ACT PRESENTATION 6
APPLICATION OF SOIL MORPHOLOGY AS AN INDICATOR OF WHOLE LANDSCAPE HYDROLOGY
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FLORIDA DEPARTMENT OF HEALTH

DIVISION OF Environmental Health

Topic:
Application of Soil Morphology as an Indicator of Whole Landscape Hydrology and an Interpretation for Wetland Restoration and Creation and On-Site Treatment and Disposal Systems

This presentation is originally from Wade Hurt, Soil Scientist at the University of Florida.

Introduction

- **Problem: Septic tank systems often fail when the hydrology and soil characteristics of the proposed construction site is not properly identified.**

SOLUTION

- Familiarity with redoximorphic processes and recognizing their morphological expressions in soils facilitates on-site determination of depth to soil saturation or the probability of inundation.

SOLUTION

- In the soil to the right the depth to saturation in indicated by the bar. This lecture describes the soil morphologies which allow up to make this interpretation for all soils.

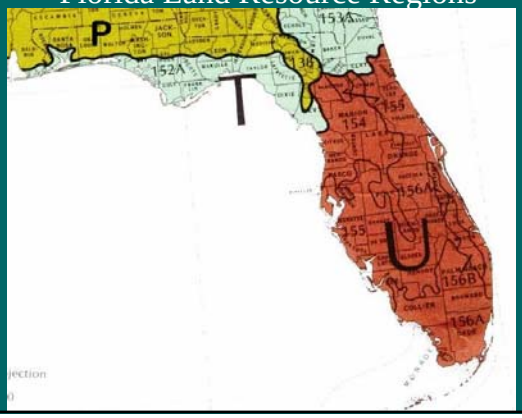
A Word About the Field Indicators

- The publication *Field Indicators of Hydric Soils in the US* (Hurt, et al. 2002) is the reference. Any statement in this lecture such as "see glossary" refers to this publication.
- There are three divisions to the indicators:
  - Indicators with the letter A preceding a number are used for all soils, regardless of texture.
  - Indicators with the letter S preceding a number are used for LFS and coarser soil material.
  - Indicators with the letter F preceding a number are used for all LFVS and finer soil material.

A Word About the Field Indicators

- Not all field indicators can be used in all areas.
- Florida has three "Land Resource Regions"
- Make sure that the indicator you are trying to use can be used in your area.
- Following slide has Florida's Land Resource Regions.

Florida Land Resource Regions



Suggested Guidelines for the Use of Soil Morphology for Hydrology Evidence.

- In the absence of hydrologic modifications the morphology of soils give evidence of saturation or inundation as follows :
- Group 1 Soils. Soils with a hydric soil indicator (we have identified four subsets of hydric soil morphologies):

Group 1a Soils. Hydric Soils with the following 13 hydric soil indicators have seasonal saturation to the soil surface: Most are inundated above the surface (colored ones are used in FL)

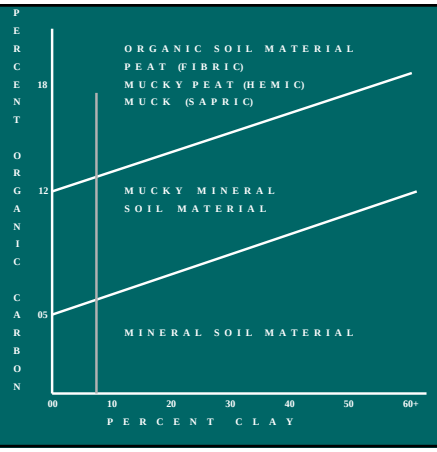
- These are:
- **A1 (Histosols), A2 (Histic Epipedon), A3 (Black Histic), A4 (Hydrogen Sulfide), A7 (5 cm Mucky Mineral), A8 (Muck Presence), A9 (1 cm Muck),** A10 (2 cm Muck), S1 (Sandy Mucky Mineral), F1 (Loamy Mucky Mineral), **F10 (Marl)**, F11 (Depleted Ochric), F16 High Plains Depression).

