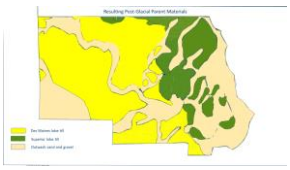
Agenda



- Overview of hydric soil development and common soil indicators for HGM wetland types
- Role of landscape & geomorphic position in hydric soil development
- Introduction to afternoon field sites
- Lunch (bag lunch on your own) then meet at field site after lunch
- Field stations

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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

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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 horizons

- consists of mostly decomposed organic material

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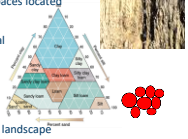
Key Soil Properties

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



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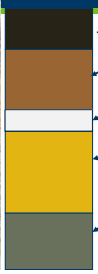
Soil Horizon- layer of soil with similar physical, chemical, and biologic properties



- O horizon- Organic horizon, thickness varies
- A Horizon- Organic accumulation (typically ~10%), 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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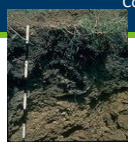
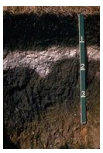
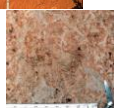
Coloring Agents in Soil

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



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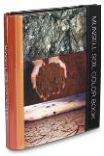
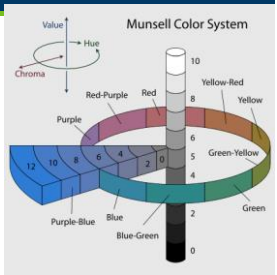
Color

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



Hue Value Chroma

10YR 2/1



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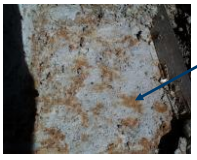
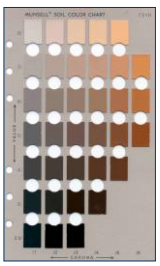
Color

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



What is the percent of redox?

30%



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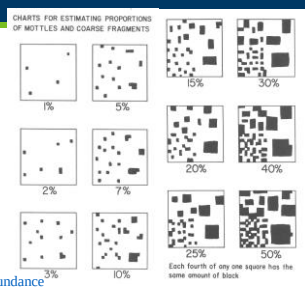
Abundance and Size of Redox

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	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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Depleted Matrix

Iron removed or re-organized in profile leaving Grey matrix

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

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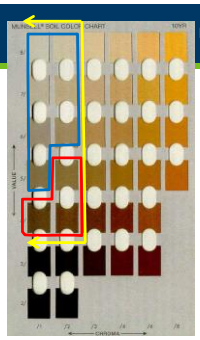
Depleted Matric Requirement

Do Not Need Concentrations

Need Concentrations (2%)



High Value (4 or more)

Low Chroma (2 or Less)

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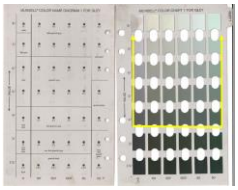
Gleyed Matrix Requirements

Gleyed Matrix

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



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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

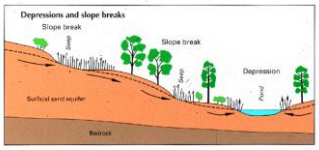

Figure D1. Precipitation analysis for a growing season showing daily precipitation, monthly precipitation, the 30-day rolling sum, and the range of normal conditions.

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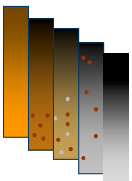
Hydric Soil Development

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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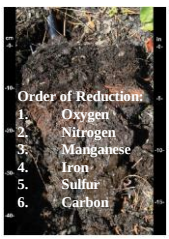
Hydric Soil Development

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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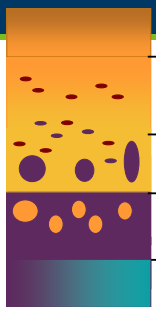
Anaerobic process



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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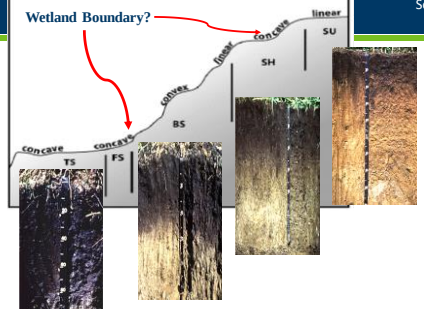
Landscape Soil Catena



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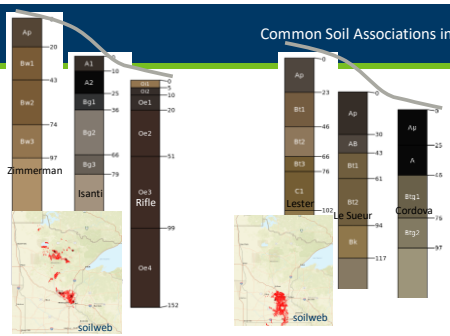
Common Soil Associations in MN



