USDA Soil Basics
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OBJECTIVES

- Define commonly used terms
- Describe appropriate use of United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) methodology
- Demonstrate methodology for correct determination of soil textures

NOTE

Additional information on certain slides will be found in the “NOTES” section and will only be visible in the “normal” view in PowerPoint

See “##” to designate these slides or areas

Soils and OSTDS

- Understanding how to correctly interpret soils is essential to the program
- Interpretation of soil properties is based on the observation and correct assessment of soil texture, colors and the soil color contrast based on the methodology of the USDA Natural Resources Conservation Service

Terminology

- *Soil Color* - the dominant morphological feature used to predict the SHWT
- *Matrix* – dominant (background) color of soil horizon (can be >1 color)
- *Mottle* – splotch of color, opposite of matrix
- *Low chroma* – any color in the Munsell Book that has a chroma of ≤2

Terminology

- *Soil Horizon* - is a layer, approximately parallel to the surface of the soil, distinguishable from adjacent layers by a distinctive set of properties produced by the soil-forming processes
- *Soil Color Contrast* – the amount of contrast between soil as determined by comparing the hue, value and chroma of each color

Terminology

- *Hue* – basis spectral color such as red, yellow, yellow-red, purple, blue, green, green-yellow, etc.
- *Value* - indicates the degree of lightness or darkness, or reflectance of an object viewed in daylight
- *Chroma* - the color intensity or relative strength of color, indicates the degree of departure from a gray of the same Value

Terminology

- *Redoximorphic (Redox) Features* – color changes formed during a minimum time period from oxidation-reduction reactions caused by the presence of water and minerals in the soil, used to predict seasonal high water tables
- Formerly called “mottling” (see site evaluation form)

Information Used to Determine Wet Season Water Table Elevation

See Florida Administrative Code Rule 64E-6.006(2)

The following information shall be used in determining the wet season water table elevation

- (a) U.S. Department of Agriculture Soil Conservation Service (NRCS) soils maps and soil interpretation records
- (b) Evaluation of soil color and the presence or absence of mottling
- (c) Evaluation of impermeable or semi-permeable soil layers

- (d) Evaluation of onsite vegetation
- (e) An onsite evaluation of the property which has used the above referenced sources of information and which has considered the season of the year when the evaluation was performed, historic weather patterns, and recent rainfall events

Seasonal High Water Tables

- Wettest Season High Water Table: the elevation of the ground water table during that period of time each year when it is expected to be at its highest level
- USDA NRCS term is Seasonal High Saturation (SHS)

REFERENCE MATERIALS

- County soil surveys and the information contained therein, plus any other soil interpretation records available through USDA NRCS
- This includes the Web Soil Survey (official soil survey of United States)

Redoximorphic Features

- The regulation uses any type of redoximorphic features
- *For DOH purposes it would actually be any soil-based feature used to determine an estimated seasonal high water table*
- Water tables above the ground surface are estimated by other methods

Impermeable Layers

- Evaluation of impermeable or semi-permeable layers existing within the natural undisturbed soil or fill material
- A semi-permeable or impermeable layer can also be created when fill material has been placed either on top of a natural soil, or natural soil has been removed and replaced by fill material

Impermeable Layers

- Could be caused by the placement of the fill itself (compaction)
- Caused by dissimilar soil textures (sand over clay)
- Caused by poor/altered drainage
- Could also include effects from artificial drainageways

Onsite Vegetation

- Observe surrounding plant ecological communities to determine ***natural vegetation*** of the area
- Vegetation has differing nutrient and water requirements
- An evaluation of the natural vegetation gives evidence of water levels based on the species of plants in the area

Onsite Vegetation

- Natural vegetation is present due to water/nutrient availability in the area, not the other way around
- Vegetation that has been planted in the surrounding area usually not as useful as an indicator

SHWT Evaluation

- All required sources of information must be used, and consider the following as part of information:

1. drought or excessively wet time
2. currently the dry or wet season
3. recent weather patterns from past few days to weeks prior to site evaluation