Group 1a Soils Reminder - Inundated soils or at least saturation to the surface.

- The soil to the right is an example of the 13 HS indicators that have saturation to the surface or inundated above the surface. It has the indicator A3 (Black Histic).

A word about Group 1a Soils

- Most of these indicators require exacting amounts of organic carbon. The exact requirements for muck is a minimum of 12 percent organic carbon if the soil contains 0 percent clay and 18 percent if the soil contains 60+ percent clay. Soils with an intermediate amount of clay require intermediate amounts of organic carbon. The exact requirements for mucky mineral are between 5 and 12 percent organic carbon if the soil has 0 percent clay and between 12 and 18 percent organic carbon if the soil contains 60+ percent clay. Once again, soils with an intermediate amount of clay require intermediate amounts of organic carbon



Estimating Organic Carbon Content

- Lacking laboratory analysis this (estimating percent organic carbon) is best estimated by the near-saturated soil rub test. If, after two light quick rubs, the soil feels either gritty (if dominated by sand) or slick [plastic] (if dominated by silt or clay), the soil is neither mucky mineral or muck; it is mineral. If, after 2 or 3 more light quick rubs, the soil feels either gritty (if dominated by sand) or slick [plastic] (if dominated by silt or clay), the soil is not muck; it is mucky mineral. Only after not feeling gritty or slick [plastic] after five light quick light rubs should a soil be considered to be a muck (organic soil material beginning at six rubs).

USE OF HAND LENS CRITERIA

- **ALL REFERENCES TO THE USE OF A HAND LENS MEANS ONLY A 10X OR 15X HAND LENS.**
- ***ANY OBSERVATIONS WITHOUT A HAND LENS APPEARS TO BE CLOSE TO 100% MASKED, AS OPPOSED TO 70% WHEN USING A HAND LENS.***

Group 1b Soils. Hydric Soils with the following 11 hydric soil indicators have saturation within 15 cm of the soil surface; on certain landforms they may be inundated above the surface. (**colored** ones are used in FL)

- These are:
- **A5 (Stratified Layers), A6 (Organic Bodies)**, S2 (2.5 cm Mucky Peat or Peat), S3 (5cm Mucky Peat or Peat), **S4 (Sandy Gleyed Matrix), S5 (Sandy Redox), S6 (Stripped Matrix), S7 (Dark Surface), S8 (Polyvalue Below Surface), S9 (Thin Dark Surface), F13 (Umbric Surface)**.

A5. Stratified Layers

- *For use in all of Florida* **. Several stratified layers starting within the upper 15 cm (6 inches) of the soil surface. One or more of the layers has value 3 or less with chroma 1 or less and/or it is muck, mucky peat, peat, or mucky modified mineral texture. The remaining layers have chroma 2 or less. Any sandy material that constitutes the value 3 or less and chroma 1 or less must have at least 70% of the visible soil particles masked with organic material when using a hand lens.**
- Stratified Layers User Notes: The minimum organic carbon content of at least one layer of this indicator is slightly less than required for indicator A7 (Mucky Modified Mineral Texture); at least 70 percent of soil material is masked with organic matter. An undisturbed sample must be observed. Individual strata are dominantly less than 2.5 cm (1 inches) thick. A hand lens is an excellent tool to aid in the identification of this indicator. Many alluvial soils have stratified layers at greater depths; these are not hydric soils. Many alluvial soils have stratified layers at the required depths but lack chroma 2 or less; these do not fit this indicator. Stratified Layers occur in any type soil material.

Indicator A5 (Stratified Layers) in sandy materials (right). Scale is inches. Indicator A5 in loamy material (left). Scale is inches (R) and cm (L)

A5 Stratified layers

- Next slide: the required dark layer is the near surface. The layer with redox concentrations is too thin to meet the requirements of S5 (Sandy Redox).
- Slide after shows the required dark layer is between 1 and 2 inches

- Stratified Layers: the required dark layer is the near surface. The layer with redox concentrations is too thin to meet the requirements of S5 (Sandy Redox).