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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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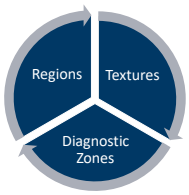
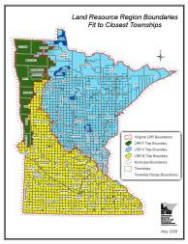
Field Indicator Organization- Regions





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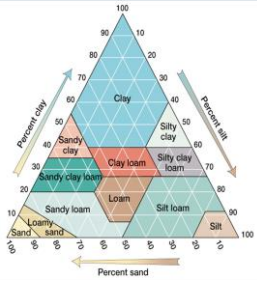
Field Indicator Organization- Texture

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



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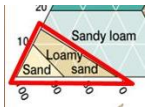
Soil Indicator Groups- Texture

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

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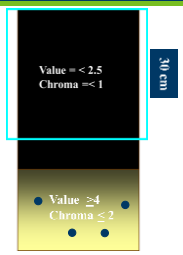
Diagnostic Zones

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



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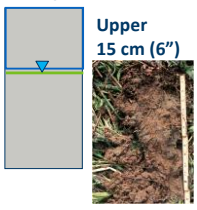
Diagnostic Zones for S and F indicator groups

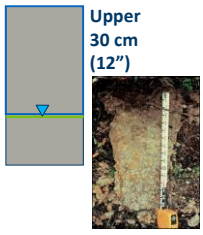
Sandy (S)

Upper 15 cm (6")



Loamy / Clayey (F)

Upper 30 cm (12")



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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.

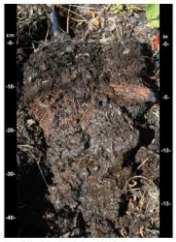

Figure 7.—Indicator A1 (Histosol or Histel). This soil has more than 40 cm (16 inches) of organic material, starting at the soil surface

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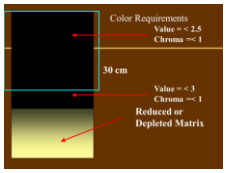
A12- Thick Dark Surface

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

Figure 17.—Indicator A12 (Thick Dark Surface). Deep observation is needed to determine whether a soil meets the requirements of this indicator. In this soil, depth to the depleted matrix is about 55 cm.

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.

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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 M, X, and Y; for testing in LRRs M, 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.

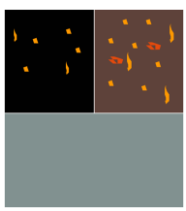

Figure 31.—Indicators F6 (Redox Dark Surface) and F7 (Depleted Dark Surface). A soil that meets the requirements of indicator F7 commonly also meets the requirements of indicator F6. If the dark surface layer has depletions, it most likely also has concentrations.

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Common Indicators for Depression Wetlands

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

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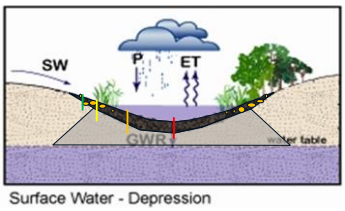
Cross Section of Hydric Soils in Depression Wetlands

- Histosol
- Thick dark surface
- Depleted below dark surface
- Redox dark surface



Surface Water - Depression

38

Common Indicators for Sloped Wetlands

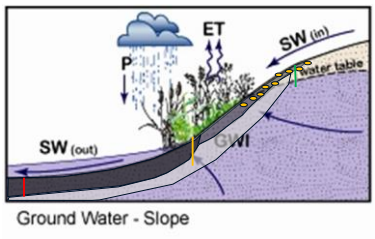
HGM Class	Typical Water Regimes	Hydrology Indicators Common to Water Regime	Soil Indicators Common to Water Regime
Sloped	Saturated	A2- High Water Table, A3- Saturation, B15- Marl Deposits, C3- Oxidized Rhizospheres along living roots, C7- Thin Muck Surface, C9- Saturation Visible on Aerial Imagery, D2-Geomorphic Position, D5- FAC-neutral Test	A1- Histosol, A2- Histic Epipedon, A3- Black Histic, A11- Depleted Below Dark Surface, A12- Thick Dark Surface, F1- Loamy Mucky Mineral, F3- Depleted Matrix, F6- Redox Dark Surface, S1- Sandy Mucky Mineral, S3- 2" Mucky Peat, S5- Sandy Redox

