Wetlands 101 Webinar Series

Part 3: Hydric Soils

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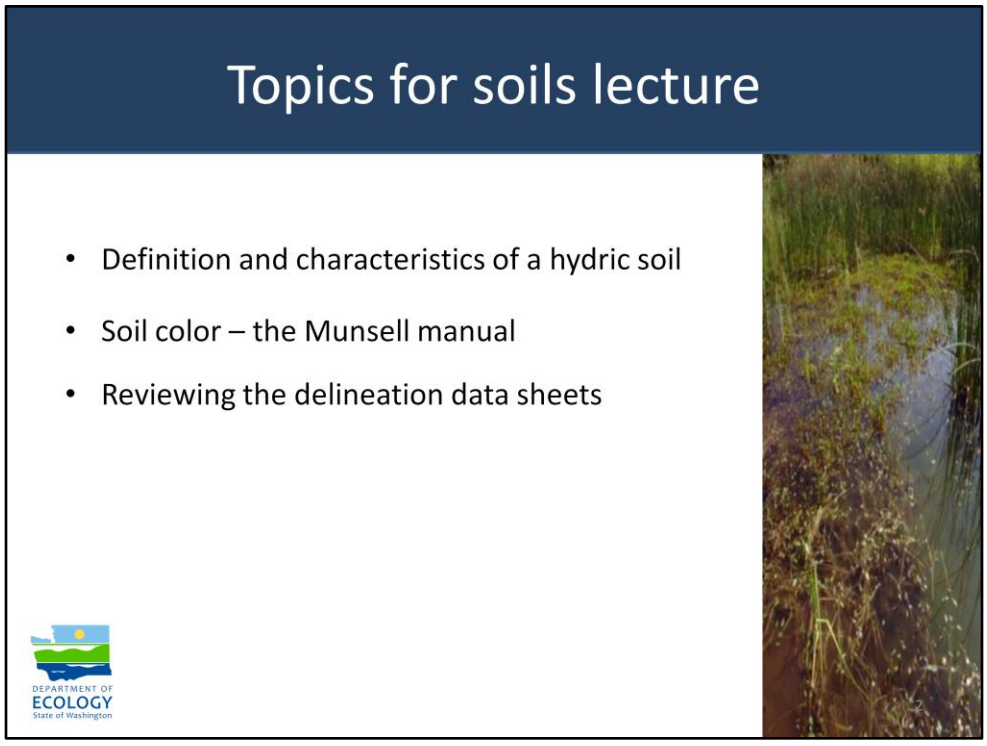
DEPARTMENT OF ECOLOGY State of Washington

COASTAL TRAINING PROGRAM Washington



These are the three topics that we will cover in today's hydric soils presentation. The purpose of the presentation is to provide a brief introduction into the regulatory definition and characteristics of a hydric soil, how soils are described and the Munsell color system and how to critique the soils section of a delineation data sheet. We realize that there is a lot of information in these presentations and that practice in the field is essential to learning how to delineate and recognize a wetland. Our purpose is to help you understand the process and be able to critically review delineation reports.

Definition and Characteristics 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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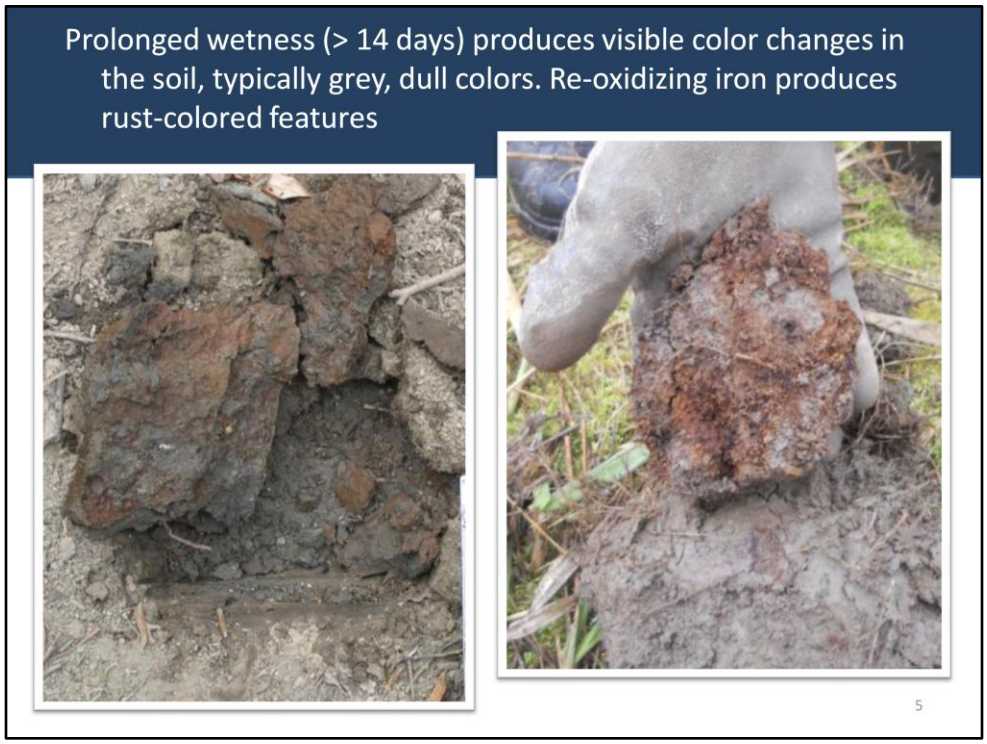
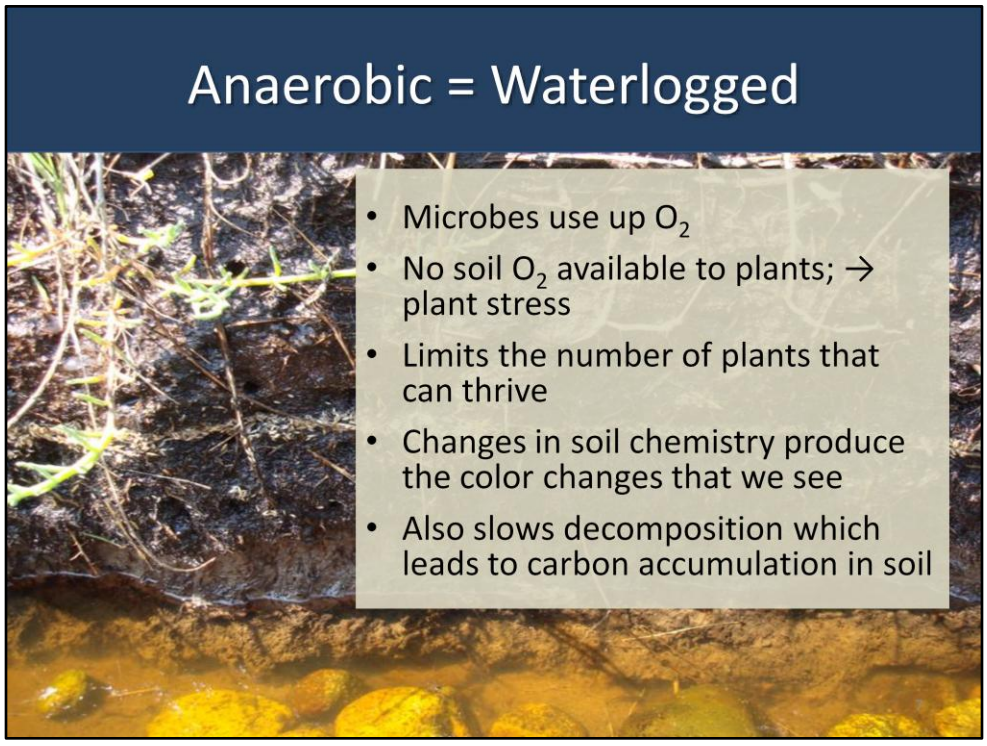
Hydric soils are one-third of the wetland recipe; the most enduring leg of the three-legged stool. To identify and delineate a wetland, you need to be able to identify whether a soil is hydric or not. You also need to know how to document this on the field data sheets. This is the definition developed by the National Technical Committee for Hydric Soils and is the regulatory definition.