- The required dark layer is between 1 and 2 inches

A6. Organic Bodies.

- *For use in all of Florida.* **Presence of 2% or more organic bodies of muck or a mucky modified mineral texture, approximately 1 to 3 cm (0.4 to 1.2 inches) in diameter, starting within 15 cm (6 inches) of the soil surface.**
- Organic Bodies User Notes: The percent organic carbon in organic bodies is the same as in the Muck or Mucky Texture Indicators. This indicator includes the indicator previously named "accretions" (Florida Soil Survey Staff, 1992). Often organic bodies occur without the required amounts of organic carbon; they are sandy and are not indicative of hydric soils. The content of organic carbon should be known before this indicator is used. Organic bodies of hemic (mucky peat) and/or fibric (peat) soil materials do not qualify as this indicator. Material consisting of partially decomposed root tissue does not qualify as the indicator.

A6. Organic Bodies. The mucky organic bodies layer occurs between 0 and 10 cm (left) Indicator S7 (Dark Surface) is also present. The individual organic bodies are 1 -3 cm in size (right) from the soil on the left. Scale is inches (top) and cm (bottom).

Indicator A6 states that the size of organic bodies are about 1-3 cm. Sometimes they are smaller. Scale is inches. This indicator is easy to identify. Bodies that adhere to roots and qualify for A6 feel greasy; bodies that adhere to roots and fail to qualify for A6 feel gritty.

S5. Sandy Redox

- *For use in all of Florida.* **A layer starting within 15 cm (6 inches) of the soil surface that is at least 10 cm (4 inches) thick, and has a matrix with 60% or more chroma 2 or less with 2% or more distinct or prominent redox concentrations as soft masses and/or pore linings.**
- Sandy Redox User Notes: Distinct and prominent are defined in the Glossary. Redox concentrations include iron (reddish redox concentrations) and iron/manganese masses (dark brown to dark reddish brown redox concentrations) mainly as pore linings (Vepraskas, 1994). The redox concentrations should have diffuse boundaries. The iron/manganese masses are 2 to 5 mm in size and have value 3 or less and chroma 3 or less. Iron/manganese masses should not be confused with concretions and nodules associated with plinthitic (Soil Survey Staff. 1999) or relict conditions. Common to many redox concentrations are required.

Indicator S5 (Sandy Redox). The redox concentrations are reddest in the center (near a pore) and diffuse into the matrix. They occur below a depth of about 10 cm. Scale is inches.

Sandy Redox

SANDY REDOX (also look in hole)

Sandy Redox

S6. Stripped Matrix

- *For use in all of Florida.* **A layer starting within 15 cm (6 inches) of the soil surface in which iron/manganese oxides and/or organic matter have been stripped from the matrix exposing the primary base color of soil materials. The stripped areas and translocated oxides and/or organic matter form a faintly contrasting color pattern (splotchy and diffuse) of two or more colors. The stripped zones are 10% or more of the volume.**
- Stripped Matrix User Notes: This indicator includes the indicator previously named "polychromatic matrix" (Florida Soil Survey Staff, 1992) as well as the term "streaking" (Environmental Laboratory, 1987). Common to many areas of stripped (uncoated) soil materials 1 to 3 cm (0.39 to 1.2 inches) in size is a requirement. Commonly the splotches of color have value 5 or more and chroma 1 and/or 2 (stripped) and chroma 3 and/or 4 (unstripped). The matrix may lack the 3 and/or 4 chroma material. The mobilization and translocation of the oxides and/or organic matter is the important process and should result in splotchy coated and uncoated soil areas. This indicator is perhaps the most difficult one with which to become familiar.

Indicator S6 (Stripped Matrix). The matrix stripped of iron oxides (left photo) begins below a depth of about 10 cm. Scale is inches (R) and cm (L). The matrix stripped of organic matter begins beneath the surface layer (right photo). Scale is inches.