Ground Water - Slope

39

Cross Section of Hydric Soils in Sloped Wetlands

- Histosol
- Depleted below dark surface
- Redox Dark Surface

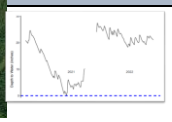


40

Common Indicators for Lacustrine Fringe Wetlands

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

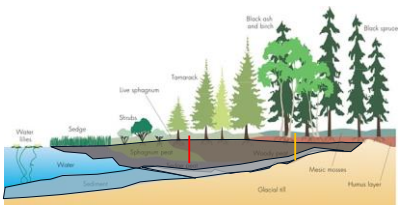





41

Cross Section of Hydric Soils in Lacustrine Fringe

- Histosol
- Thick Dark Surface



42

Stearns County Soils: Origin and Nature of Parent Materials, Weathering Processes, and Landscape Position of Common Map Units

Compiled by Brad Wenz, Stearns Co. SWCD from:
QUATERNARY GEOLOGY OF STEARNS COUNTY
by Gary Meyer and Alan Knaeble, Minnesota Geological Survey, and the Soil Survey of Stearns County Minnesota, USDA SCS, 1985.

The new soil correlations are adapted to the block diagrams published in the 1985 soil survey. These adapted diagrams are considered "draft" and not for public use.

43

The soils and landscape that we see today in Stearns County are the result of the late Wisconsinan glaciation which occurred about 35,000 to 10,000 years ago.

It is important to recognize the geographic origin or source of the most recent glacial advances. Their flow path across vastly different rock types created the unique textural, chemical, and biological characteristics of the associated sediment that we see today.

44

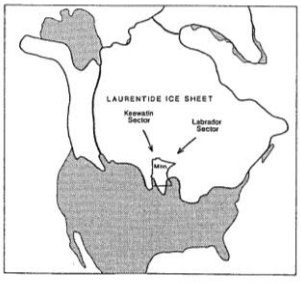


FIGURE 3.1.
Approximate extent of the Laurentide ice sheet at its glacial maximum and the direction of ice flow from the Keewatin and Labrador sectors.

45

Labrador Source - Rainy River and Lake Superior basin

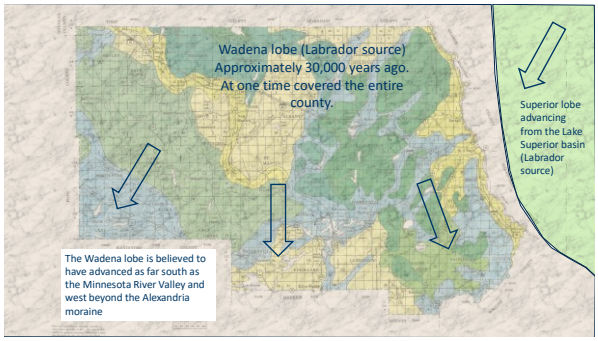
Wadena lobe till: sandy texture, buff to yellow brown oxidized color, common carbonate pebbles, very little red felsite and sandstone, soft cretaceous shale is absent or rare.

Superior lobe till: sandy, rocky texture, brown to redish brown oxidized color, rare carbonate pebbles, common red felsite and sandstone, soft cretaceous shale is absent.

Keewatin Source – Manitoba and the Red River Valley

Des Moines lobe till: loamy texture, yellow brown to olive brown, carbonate pebbles common to abundant, uncommon red felsite and sandstone, soft, cretaceous shale often common or abundant. Few boulders.

46



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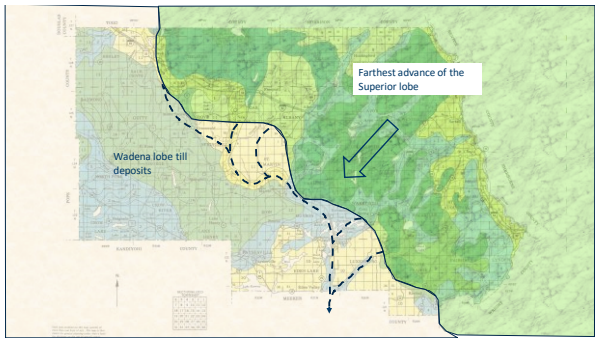