In most settings, 14 continuous days of saturation/inundation is enough to produce noticeable soil color changes. The growing season is important because the soil needs to be warm enough (> 5 °C or 41 °F) for microbial activity; microbes are largely responsible for the hydric soil color changes. Generally, soils need to be saturated within 12" of the surface to produce the hydric soil color changes. Since sandy soils usually drain more quickly, saturation and hydric soil indicators should be present closer to the surface.



Hydric (wetland) soils are typically low chroma (≤ 2) giving them a dull appearance. Oxidized iron (Fe^3) turns orange/red and typically has a high chroma (≥ 6). Soils that have been wet for long periods may change to a redder color as the soil is exposed to the air and are said to have a reduced matrix. The gray colors that we see in these two soil samples are typical of hydric soils.

Upland soils are often a brighter color and have a “fluffy” or granular appearance. Again, you can see that the wetland soil is gray, whereas the upland soil is reddish brown.



Once a soil becomes saturated (or inundated), it takes a while for soil to become anaerobic and a bit longer for the soil to become reduced. Once the soil becomes reduced it will stay reduced (and the electrical charge will continue to fall) until the soil drains and is no longer saturated. For delineation purposes, a positive reaction to alpha-alpha dipyridyl or dipyridyl paper is typically sufficient evidence of reduction. A reduced matrix, soil color change after approx. 30 minutes exposure to the air also shows that soils are reduced.

Before we move on to soil colors, does anyone have any questions on the definition or characteristics of hydric soil?

What We Look at in the Soil

- Color
  - Based on Munsell soils color system
  - Matrix and inclusions
- Redox features
  - Concentrations and depletions
- Texture
  - Mineral or organic
  - Mineral textures: sandy or loamy

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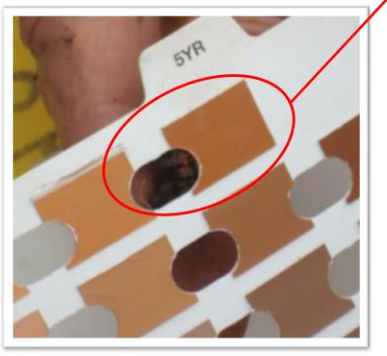
When describing soil colors, you should describe all of the colors that you see for a given layer. The matrix is the dominant portion of the soil. Soil layers are based on a visible change in color, texture or the abundance of inclusions. There are three different principal colors in this photograph. The lighter area in the top central portion of the soil is depleted, the matrix above it and to sides is browner in color and then there is a orange band of redoximorphic concentrations in the center of the photo.

Soil Colors

Munsell Soil Color Chart chips are used to match soil color with respect to hue (H), value (V), and chroma (C).

Soils should be **moist** when matching colors.



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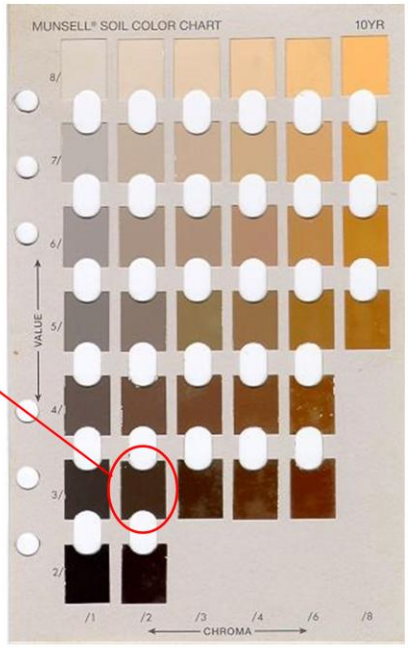
The Munsell Soil Color Chart is the only system that should be used to describe soil colors. When describing soil colors, soils should be moist (not dripping wet) and should be colored in the field soon after opening up the soil pit. Hold the soil in the opening next to the color chip to compare the color. The soil color is described by hue (the Munsell page) and then value and chroma.

Soil colors

10YR 3/2 (H V/C)

Soil colors can be intermediate to the chips

Colors should not be "rounded" to meet an indicator



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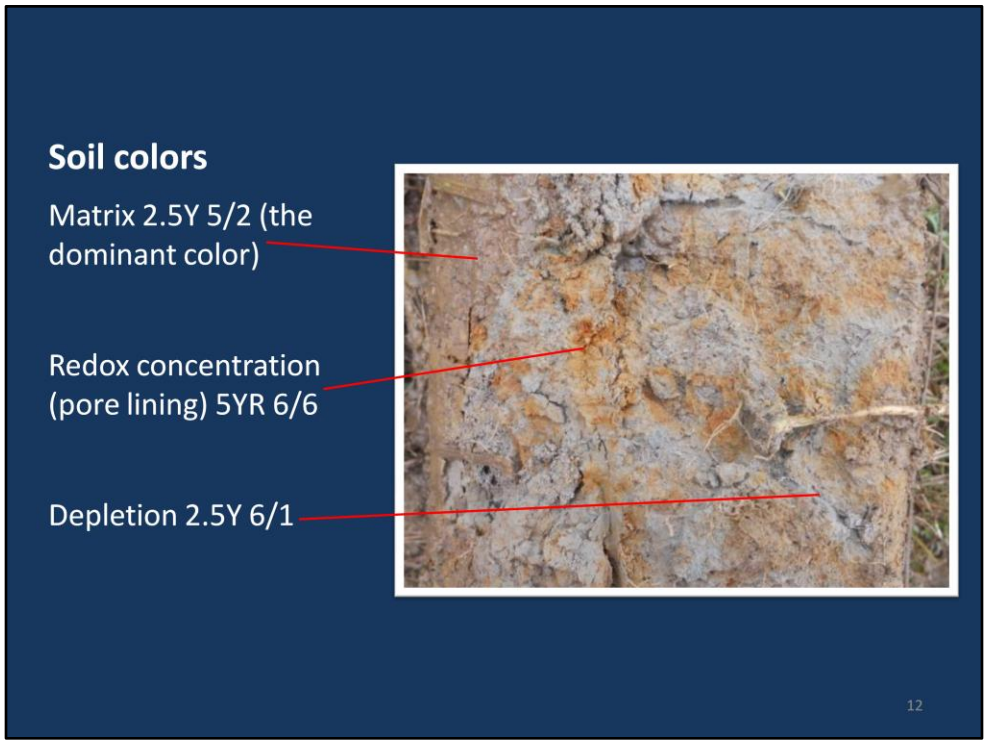
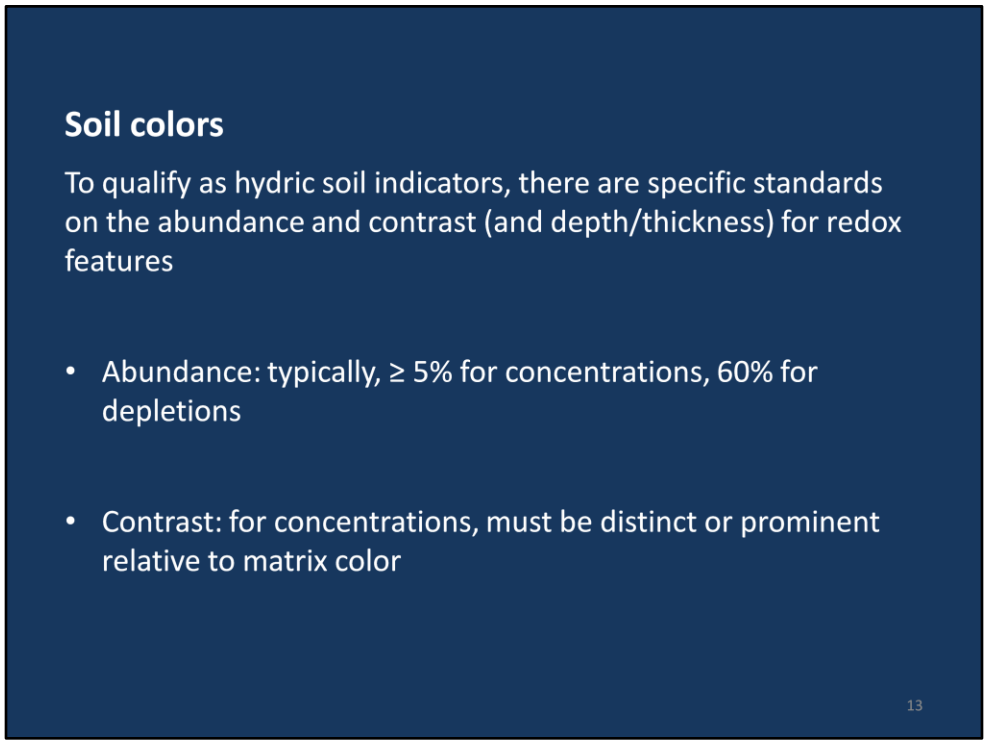
If a soil indicator lists a specific color such as a matrix value ≥ 4 and you color the soil at a value of 3.5, it does not meet the minimum value specified for the indicator.