Indicator S6 (Stripped Matrix). The knife blade is pointing to a perfect example of a stripped splotch. This morphology is the results of microbes eating a dead root (dark spot near the center of the splotch), thereby releasing electrons which reduce oxides in the splotch and leave the splotch totally stripped and reduced at the time of its production.

S7. Dark Surface

- *For use in all of Florida.* **A layer 10 cm (4 inches) or more thick starting within the upper 15 cm (6 inches) of the soil surface with a matrix value 3 or less and chroma 1 or less. At least 70% of the visible soil particles must be masked with organic material. The matrix color of the layer immediately below the dark layer must have the same colors as those described above or any color that has chroma 2 or less.**
- Dark Surface User Notes: The organic carbon content of this indicator is slightly less than required for "mucky." An undisturbed sample must be observed. A 10X or 15X hand lens is an excellent tool to help aid this decision. Many wet soils have a ratio of about 50 percent soil particles that are masked with organic matter and about 50 percent uncoated soil particles, giving the soil a salt and pepper appearance. Where the percent of coverage is less than 70 percent, a Dark Surface indicator is not present.

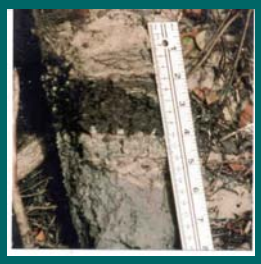
Indicator S7 (Dark Surface). This soil also has Indicator S1 (Sandy Mucky Mineral). Mucky mineral material is about 8 cm thick and the dark surface is 17 cm thick. Scale is inches (R) and cm (L). A 10X or 15X hand lens (www.forestry-suppliers.com) is a tool to help make this decision.

70% Masked Criteria

- The picture on the right is sandy soil material with (clockwise from top) 50, 60, and 70% masked with organic material. Organic carbon content of the samples are about 2, 3, and 4 % respectively.

Group 1b Soils Reminder - Seasonal saturation is within 15 cm of the surface. Inundation may occur.

- The soil on the right has Indicator A5 (Stratified Layers) and would therefore have saturation within 15 cm or inundation above the surface if it is located on a flood plain. Scale is inches (R) and cm (L).



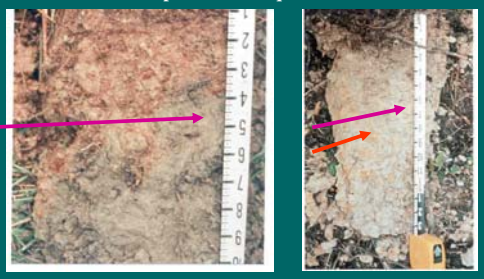
Group 1c Soils. Hydric Soils with the following 9 hydric soil indicators have saturation within 30 cm of the soil surface; on certain landforms they may be inundated above the surface. (**colored** ones are used in FL)

- These are:
- **A12 (Thick Dark Surface),** S10 (Alaska Gleyed), F2 (Loamy Gleyed Matrix), **F3 (Depleted Matrix),** F4 (Depleted Below Dark Surface), **F6 (Redox Dark Surface), F7 (Depleted Dark Surface)**, F14 (Alaska Redox Gleyed), F15 (Alaska Gleyed Pores).

F3. Depleted Matrix

- *For use in all of Florida.* **A layer with a depleted matrix that has 60% or more chroma 2 or less that has a minimum thickness of either:**
  - **a. 5 cm (2 inches) if 5 cm (2 inches) is entirely within the upper 15 cm (6 inches) of the soil, or**
  - **b. 15 cm (6 inches) and starts within 25 cm (10 inches) of the soil surface.**
    - Depleted Matrix User Notes: Redox concentrations including iron/manganese soft masses and/or pore linings are required in soils with matrix colors of 4/1, 4/2, and 5/2. A, E and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present. See glossary for the complete definition of depleted matrix. The low chroma matrix must be due to wetness and not a relict or parent material feature.