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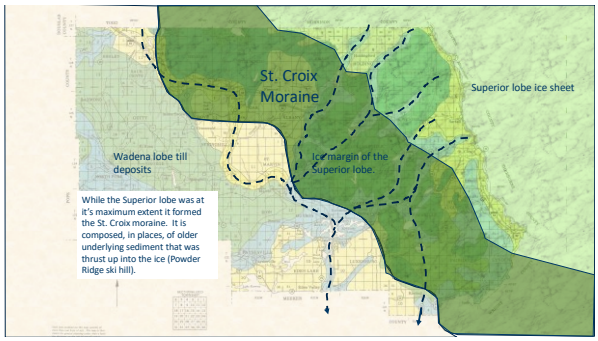
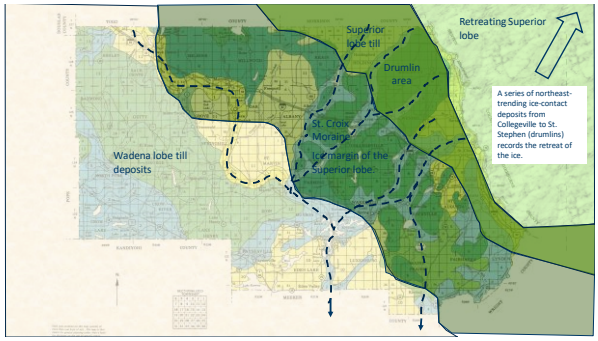
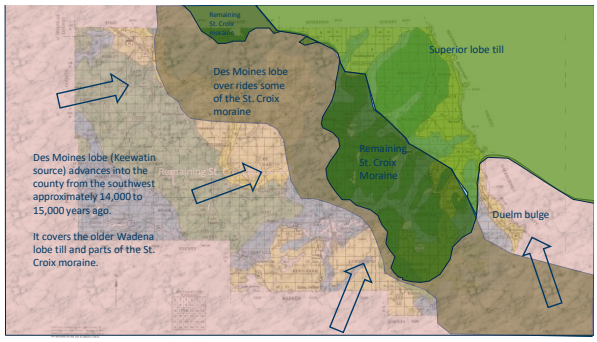

St. Croix Moraine
Superior lobe ice sheet
Wadena lobe till deposits
Ice margin of the Superior lobe.
While the Superior lobe was at it's maximum extent it formed the St. Croix moraine. It is composed, in places, of older underlying sediment that was thrust up into the ice (Powder Ridge ski hill).

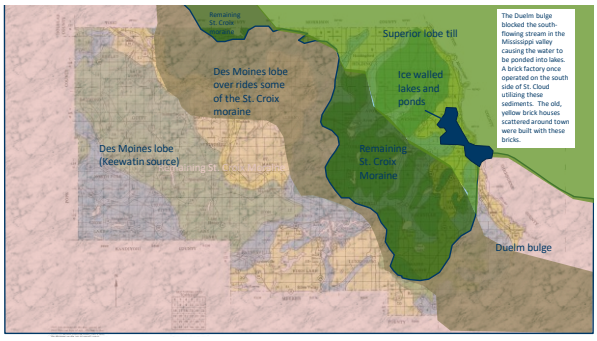
49


Superior lobe till
Retreating Superior lobe
Drumlin area
A series of northeast-trending ice-contact deposits from Collegeville to St. Stephen (drumlins) records the retreat of the ice.
St. Croix Moraine
Wadena lobe till deposits
Ice margin of the Superior lobe.

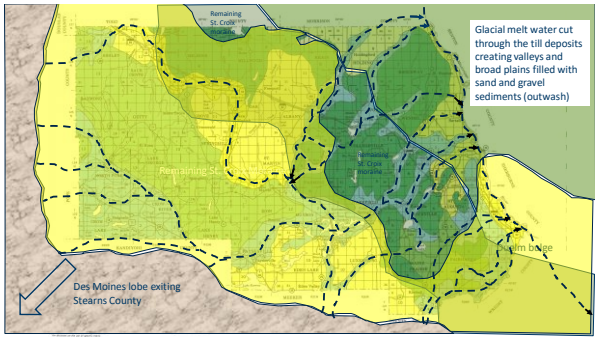
50


Remaining St. Croix moraine
Superior lobe till
Des Moines lobe over rides some of the St. Croix moraine
Des Moines lobe (Keewatin source) advances into the county from the southwest approximately 14,000 to 15,000 years ago.
It covers the older Wadena lobe till and parts of the St. Croix moraine.
Remaining St. Croix Moraine
Duelm bulge

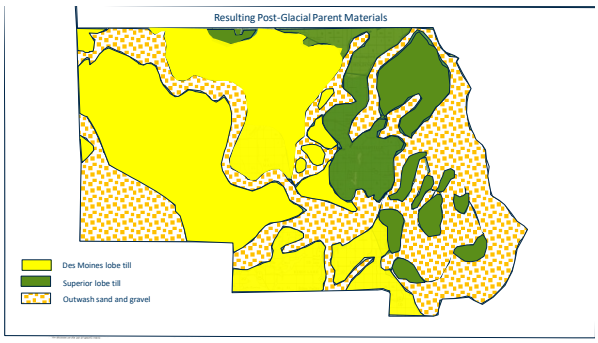
51


Remaining St. Croix moraine
Superior lobe till
Des Moines lobe over rides some of the St. Croix moraine
Ice walled lakes and ponds
Des Moines lobe (Keewatin source)
Remaining St. Croix Moraine
Duelm bulge
The Duelm bulge blocked the south-flowing stream in the Mississippi valley causing the water to be ponded into lakes. A brick factory once operated on the south side of St. Cloud utilizing these sediments. The old, yellow brick houses scattered around town were built with these bricks.