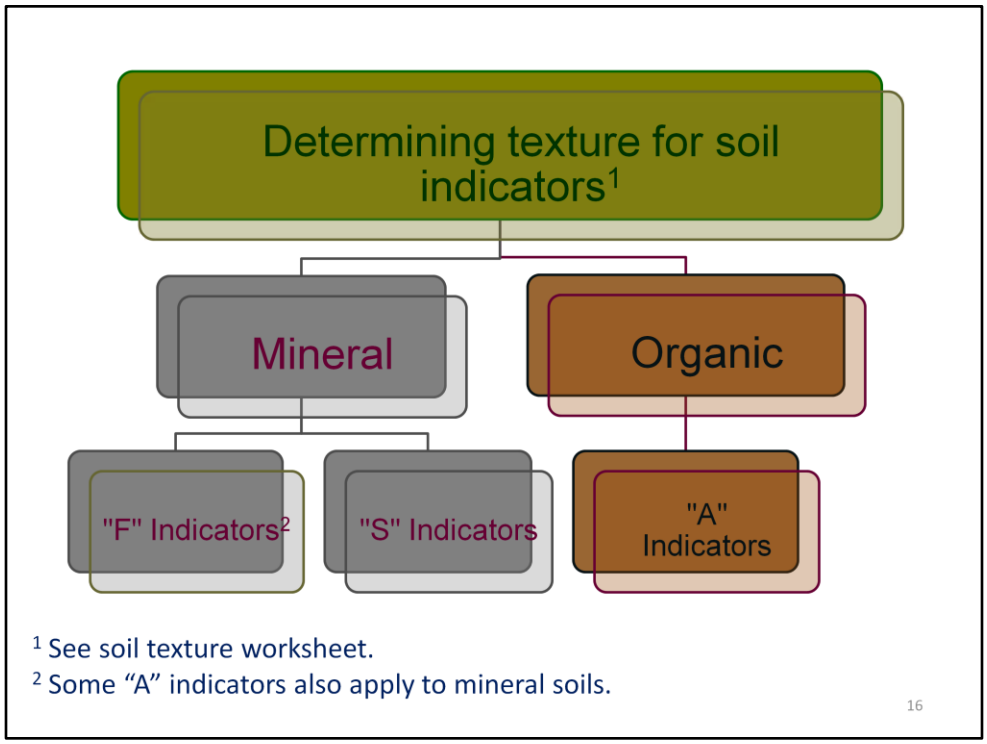
Redox features (concentrations and depletions) are clearly evident in this soil slice. When describing soil features, be sure to list the depth, thickness and texture of the soil layer as well as the color and percentage of the matrix and inclusions. Colors, percent of the soil ped and textures should be described for each inclusion within a layer.



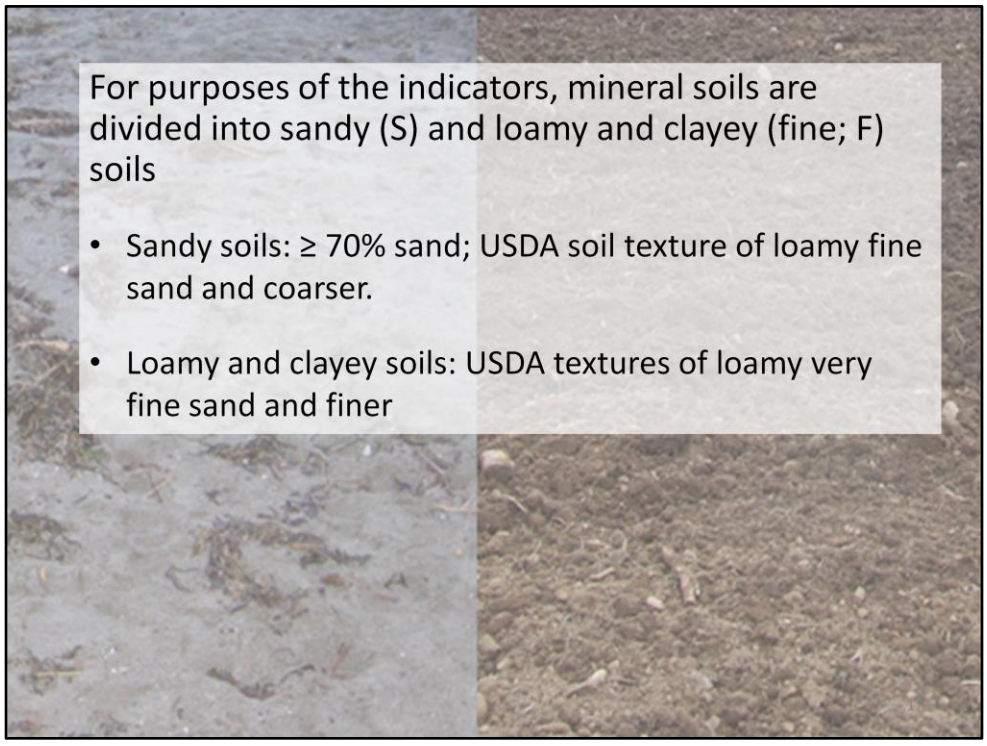
Estimate abundance as best you can. There are sample percentages shown in the front of the Munsell books. When determining if a soil is hydric, be sure to review the minimum criteria for abundance and contrast for a given indicator.

Rust-colored areas in this soil include a pore lining along a root channel. As hydric soil indicators, these inclusions should be soft masses and not hard nodules or concretions. Diffuse edges (halos) around the redox concentration typically indicate that soils are currently wet (not relict features). Redox concentrations in pore linings along living roots (oxidized rhizospheres) always indicate contemporary wetland hydrology (Hydrology Indicator C3) and may be a hydric soil indicator.