Indicator F3 (Depleted Matrix). The chroma is 1 within a depth of about 10 to 15 cm (left photo). Redox concentrations are absent. Scale is inches. The chroma is 2 below a depth of about 15 cm (right photo). Redox concentrations are present as required. Scale is inches.



F6. Redox Dark Surface

- *For use in all of Florida.* **A layer at least 10 cm (4 inches) thick entirely within the upper 30 cm (12 inches) of the mineral soil that has:**
- **a. matrix value 3 or less and chroma 1 or less with 2% or more distinct or prominent redox concentrations as soft masses or pore linings, or**
- **b. matrix value 3 or less and chroma 2 with 5% or more distinct or prominent redox concentrations as soft masses or pore linings.**

Redox Dark Surface User Notes:

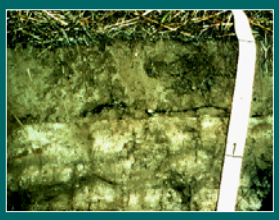
- Redox concentrations in high organic matter mineral soils with dark surfaces are often difficult to see. The organic matter "masks" some or all of the concentrations that may be present. Careful examination is required in order to see what are often brownish "mottles" in the darkened materials. In soils which are wet due to subsurface saturation, the layer immediately below the dark epipedon should have a depleted or gleyed matrix. Soils which are wet due to ponding or shallow perched layer of saturation may not always have a depleted/gleyed matrix below the dark surface. Redox concentrations including iron/manganese soft masses and/or pore linings are required in soils with matrix colors of 4/1, 4/2, and 5/2. A, E and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present.
- In some instances, drying of the samples makes the concentrations (if present) easier to see. If soil is saturated the redox concentrations may be apparent only after drying the soil to at least a moist state.

Indicator F6 (Redox Dark Surface). Prominent redox concentrations as soft masses and pore linings are present (left photo). Below the dark epipedon is indicator F4 (Depleted Below Dark Surface). Scale is cm. Often, as in this soil (right Photo) the redox concentrations are small (fine).

F10. Marl

- *For use in south Florida.* **A layer of marl with a value 5 or more starting within 10 cm (4 inches) of the soil surface.**
  - Marl User Notes: Marl is a limnic material deposited in water by precipitation of $CaCO_3$ by algae as defined in Soil Taxonomy (USDA, NRCS, Soil Survey Staff. 1999). It has a Munsell value 5 or more and reacts with dilute HCl to evolve CO_2. Marl is not the carbonatic substrate material associated with limestone bedrock. Some soils have materials with all the properties of marl except they lack the required Munsell value. These soils are hydric if the required value is present within 10 cm (4 in) of the soil surface. Normally marl **is** the soil surface. No thickness is required. This indicator is known to occur only in south Florida.

Indicator F10 (Marl). This indicator is known to occur only in south Florida. Scale is feet.



F13. Umbric Surface.

- *For use in all of Florida.* **In depressions and other concave landforms, a layer 25 cm (10 inches) or more thick starting within 15 cm (6 inches) of the soil surface in which the upper 15 cm (6 inches) must have value 3 or less and chroma 1 or less, and the lower 10 cm (4 inches) of the layer must have the same colors as above or any other color that has a chroma 2 or less.**
  - Umbric Surface User Notes: Thickness requirements maybe slightly less that those required for an umbric epipedon. Microlows are not considered to be concave landforms. Umbric surfaces on higher landscape positions, such as side slopes dominated by Humic Dystrudepts, are excluded. This indicator is only rarely used to delineate wetlands in the LRRs indicated; most often it occurs in slightly wetter ecosystems than the delineations drawn most often by F3 and F6.

Indicator F13 (Umbric Surface). This umbric surface is about 20 cm. thick (green bar). Scale is inches.

Group 1c Soils Reminder - Seasonal saturation is within 30 cm of the surface. Inundation may occur.

- The soil on the right has the indicator F4 (Depleted Below Below Dark Surface) and would therefore have saturation within 30 cm of the surface or inundation above the surface if present in a depression.