52

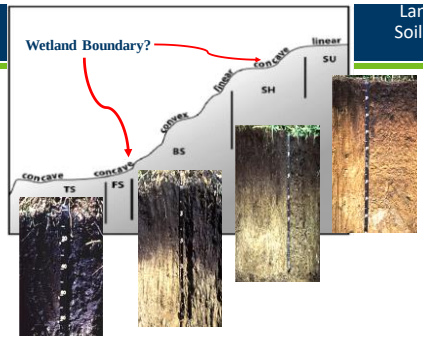

Remaining St. Croix moraine
Glacial melt water cut through the till deposits creating valleys and broad plains filled with sand and gravel sediments (outwash)
Des Moines lobe exiting Stearns County

53


Resulting Post-Glacial Parent Materials
Des Moines lobe till
Superior lobe till
Outwash sand and gravel

55

Landscape Soil Catena



56

Post-Glacial Weathering and Soil Development

The characteristics and properties of soil are the product of the five soil forming factors: **parent material, climate, living organisms, landscape position, and time.**

A descriptive way to present this is: ***The properties of soil are due to the effect of climate and living organisms acting on parent material over time as influenced by topography.***

57

These 5 soil forming factors, acting in concert, influence the processes (weathering) that change the parent material into the soil that we see today.

These processes are:

- **Additions** – deposition from water, wind, mass movement, accumulation of soil organic matter, etc.
- **Losses** – wearing away of the soil from erosion, leaching loss of minerals such as clay and carbonates, loss of soil organic matter through decay, loss of nitrogen due through gasification and leaching loss, etc.
- **Translocation** – movement of minerals and organic mater from one part of the soil profile to another, both up and down.
- **Transformation** – changes that take place in the soil such as chemical weathering of minerals, changes in the nature of the organic matter, and changes in the state of oxidation of iron, aluminum, and manganese.

Stearns County soils have been weathering for about 10,000 years and it is an on-going process that is much influenced by human activity.

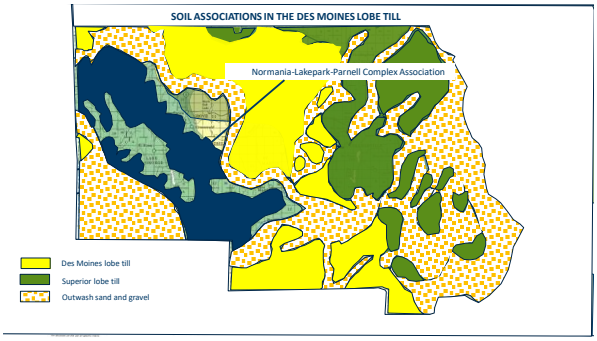
58

One interesting thing to note about Stearns County soils is that they include 3 major groups of formative vegetation: **prairie, forest, and savannah (prairie/forest transition or intergrade).** These are all in close proximity.

Two factors influence this the most:

- **Parent material**: sandy, droughty soils tend to favor grasses over trees.
- **Fire as related to topography**: level to gently rolling landscapes with few entrenched valleys and drainageways, allowed fires to sweep through the landscape, killing most of the woody vegetation on a regular basis. Intermediate landscapes favored savannah.

59



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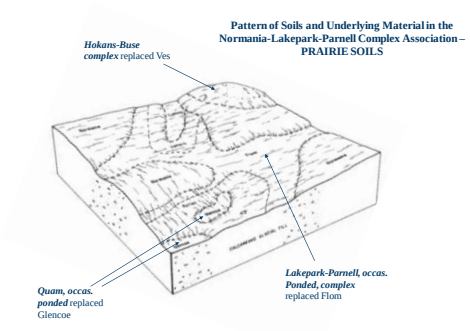

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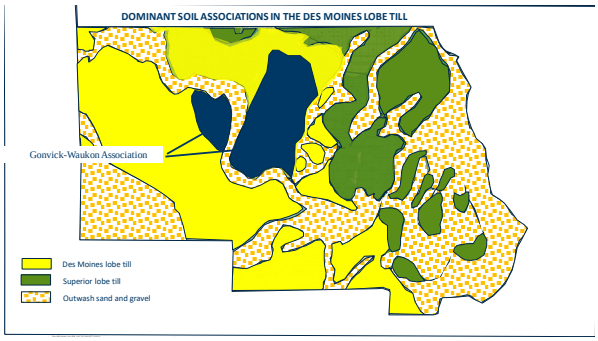
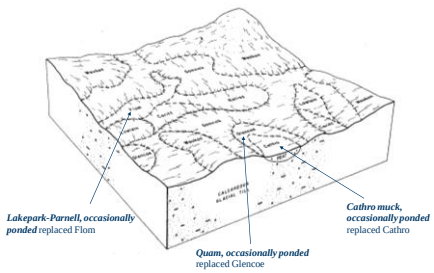