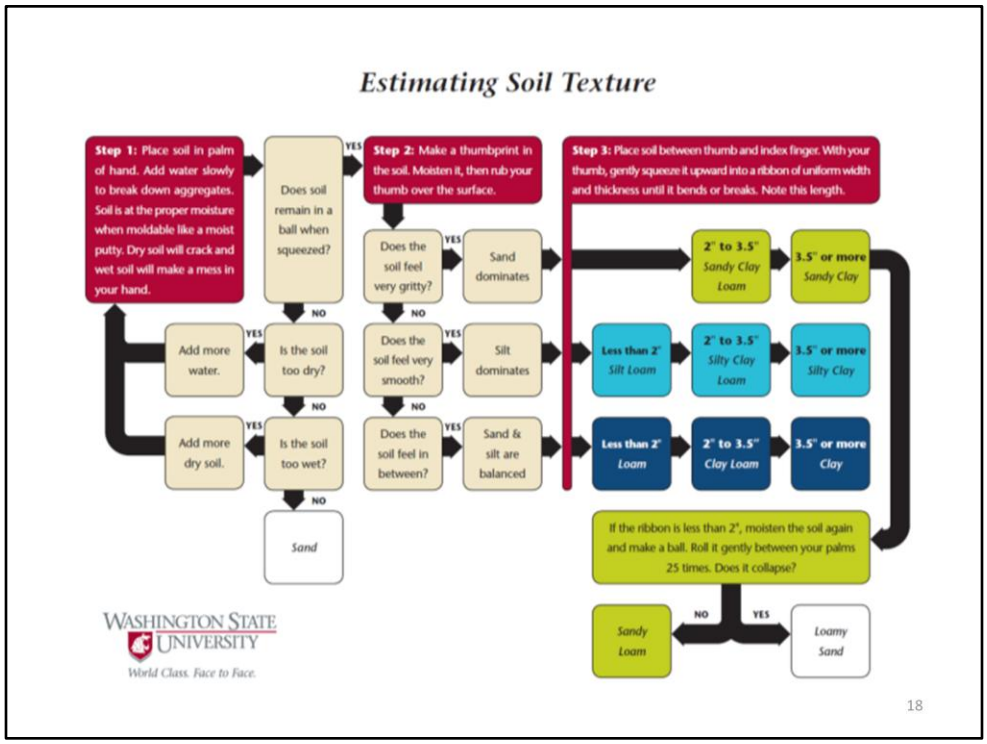
Depletions are light-colored areas within the soil where water has stripped away iron, manganese and organics. There are specific criteria for a depleted matrix which are listed in the regional supplement and hydric soil indicators glossaries.



Several "A" indicators also apply to mineral soils; if you have a 2-4" layer of muck within the upper 6" of soil, you may have a mucky modified mineral soil and should look at the appropriate indicator (S1 or F1). Field tests for determining organic content are described in the Regional Supplements (when you rub the soil, organic soils will feel greasy). Determining whether a mineral soil is a sandy or loamy soil is described below.



In examining a soil, the first question to answer is whether you are working with a mineral or organic soil. Organic soils are covered in the All Soils (A) indicators. If the soil you are working with is mineral, then you need to decide if it has a sandy texture or is finer than a sand. In reviewing the data sheets and wetland report, the listed soil textures should be the USDA textures. There are engineering textures but they should not be used for wetland delineation purposes.



To determine if the texture of a soil is sand, remove all of the roots and gravel from ~ a ¼ cup volume of soil, thoroughly moisten the soil and squeeze into a ball. Drop the ball of soil into your open palm from ~ 12" height. If the ball cracks or breaks apart, the soil texture is sand and you should be using the "S", not "F" indicators.

Organic Soils

Organic soils are classified by the proportion of identifiable plant fragments

- Peat – minimal decomposition
  - identifiable plant fibers
  - red – brown color
- Mucky Peat – intermediate decomposition
- Muck – highly decomposed
  - few to no identifiable plant fibers
  - dark brown – black color

Muck will stain your hands; mineral soil will dry to a powder that can be brushed off

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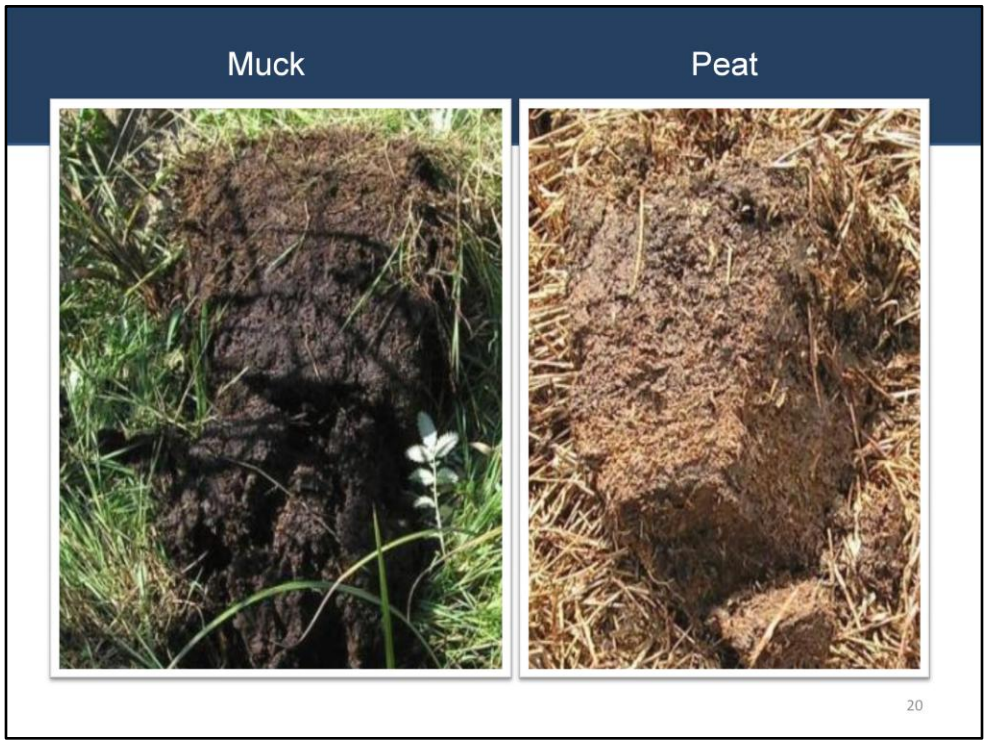
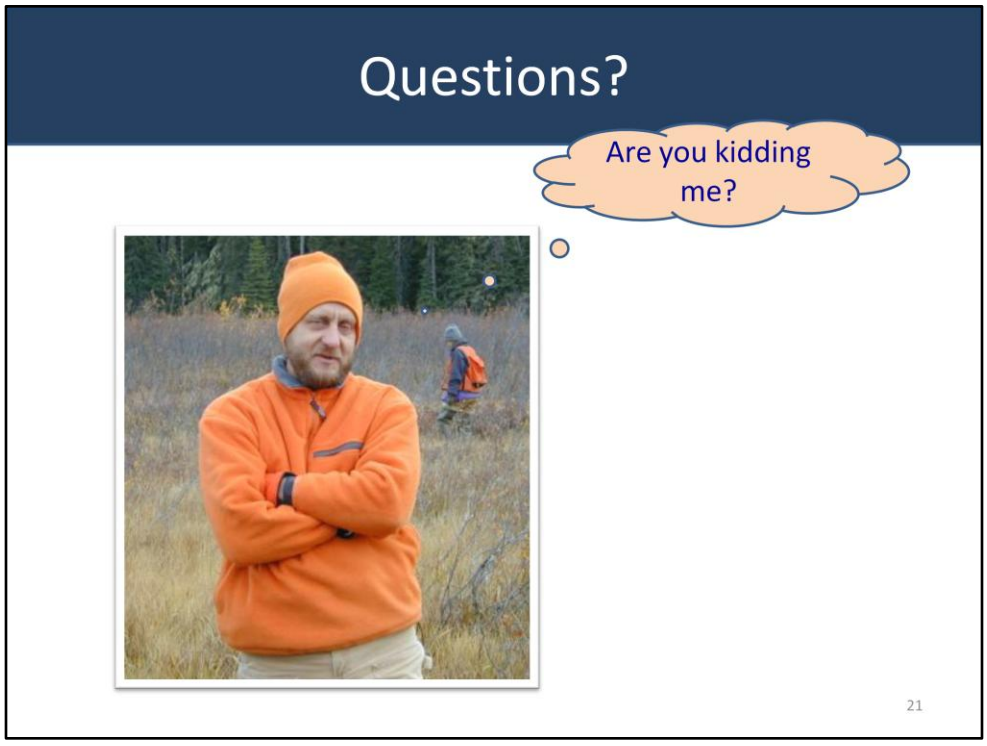


Mucks are typically dark brown or black (v/c 2/1, 2/2) with very few identifiable plant fragments. Peats may be dark brown to reddish brown (2/2, 4/3) with visible plant fibers.