Example

- Evaluation performed three weeks after the last significant rainfall in a “normal rainfall” year
- Observed water table was at 30 inches
- Need to document information, i.e. “no rainfall in this area in three weeks”

Evidentiary Value

- Given a different weight of evidence when compared to a site if the observed water table was at 30 inches one day after significant rainfall during a normal rainfall year
- Include information in the site evaluation remarks section to help validate the SHWT determination

DOH Questioning Soil Profiles/SHWT Estimation of Non-departmental Evaluators

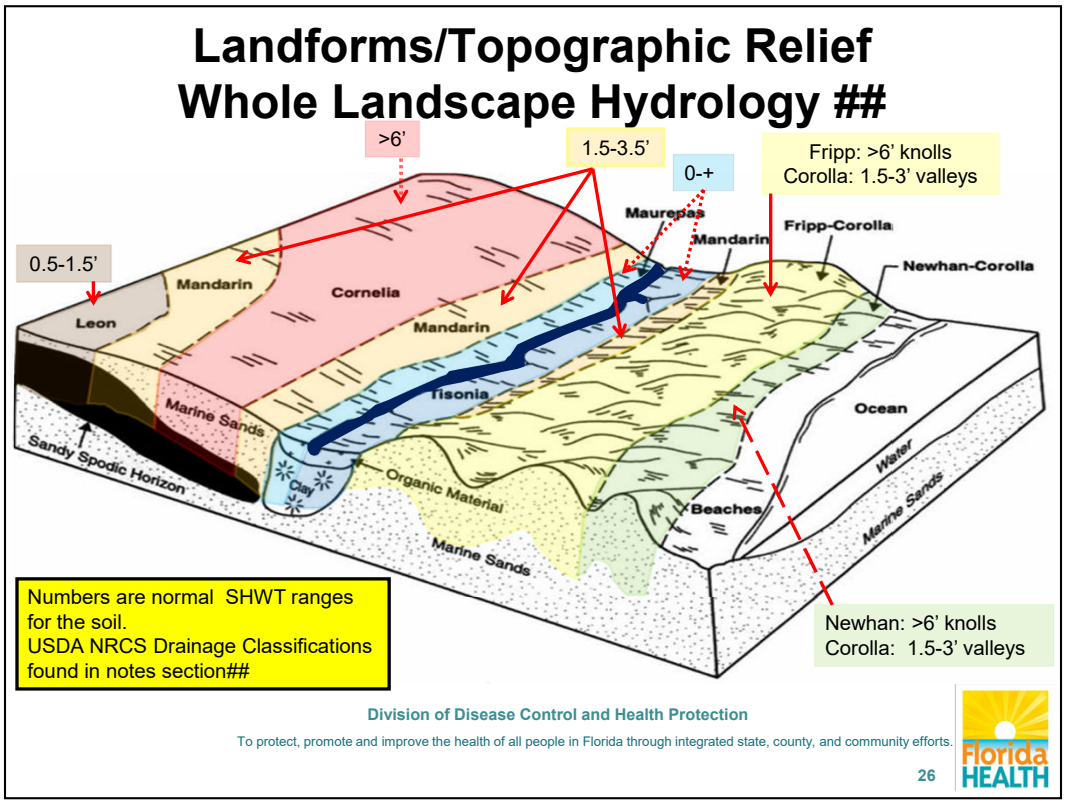
Meaning

- Site evaluation must be complete and accurate
- Conclusions must be validated and justified by facts found in the evaluation
- Cannot assume information that is not presented

QUESTIONS?