62

Pattern of Soils and Underlying Material in the Gonvick-Waukon Association – SAVANNA SOILS



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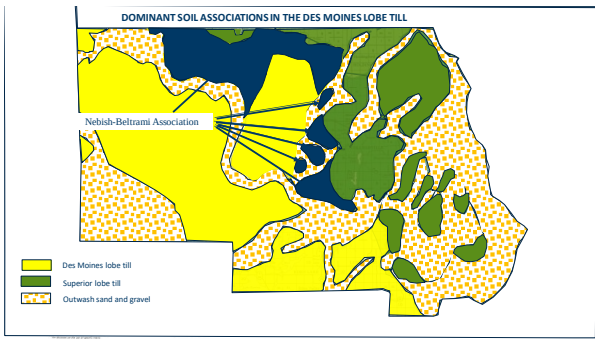
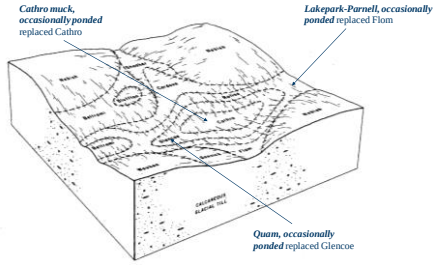


64

Pattern of Soils and Underlying Material in the Nebish-Beltrami Association – FOREST SOILS



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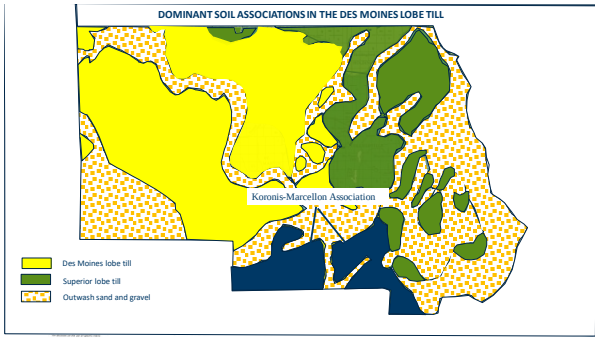
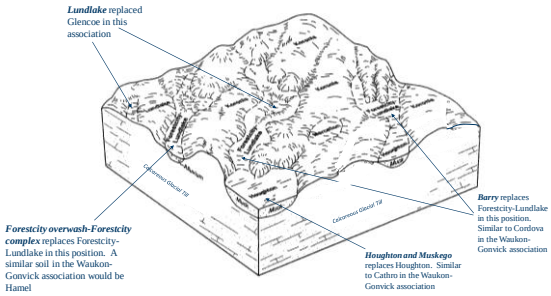


66

Pattern of Soils and Underlying Material in the Koronis-Marcellon Association (draft) – SAVANNA SOILS (adapted from the Wright County Soil Survey Report)



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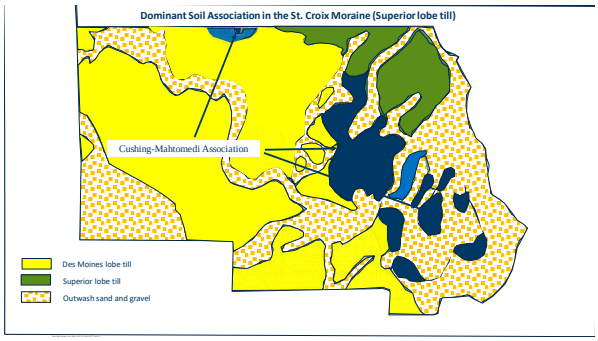
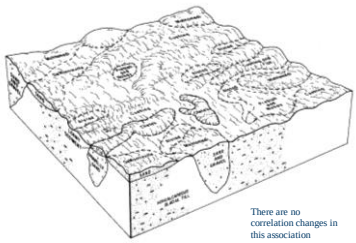


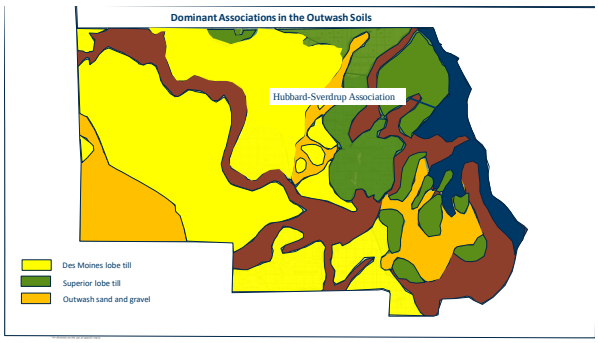
68

Pattern of Soil and Underlying Material in the Cushing-Mahtomedi Association (St. Croix Moraine) – FOREST SOILS