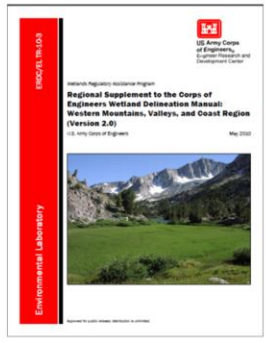


Before we move on to reviewing the delineation data sheets, are there any questions on describing soil colors?

Delineation Data Sheet

In March 2011 state delineation manual was rescinded and use of applicable Corps regional supplement required for state applications

- Columbia Basin: Arid West Regional Supplement (AW)
- Remainder of state: Western Mountains, Valleys and Coast Regional Supplement (WMVC)
- Regional supplements available at: http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/reg_supp.aspx



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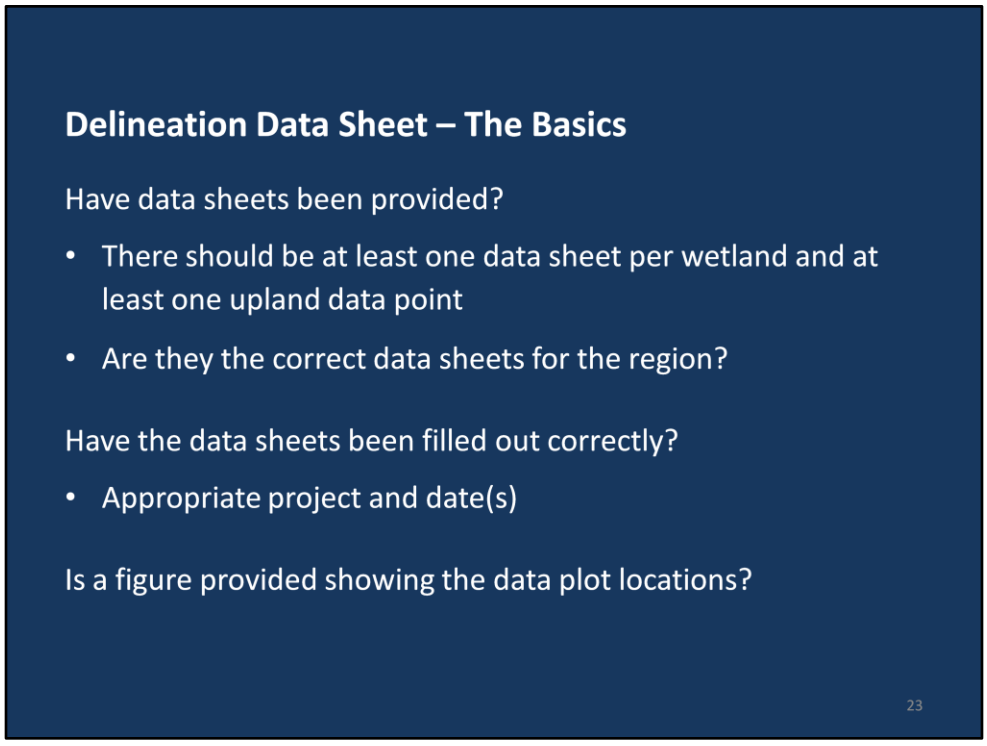
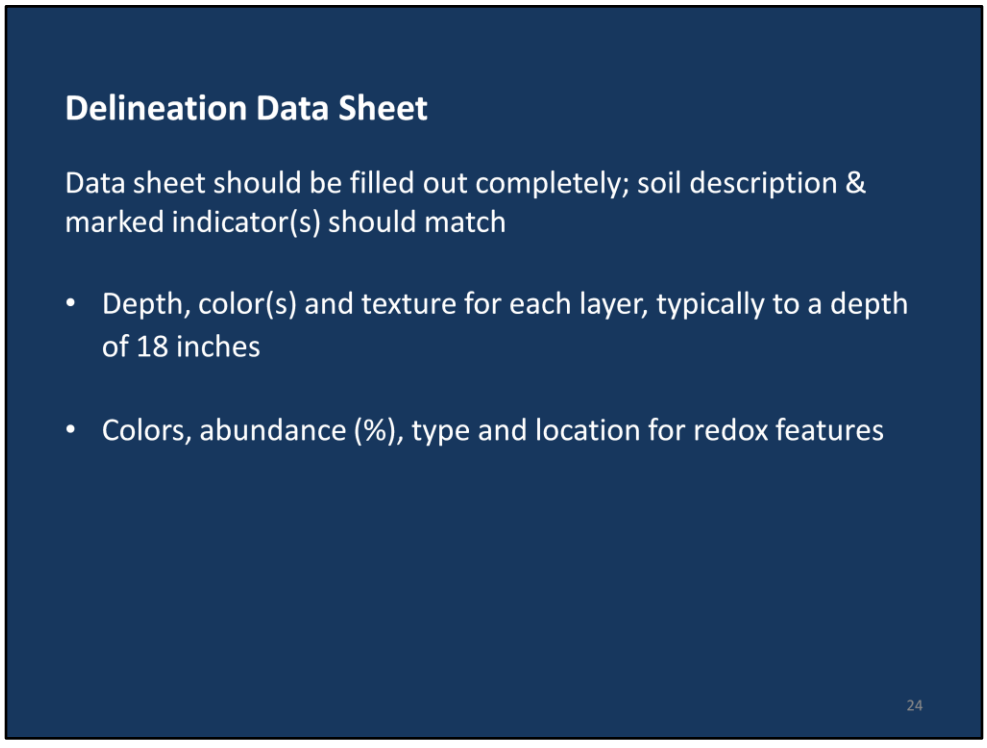
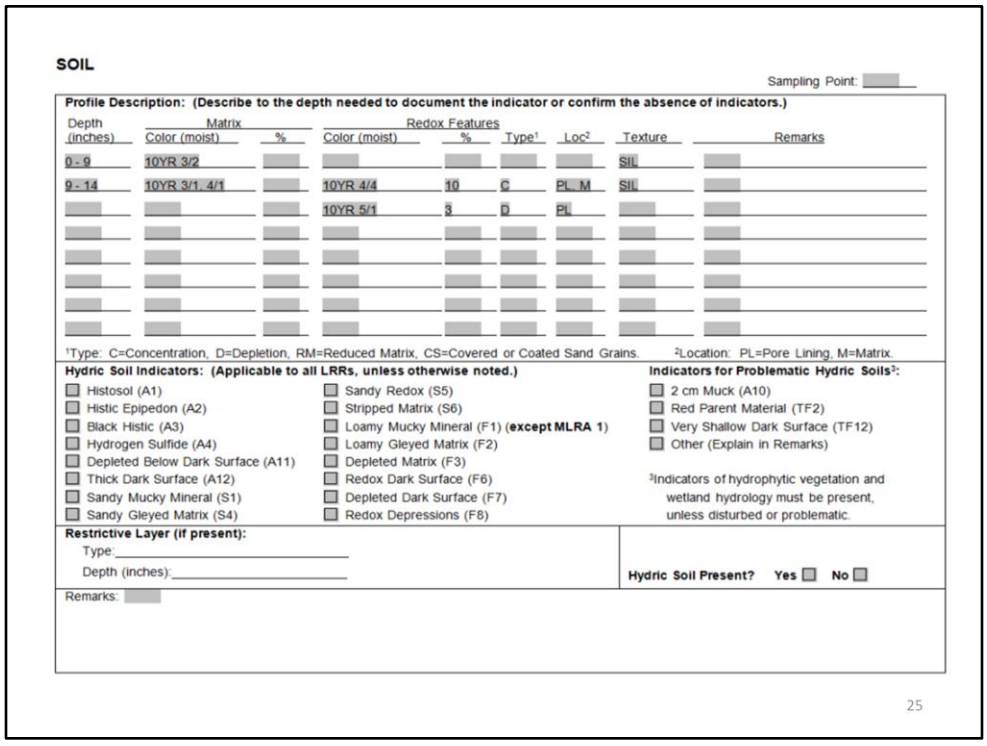
Corps regional supplements are now the state required standard for delineating wetlands. Local jurisdictions may still require 1997 state delineation manual. When reviewing a delineation report, one of the first places to check is the delineation data sheets. You should be at least somewhat familiar with the applicable Corps regional supplement to review a delineation. A delineation report that does not include data sheets and a figure showing the delineation sampling points is incomplete.