Group 1d Soils: Hydric Soils with the following 3 hydric soil indicators have inundation above the soil surface. These indicators are poor indicators of soil saturation. (**colored** ones are used in FL)

- These are:
- **F8 (Redox Depressions),** F9 (Vernal Pools), **F12 (Iron/Manganese Masses)**. These HS indicators occur only on depressions or flood plains.

F12. Iron/Manganese Masses

- *For use in LRRs P and T.* **On flood plains, a layer 10 cm (4 inches) or more thick with a depleted matrix that has 40% or more chroma 2 or less, and 2% or more distinct or prominent redox concentrations as soft iron/manganese masses with diffuse boundaries. The layer occurs entirely within 30 cm (12 inches) of the soil surface. Iron/manganese masses have value 3 or less and chroma 3 or less; most commonly they are black.**
- **The thickness requirement is waived if the layer is the mineral surface layer.**
- **Note landform restriction (floodplain).**

Iron/Manganese Masses User Notes:

- These iron/manganese masses are usually small (2 to 5 mm in size) and have a value and chroma 3 or less. They can be black. The low matrix chroma must be due to wetness and not be a relict or parent material feature. Iron/manganese masses should not be confused with the larger and redder iron nodules associated with plinthite (USDA, NRCS, 1998a) or with concretions that have sharp boundaries. This indicator occurs on flood plains of rivers such as the Apalachicola, Congaree, Mobile, Savannah, and Tennessee Rivers.
- It can be any thickness if it is the mineral surface layer. This indicator is a common indicator on flood plains.

Indicator F12. (Iron/Manganese Masses) in a 40 percent depleted matrix. Scale is inches.

Group 1d Soils Reminder - Inundation occurs above the surface.

- The soil on the right has the indicator F9 (Vernal Pools) and would therefore have inundation above the surface. The soil has insignificant saturation. Scale is inches.

QUESTIONS???

Wetland Restoration

- Wetland restoration (by definition) is limited to hydric soils that currently have hydrologic modifications. You can't restore what never existed and the only positive proof that wetlands once existed at a particular site is that the site has one of the hydric soil indicators listed above.

Wetland Restoration

- The soil on the right has the indicator F5 (Thick Dark Surface) and is the soil which is currently drained as depicted in the previous slide. If the ditch was filled and the tile drains removed the area would revert to wetlands; it would be a restored wetland.

Onsite Sewage Treatment and Disposal Systems

- Onsite sewage treatment and disposal systems are not to be located on soils with saturation to the surface or on inundated soils. These include soils with the Group 1a and Group 1d indicators listed above. Additionally, many of the Group 1b and Group 1c soils may have similar wetness.

Onsite Sewage Treatment and Disposal Systems

- Onsite sewage treatment and disposal systems are can be located on some of the Group 1b and Group 1c soils. But:

All Other Soils

- Group 2 Soils. These are Soils without a hydric soil indicator (we have identified five subsets of nonhydric soil morphologies). These soils do not have a hydric soil indicator. They do not support wetland ecosystems nor do they have the capability of supporting wetland ecosystems without major soil modifications (excavations) or an external source of water.

Group 2a Soils: 4. In nonhydric soils that meet all the requirements of a hydric soil indicator except depth, the depth to saturation is the depth to the indicator:

- The soil to the right has a stripped matrix which meets all the requirements of the hydric soil indicator except depth (the stripped matrix starts below a depth of 15 cm). This is the height of seasonal high saturation.

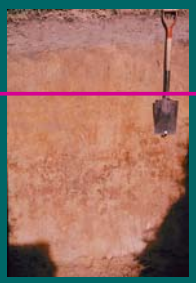
Group 2a Soils. The nonhydric soils below meet all the requirements of a hydric soil indicator except depth. The soil to the right has a stripped matrix and the soil on the left has sandy redox. The bars indicate depth to these morphologies and the height of seasonal high saturation.

Group 2a Soils Note

- To create a wetland on landforms represented in the three previous soils, soil material would have to be removed from the surface with the resulting new soil having a stripped matrix or sandy redox starting within 15 cm of the surface. I recommend soil removal to the depth of the indicator and back filling with a couple or three inches of topsoil.