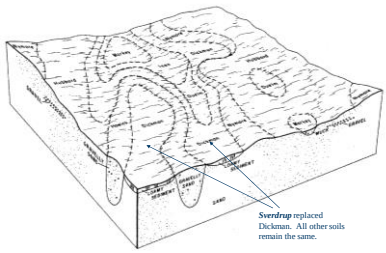
There are no correlation changes in this association

69



70

Pattern of Soils and Underlying Material in the Hubbard-Sverdrup Association – PRAIRIE SOILS



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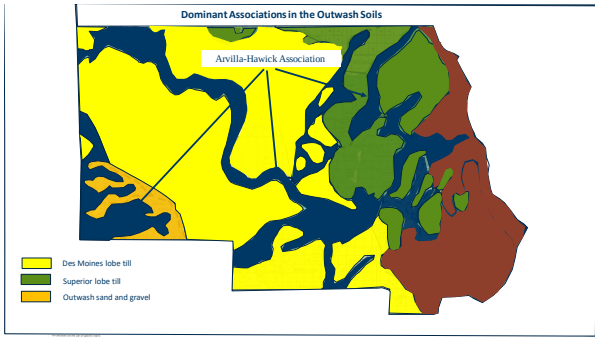
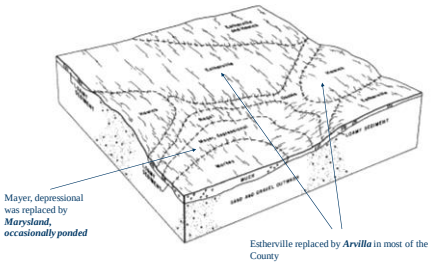


72

Pattern of Soils and Underlying Material in the Arvilla-Hawick Association – PRAIRIE SOILS

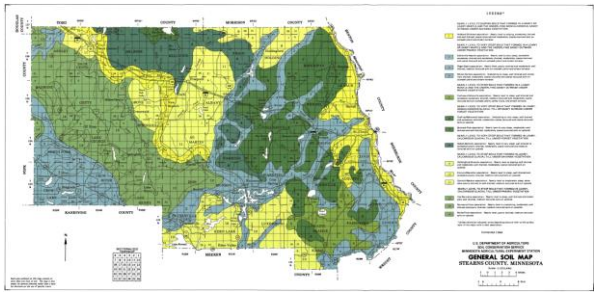


73

As we've seen, most soils in the county occupy specific positions on the landscape.

Therefore, in order to correctly use and interpret a soils map, you must first read the map unit description and acquaint yourself with the landform that best represents this map unit on the landscape.

74



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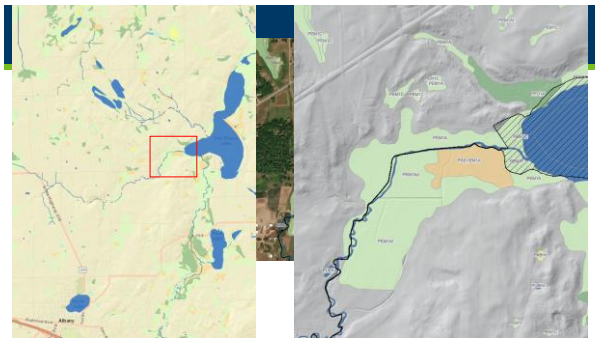

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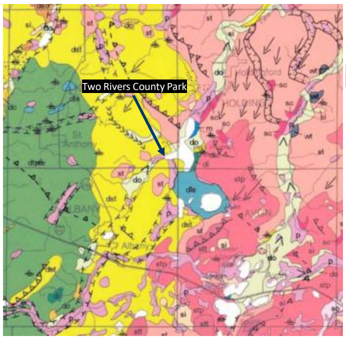


Surficial Geology of Two Rivers County Park

p — **Peat**—Partially decomposed plant matter deposited in marshes; mapped where mostly more than three feet thick. Includes fine-grained organic matter laid down in ponded water, and marl at depth in places. Also includes alluvium along smaller streams, and small bodies of open water. Many thick deposits too small to show in color are indicated by symbol.

dst — **Till over Superior lobe deposits**—Chiefly loam-textured to sandy loam textured till less than twenty feet thick over Superior lobe sandy till, sand, or gravel. Toward the base of the till, and near boundaries with Superior lobe deposits, complex zones of mixed sediment of both lobes are commonly present. Small areas of Superior lobe sandy till at or near the surface are common in the northern and eastern parts of the mapped area. Superior lobe and older sediments are exposed in places along steep sides of meltwater channels.

st — **Till**—Chiefly sandy loam textured, unsorted sediment, with pebbles, cobbles, and boulders. Generally less than ten feet of supraglacial till over dense, subglacial till. Sand and gravel lenses are generally uncommon. Color varies from reddish brown to yellowish brown; yellowish tint is especially evident with depth, owing to incorporation of underlying older sediment. Superior lobe till in general becomes yellower westward across the county. Older sediment is at or near the surface in places along the steep sides of meltwater channels.