Local ordinances may still reference the 1997 state delineation manual. If the project will be working in wetlands, state approval will be required and the applicable Corps regional supplement is the delineation standard.



Each soil should be described to a depth of ~ 18". There shouldn't be any gaps, such as no description for the surface layer, although if soils are uniform below a given depth, it is a common practice to list the last depth with a + (13"+).



SOIL

Sampling Point:

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0 - 9	10YR 3/2						SIL	
9 - 14	10YR 3/1, 4/1		10YR 4/4	10	C	PL, M	SIL	
			10YR 5/1	3	D	PL		

[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: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

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

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ No ☐

Remarks:

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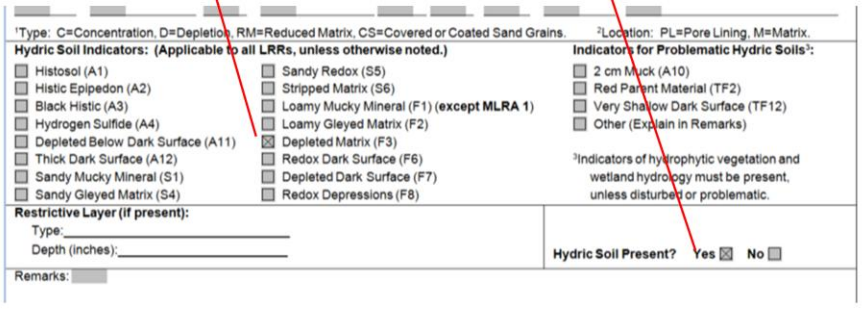
The Soils section of the WMVC delineation data sheet. When reviewing a delineation report, the data sheets are typically the first thing I check. If you receive a delineation report that doesn't include the data sheets, you should ask that they be provided.

Delineation Data Sheet

If a hydric soil indicator is checked on the data sheet then the "Yes" box should be checked for "Hydric Soils Present?"

- Soil section of data sheet
- Summary of Findings on first page of data sheet



[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: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☒ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

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

Restrictive Layer (if present):

Type:_____

Depth (inches):_____

Hydric Soil Present? Yes ☒ No ☐

Remarks:

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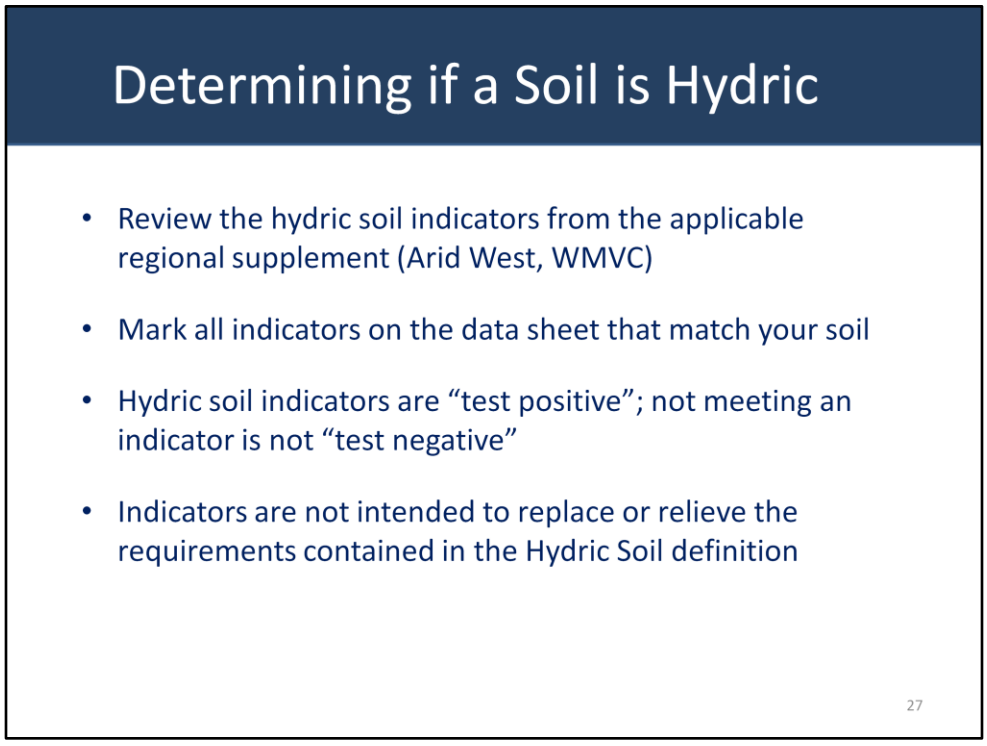
Should check delineation data sheets for internal consistency. If a soil is determined to be hydric but a hydric soil indicator is not checked, explanation should be provided in Remarks section justifying determination.



Occasionally a soil sample will match more than one indicator and each of those indicators should be marked on the data sheet. If you have a reduced matrix that should be included in the remarks. A reduced matrix = layer ≥ 4" thick within the upper 12" with matrix value ≥ 4 and chroma ≤ 2 whose hue becomes redder ≥ 1 page and/or chroma ↑ ≥ 1 chip.

Regional Supplement Indicator Descriptions

Indicator A12: Thick Dark Surface

Technical Description: A layer at least 6 in. (15 cm) thick with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less starting below 12 in. (30 cm) of the surface. The layer(s) above the depleted or gleyed matrix must have a value of 2.5 or less and chroma of 1 or less to a depth of at least 12 in. (30 cm) and a value of 3 or less and chroma of 1 or less in any remaining layers above the depleted or gleyed matrix. Any sandy material above the depleted or gleyed matrix, when observed with a 10- or 15-power hand lens, must have at least 70 percent of the visible soil particles masked with organic material. When observed without a hand lens, the material appears to be nearly 100 percent masked.

Applicable Subregions: Applicable throughout the Western Mountains, Valleys, and Coast Region.

User Notes: The soil has a depleted matrix or gleyed matrix below a black or very dark gray surface layer 12 in. (30 cm) or more thick (Figure 9). This indicator is most often associated with overthickened soils in concave landscape positions. Two percent or more distinct or prominent redox concentrations (Table A1), including iron/manganese soft masses, pore linings, or both, are required in soils that have matrix values/chromas of 4/1, 4/2, and 5/2 (Figure A1). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. See the Glossary (Appendix A) for the definitions of depleted and gleyed matrix.

Figure 9. Deep observations may be necessary to identify the depleted or gleyed matrix below a thick, dark surface layer. In this example, the depleted matrix starts at 20 in. (50 cm).

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Sample indicator description (Indicator A12) from the WMVC Regional Supplement. All of the indicators follow the same format with the Technical Description, followed by the Applicable Subregions and the User Notes. For all of the indicators, you should read the User Notes to fully understand the indicator description.

Most Frequently Seen Indicators

A11

S5 (WMVC)

F3

F6

SOIL Sampling Point: _____

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks

[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: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ★ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ★ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ★ Depleted Matrix (F3)
- ★ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

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

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No _____

Remarks:

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Here are the most frequently encountered indicators within the AW and WMVC. F3 (Depleted Matrix) is the most frequently seen hydric soil indicator at wetland boundaries.