Essential Element in the Definition

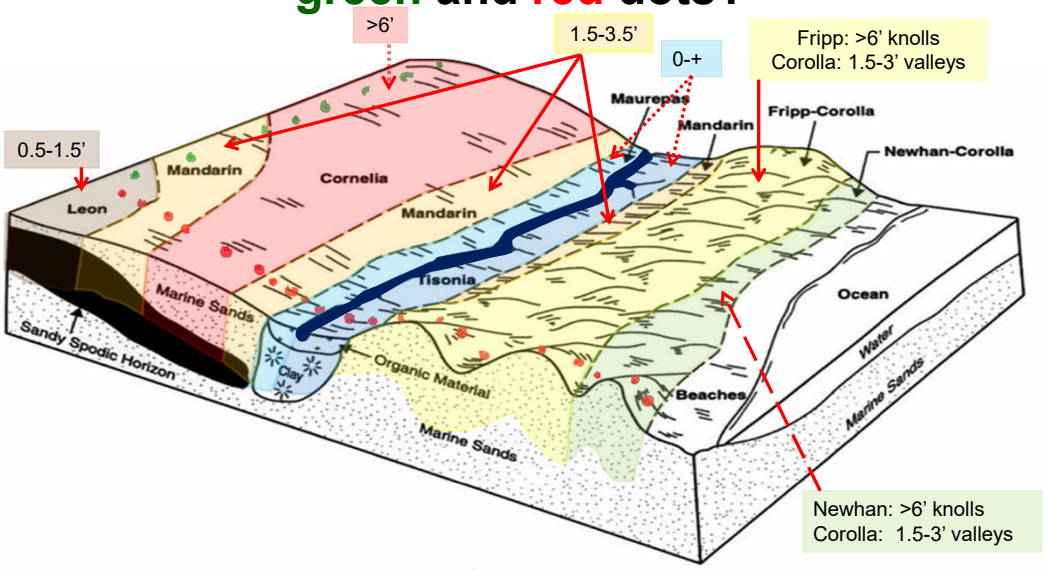
- Landforms (hills, slopes, flatwoods)
- Soil Genesis (formation of soil)
- Soil Material (sands/clays)
- Soil Horizons
- Soil Morphology-observable characteristics of the soil within soil horizons, including their description of kind and arrangement



USDA NRCS Soil Drainage Classifications (agricultural)- Leon: poorly to very poorly drained, depressional areas are ponded. Mandarin: somewhat poorly drained. Cornelia: excessively drained. Maurepas: very poorly drained. Tisonia: very poorly drained. Fripp: excessively drained. Newhan: excessively drained. Corolla: moderately well to somewhat poorly drained

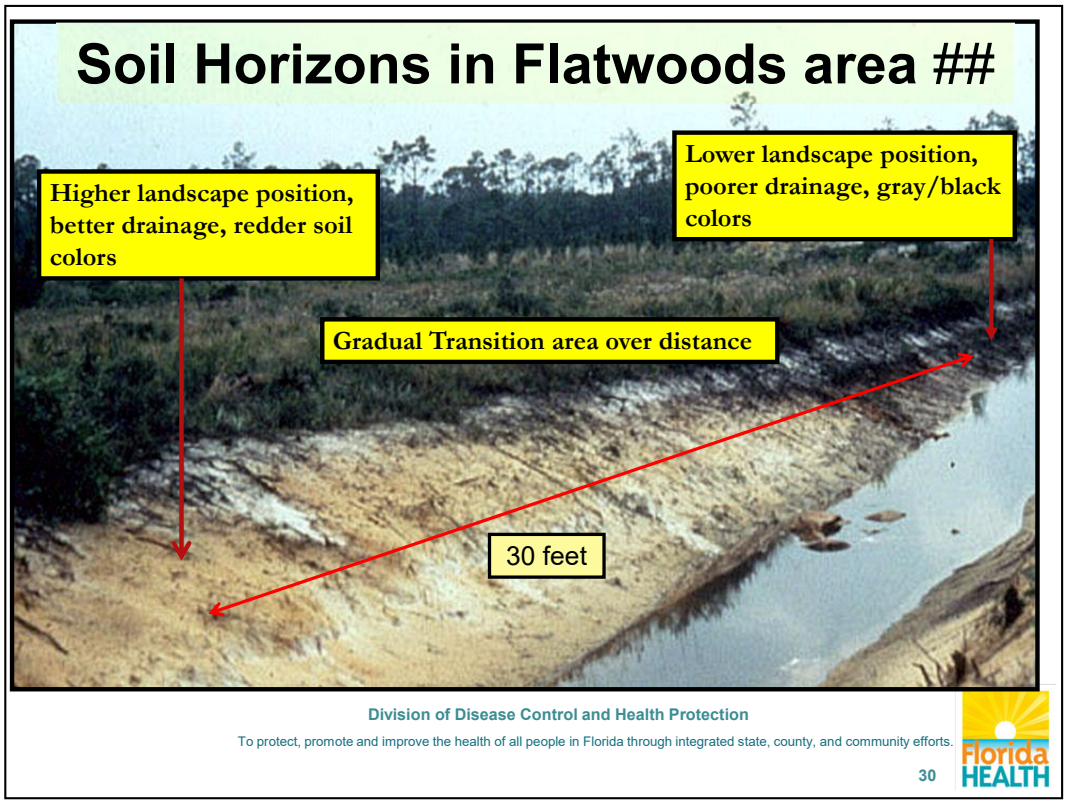
- When determining the SHWT of the site in question, one must consider the ENTIRE LANDSCAPE HYDROLOGY
- Look around the site
- Use the soil surveys for clues to validate SHWT determination, especially where no observable redox features can be found
- Must look at soil as it was created