77

Parent Material Name

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
32C	Nebish loam, 3 to 15 percent slopes	fine-loamy till	2.0	2.2%
32E	Nebish loam, 8 to 30 percent slopes	fine-loamy till	4.0	4.3%
32F	Nebish sandy loam, 25 to 40 percent slopes	till	1.8	2.0%
109	Cordova loam	till	0.3	0.4%
114	Quam silty clay loam, occasionally ponded, 0 to 1 percent slopes	local alluvium over till	0.1	0.1%
204E	Cushing sandy loam, 15 to 25 percent slopes	till	15.2	16.5%
281	Darfur coarse sandy loam	outwash	1.0	1.1%
406E	Dorset sandy loam, 15 to 25 percent slopes	outwash	6.0	6.5%
453C	DeMontreville loamy sand, 0 to 15 percent slopes	outwash over till	2.5	2.7%
459	Corunna loam	water-worked sediments over till	3.8	4.1%
540	Seelyeville-Seelyeville, ponded, complex, 0 to 1 percent slopes	herbaceous organic material	33.5	36.5%
543	Markey muck, occasionally ponded, 0 to 1 percent slopes	herbaceous organic material over sandy outwash	3.1	3.4%
544	Cathro muck, occasionally ponded, 0 to 1 percent slopes	herbaceous organic material over till	10.3	11.2%
1042F	Cushing and Flak sandy loams, steep	till	1.6	1.7%
W	Water		6.7	7.3%
Totals for Area of Interest			91.9	100.0%

78

Stearns County, Minnesota

544—Cathro muck, occasionally ponded, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2w0lr
Elevation: 590 to 2,030 feet
Mean annual precipitation: 24 to 33 inches
Mean annual air temperature: 37 to 48 degrees F
Frost-free period: 110 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Cathro, occasionally ponded, and similar soils: 85 percent
Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cathro, Occasionally Ponded

Setting

Landform: Depressions
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Herbaceous organic material over till

Typical profile

Oa - 0 to 26 inches: muck
Cg - 26 to 79 inches: loam

79

Stearns County, Minnesota
543—Markey muck, occasionally ponded, 0 to 1 percent slopes
Map Unit Setting
National map unit symbol: 2t4td
Elevation: 590 to 2,030 feet
Mean annual precipitation: 23 to 33 inches
Mean annual air temperature: 36 to 48 degrees F
Frost-free period: 90 to 170 days
Farmland classification: Not prime farmland
Map Unit Composition
Markey, occasionally ponded, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.
Description of Markey, Occasionally Ponded
Setting
Landform: Depressions
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Herbaceous organic material over sandy outwash
Typical profile
Oe - 0 to 28 inches: muck
Cg - 28 to 79 inches: sand

80

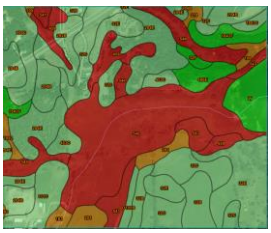
Stearns County, Minnesota
540—Seelyeville-Seelyeville, ponded, complex, 0 to 1 percent slopes
Map Unit Setting
National map unit symbol: 2vvsl
Elevation: 590 to 2,030 feet
Mean annual precipitation: 24 to 33 inches
Mean annual air temperature: 37 to 48 degrees F
Frost-free period: 110 to 170 days
Farmland classification: Not prime farmland
Map Unit Composition
Seelyeville and similar soils: 55 percent
Seelyeville, ponded, and similar soils: 45 percent
Estimates are based on observations, descriptions, and transects of the mapunit.
Description of Seelyeville
Setting
Landform: Depressions
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Herbaceous organic material
Typical profile
Oa1 - 0 to 10 inches: muck
Oa2 - 10 to 79 inches: muck

81

544—Cathro muck, occasionally ponded, 0 to 1 percent slopes
Map Unit Setting

543—Markey muck, occasionally ponded, 0 to 1 percent slopes
Map Unit Setting

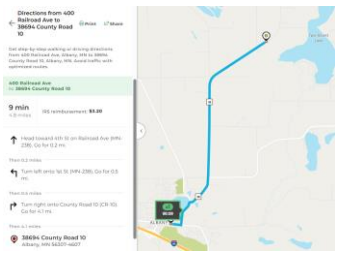
540—Seelyeville-Seelyeville, ponded, complex, 0 to 1 percent slopes
Map Unit Setting



82


Cathro
Markey
Seelyeville
Elevation Profile

83


Directions from 400 Railroad Ave to 38694 County Road 10
9 min

84