Group 2b Soils: 1. In other nonhydric soils with sandy (LFS and coarser) soil material with a chroma 3 or more the depth to saturation is the depth to:

- Common to many distinct or prominent redox concentrations with hue 2.5YR to 10YR, value 5 or more , and chroma 6 or more. The soil on the right has these features where indicated by the bar.



Group 2b Soils. The soils below have saturation to the height indicated by the bars. This is where many prominent redox concentration with hue 2.5YR to 10YR, value 5 or more , and chroma 6 or more begin in the soils.

Group 2c Soils. In nonhydric soils with loamy/clayey (LVFS and finer) soil material the depth to saturation is the depth to:

- Common to many distinct or prominent redox depletions with value 5 or more and chroma 2 or less and occurs between 30cm and 1 meter. The soil on the right has these features where indicated by the bar.

Group 2c Soils. The soils below have saturation to the height indicated by the bars. This is where many prominent redox depletions with value 5 or more and chroma 2 or less begin in the soils.

Assuming suitable soil the bottom surface of drainfields would be where indicated.

Group 2d Soils. In nonhydric soils with loamy/clayey (LVFS and finer) soil material the depth to saturation is the depth to:

- Common to many distinct or prominent redox depletions with value 5 or more and chroma 3 or less and occurs below 1 meter. The soil on the right has these features where indicated by the bar.

Group 2d Soils. The soils below have saturation to the height indicated by the bars. This is where many prominent redox depletions with value 5 or more and chroma 3 or less begin in the soils.

Group 2c Soils and Group 2d Soils Note

- Note: For depths of one meter or less depletions of chroma 2 or less is required and for depths of more than one meter depletions of chroma 3 or less is required.
- Why the difference? First, we are reporting what we have noted after thousands and thousands of observations. Second, by remembering (from the redox features lecture) the requirements for reduction (microbial activity, saturated soil, lack of oxygen, and organic matter) and by noting that, with depth, roots (the main source of organic matter) become less and this might lead to less dissolution of iron even when the soils are just as wet and just as reduced.

Group 2e Soils: 5. In other nonhydric soils that lack any of the above described soil morphologies saturation is lacking within the observed depth.

- The soil to the right has none of the soil morphologies described above and thereby lacks saturation within the observed depth.

Group 2e Soils. The nonhydric soils below have none of the soil morphologies described in this lecture and thereby lack saturation within the observed depth.

Created Wetlands

- This wetland was created by leveling large areas of hydric and nonhydric soils and flooding with tertiary treated waste-water. It would not have been successful if excess water was not applied.

Case Example: Success

- By excavating to this depth, a freshwater wetland can be created.
- By excavating to this depth, a saline wetland can be created. The darkened area indicates an accumulation of sulfur.

Successfully Created Wetland

- An example of a wetland created from soils represented by the previous slide.
- This site was excavated to the depth of morphological evidence resulting in a successfully created saline wetland.

Summary Recommendations

- Wetland Restoration efforts must (by definition) be limited to hydric soils as explained above. These are the Group 1 Soils (1a, 1b, 1c, and 1d).
- Wetlands can be created by excavating to depths indicated by morphological evidence as explained above and back filling with on-site or off-site topsoil. These are the Group 2 Soils (2a, 2b, 2c, and 2d). It is doubtful that excavation would create wetlands on Group 2e Soils.
- Wetlands can be created on nonhydric soils without excavating but an external source of water must be readily available.

Summary Recommendations

- Onsite sewage treatment and disposal systems are not to be located on soils that are saturated to the surface or inundated. These are the Group 1a and 1d soils and many of the Group 1b and 1c soils.
- Onsite sewage treatment and disposal systems may be located on the Group 2 Soils (2a, 2b, 2c, and 2d). But creative design may still be necessary.
- Group 2e soils are the best soils for onsite sewage treatment and disposal.

QUESTIONS???

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