Depleted Below Dark Surface (A11)

User Notes: This indicator often occurs in grassland soils (Mollisols), but also applies to other soils that have dark-colored surface layers, such as umbric epipedons and dark-colored ochric epipedons (Figure 8). For soils that have dark surface layers thicker than 12 in. (30 cm), use indicator A12. Two percent or more distinct or prominent redox concentrations, including iron/manganese soft masses, pore linings, or both, are required in soils that have matrix values/chromas of 4/1, 4/2, and 5/2 (Figure A1). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. See the Glossary (Appendix A) for definitions of depleted matrix, gleyed matrix, distinct and prominent features, and fragmental soil material.

In some places, the gleyed matrix may change color upon exposure to air (reduced matrix). This phenomenon is included in the concept of a gleyed matrix (USDA Natural Resources Conservation Service 2002).

This indicator is commonly found at wetland boundaries in Mollisols and other dark-colored soils.

Figure 8. In this soil, a depleted matrix starts immediately below the black surface layer at approximately 11 in. (28 cm).

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Indicator descriptions and photos from WMVC regional supplement. This photo shows very characteristic colors for hydric soils with a dark surface layer, likely high in organics, with a lighter layer below showing depletions and redox concentrations.

Sandy Redox (S5) in WMVC

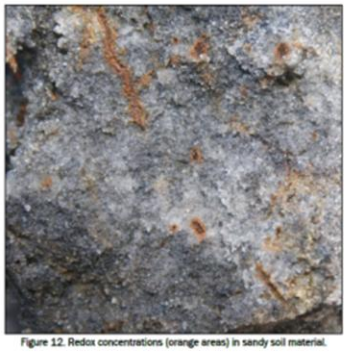

Figure 12. Redox concentrations (orange areas) in sandy soil material.

Applicable Subregions: Applicable throughout the Western Mountains, Valleys, and Coast Region.

User Notes: Distinct and prominent are defined in the Glossary (Appendix A). Redox concentrations include iron and manganese masses (reddish mottles) and pore linings (Vepraskas 1992). Included within the concept of redox concentrations are iron/manganese bodies as soft masses with diffuse boundaries. Common (2 to less than 20 percent) to many (20 percent or more) redox concentrations (USDA Natural Resources Conservation Service 2002) are required. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible.

For sandy soils in LRR E, this is the most common indicator for identifying the wetland/non-wetland boundary.

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This is the most common hydric indicator for sandy soils. For sandy soils, indicators usually must begin within 6 inches of the soil surface. The large redox concentration at the top left of this photo is along a pore lining and if it were found along a living root, it would be an oxidized rhizosphere (Hydrology Indicator C3).

Sample Data Sheet

Depth (inches)	Matrix		Redox Features				Texture
	Color (moist)	%	Color (moist)	%	Type	Loc	
0-13	10YR 3/2	95	7.5YR 5/8	5	D	PL	Si L
13-18	10YR 4/1	90	7.5YR 5/6	35	RM	M	Si L

Checked Hydric Soil Indicators: Loamy Gleyed Matrix (F2); Depleted Matrix (F3)

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This is sample data from a WMVC data sheet that we will use to practice reviewing the indicators. Has the data sheet been filled out completely and if a hydric soil indicator was checked, does the data support that conclusion?

Sample Data Sheet

Is this a hydric soil?

If so, which indicator(s) does it meet?

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Questions that should be asked when reviewing data sheets; does the data support the conclusion?

Sample Data Sheet

Is this a hydric soil? Yes

If so, which indicator(s) does it meet? Redox Dark Surface (F6)

Soil colors, redox features and depths do not match the checked indicators: Loamy Gleyed Matrix (F2); Depleted Matrix (F3)

Indicator F6: Redox Dark Surface

Technical Description: A layer that is at least 4 in. (10 cm) thick, is entirely within the upper 12 in. (30 cm) of the mineral soil, 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
- 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.

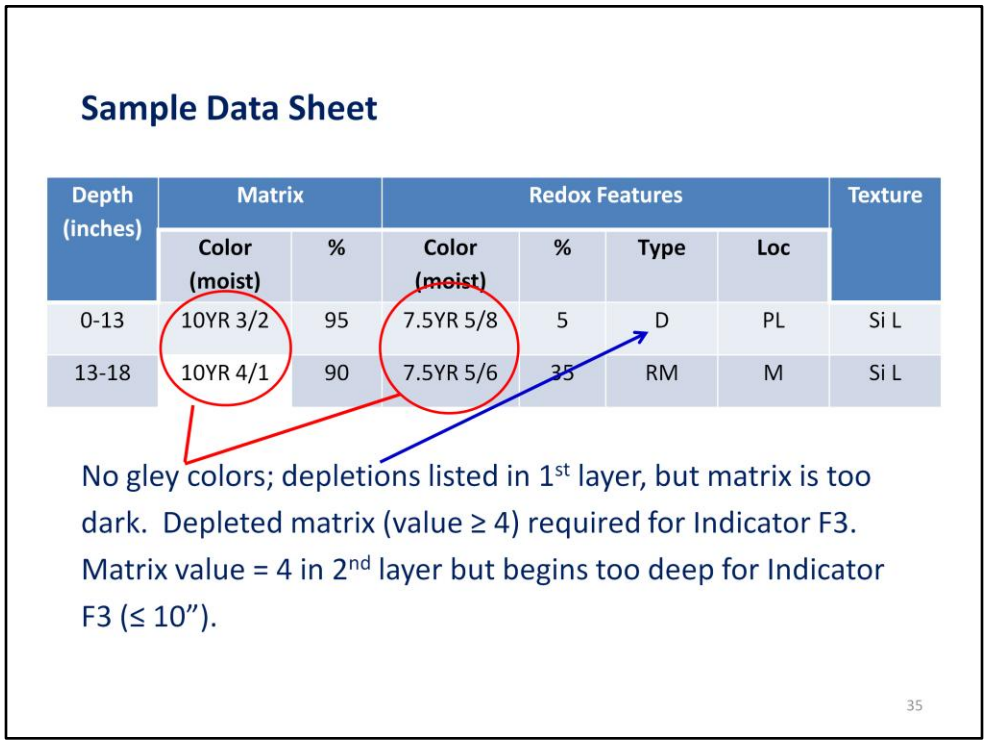
Applicable Subregions: Applicable throughout the Western Mountains, Valleys, and Coast Region.

User Notes: This is a very common indicator used to delineate wetland boundaries in soils with dark-colored surface layers. The layer meeting the requirements of the indicator may extend below 12 in. (30 cm) as long as at least 4 in. (10 cm) occurs within 12 in. (30 cm) of the surface. Redox concentrations are often small and difficult to see in mineral soils that have dark (value of 3 or less) surface layers due to high organic-matter content (Figure 18). The organic matter masks some or all of the concentrations that may be present; it also masks the diffuse boundaries of the concentrations and makes them appear to be more sharp. Careful examination is required to see what are often brownish redox concentrations in the darkened materials. If the soil is saturated at the time of sampling, it may be necessary to let it dry at least to a moist