Expectations for soil profiles performed at green and red dots?



Generally:

- Areas of brighter, more colorful soils (redder) are better drained
- Areas of less colorful, darker soils (grays) are more poorly drained



Notice the different colored layers (horizons) in this photo. This slide demonstrates why it is so important to do a site specific evaluation of the soil conditions. The soil exposed on the left hand side exhibits a higher landscape position that has soil with better drainage and associated reddish colors, as opposed to the right hand side which is low-lying and is characterized by poorer drainage and associated gray and black colors. In between you see a gradual transition from one soil type to another. This variation in soil conditions wouldn't be identified if we just used the soil survey. The soil survey draws sharp boundaries between different soil types. As you can see here the changes can occur gradually over distance.

So, does landscape position have anything to do with SHWT ?

Anthropogenic Soils

- Anthropogenic: something caused by humans or human activity
- Areas of soil that have been manipulated by man (filled, soil removal, mixed, etc.)
- Try and determine the amount of time that the fill material has been on site (essential for redox feature analysis)

Anthropogenic Soils

- May be able to use Google Earth's historic imagery feature to look back into the 1990s
- Can use other websites for historical imagery to help evaluate site (next slide)

Aerial Photography Sites

- Florida Aerial Photography at http://ufdc.ufl.edu/aerials
- Florida Department of Transportation Site at: http://www.dot.state.fl.us/surveyingandmapping/aerial_main.shtm

QUESTIONS?

Soil Horizons

- Soil has natural organization and is biologically active
- Organization results from climatic (weather) and biological forces (worms, ants, animals, etc.) altering the properties of the materials of the earth's surface

- Because these soil-forming forces exert progressively less influence with depth, they result in more or less horizontal layers that are termed “soil horizons”
- Individual layers are distinguishable from adjacent layers by a distinctive set of properties produced by the soil-forming processes##

Differences include soil texture, structure, color or any combination

- The characteristics and vertical sequence of these horizons vary in natural patterns across the landscape
- Some characteristics can change over a few feet
- Many soils are similar over large areas
- Individual kinds of soils are distinguished by their specific sequence of horizons, or “soil profile”