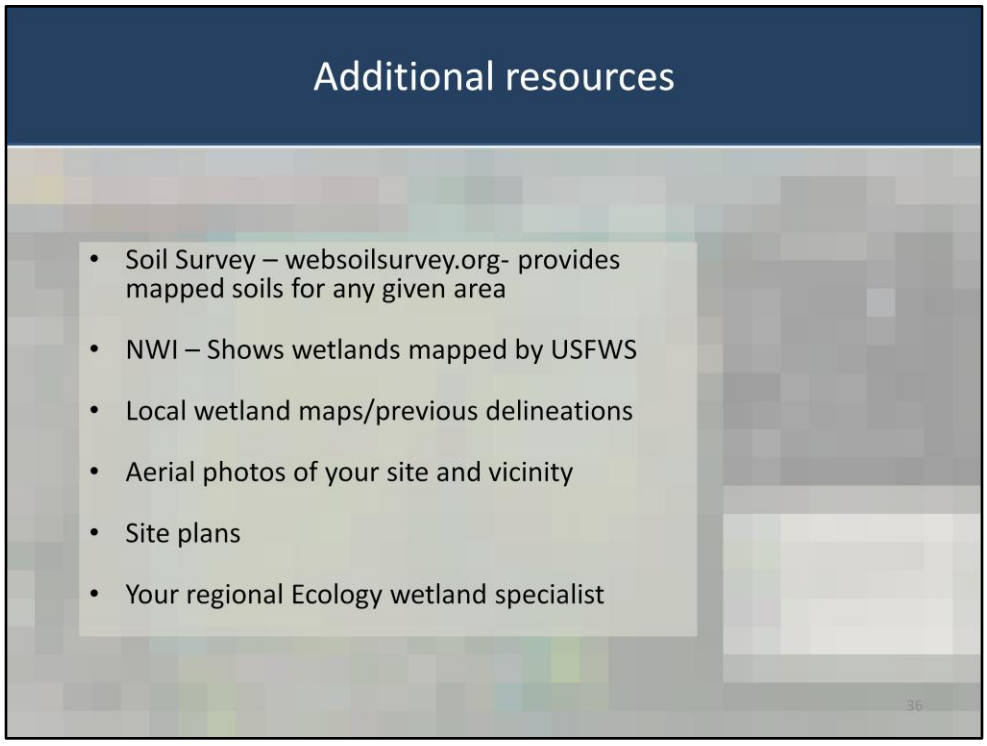
Figure 18. Redox features can be small and difficult to see within a dark soil layer.

34

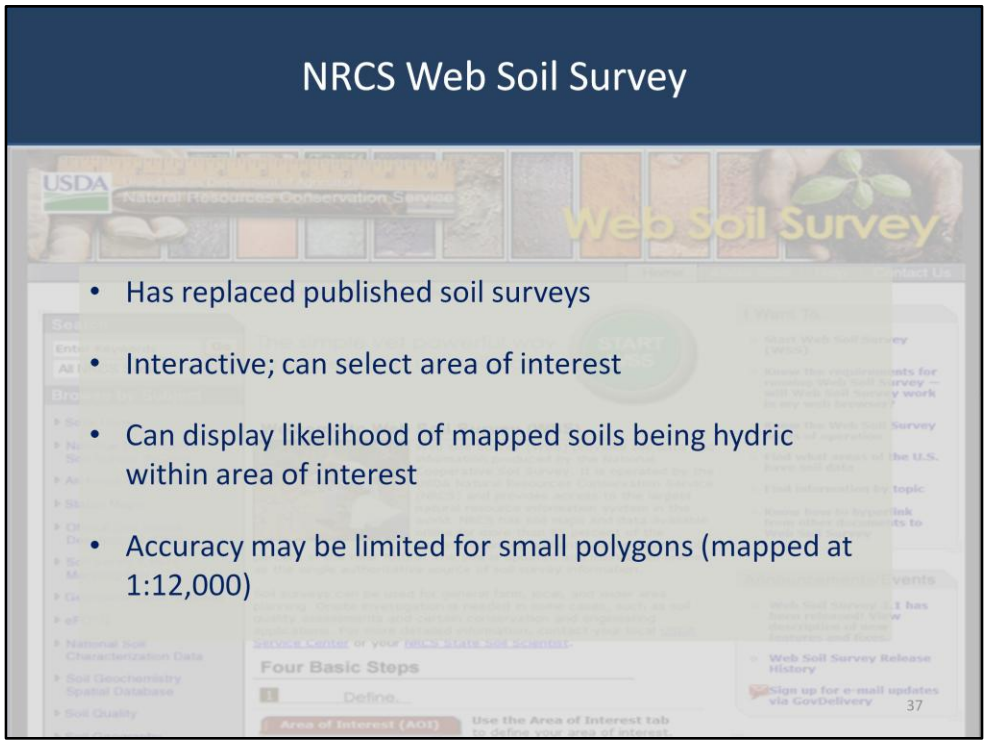
Based on the data provided, this is a hydric soil, but it doesn't meet either of the selected indicators. The correct indicator is Redox Dark Surface (Indicator F6).



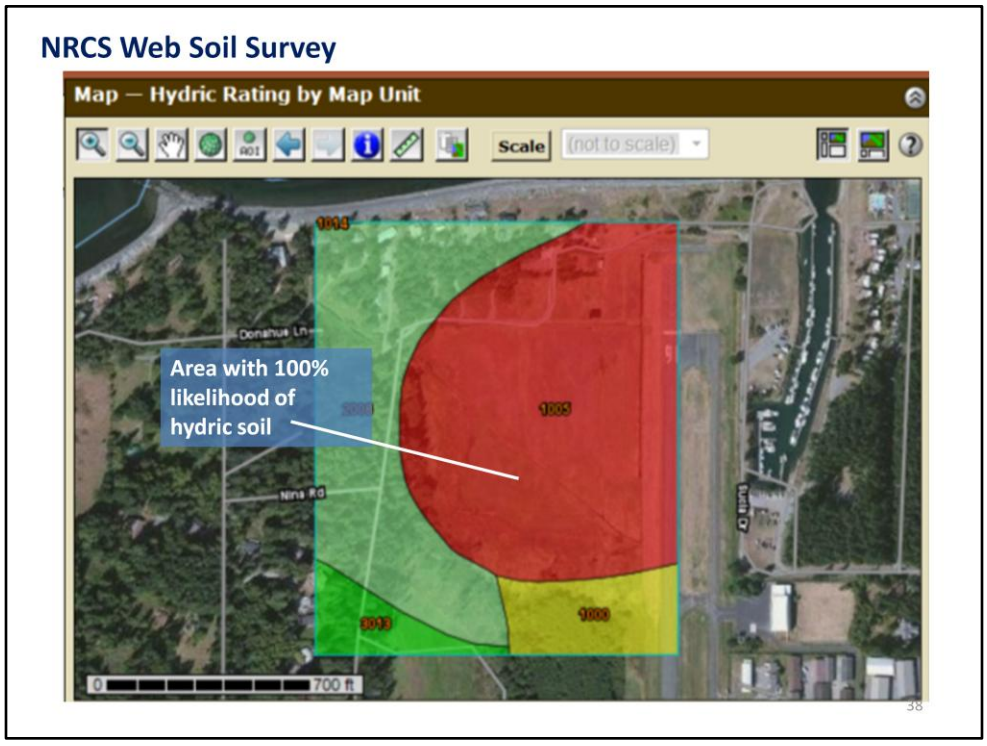
Same comments for Indicator A11, where depleted layer would need to begin within 12" of the surface. If depletions are present in 1st layer, need to describe the colors. Colors of described redox features appear to be concentrations with a prominent contrast. Also, reduced matrix is listed for Type of redox feature in 2nd layer, but insufficient information is given on contrast or time for color change. Is the redox feature listed a concentration or the color change from the 10YR 4/1 matrix. No information provided in Remarks on data sheet. Percent total for any given layer should total 100% and 2nd layer sums to 125%.



Web Soil Survey and NWI are useful tools for general information about a site and should be checked before a site visit or when reviewing a delineation. Accuracy of these resources is generally is not sufficient for permit applications and conditions on the ground should be the basis for determining if wetlands are present.



Soil surveys include a lot of useful information on soil characteristics and should be consulted as part of office preparation before a site visit or when reviewing a delineation. Soils maps are an approximation of what may be found on a given site. What you see in the field is the most important standard in making a wetland determination.



Five colors based on the likelihood of hydric soils being present: 100%, 66 to 99%, 33 to 65%, 1 to 32%, and < 1%. Based on generalized mapping data; conditions in the field may be different and should be the basis for making a wetland determination.

Any questions on reviewing delineation data sheets or anything else on hydric soils?

Questions?

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OR

Contact a regional wetlands specialist
http://www.ecy.wa.gov/programs/wetlands/contacts.htm

Thank you for your interest. We are here to assist you and if you have questions on a wetland report or delineation, please contact us. Contact information for Ecology's wetland staff are available on our Website and regional staff are available for field verifications if you have a challenging delineation.