Soil Horizon Change

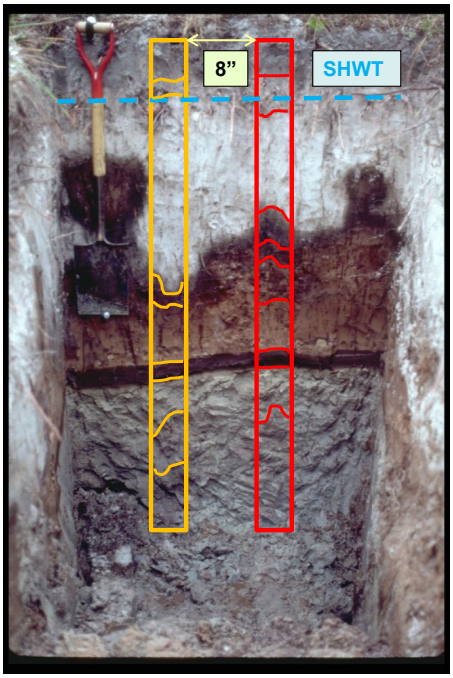
- Horizon designation changes when:
- Change in soil color
- Change in soil texture
- Change in soil structure (we don't discuss structure of soil)
- Any combination of above

Soil Profile

- Individual kinds of soils are distinguished by their specific sequence of horizons, or “soil profile”
- Soil profile is determined by using soil auger or other digging device to reveal soil horizon information

Soil Horizons

- Soil horizons (layers) exposed in a pit (the soil profile)
- The matrix color is the dominant color(s) in each layer
- Horizons have color, texture, thickness and soil structure



- Soil profile changes within one foot
- Seasonal high water table would not change in this short distance
- Observe area behind the shovel (brown soil much higher)

Soil Horizonation

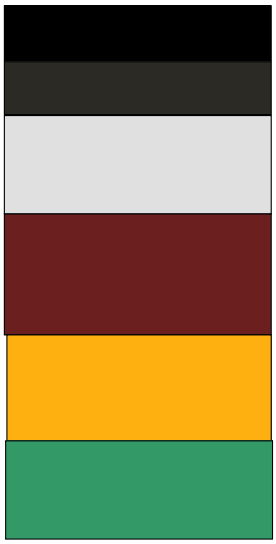
USDA Horizon Designations

- USDA NRCS describe horizons by:
- Alphabetic or alpha-numeric symbol for the type of layer
- Upper and lower boundary depth
- Munsell notation and texture
- Example: A1 -- 0 to 9 inches;(10YR 2/1) fine sand
- DOH notation is a little different

Master Horizons

All master horizons are designated by a capital letter

Major Horizon Designations



- O Horizon – Surface organic layer
- A Horizon – Surface mineral layer
- E Horizon- Leached layer
- B Horizon- Subsoil (accumulation)
- C Horizon- Underlying material
- R Horizon- Bedrock

Major Horizon Designations

- O Horizon – Organic horizon, the surface layer in extreme wet soils comprised of organic matter
- *Muck, mucky peat and peat* are all Organic horizons

Oa Horizon- (Sapric/Muck) Most highly decomposed plant materials of the O horizon category

Oi Horizon (Fibric/Peat)- formerly called “root mat” and is least decomposed of the O horizon category

Major Horizon Designations

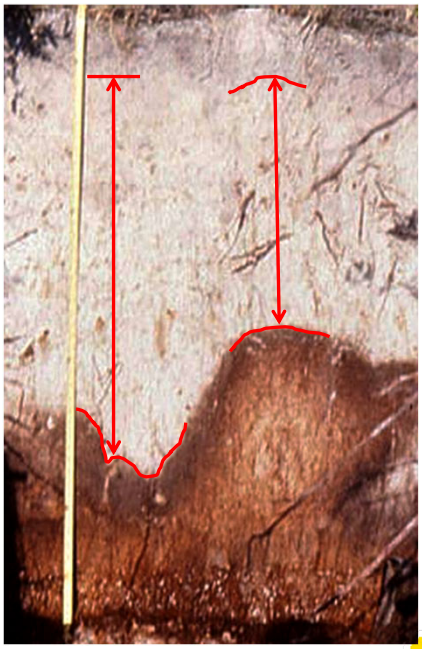
- A Horizon - topsoil or surface layer
- Surface layer in a mineral soil
- Characterized by accumulation of organic matter (accounts for darker colors at surface) and/or loss of materials (e.g., clays) to deeper layers

A Horizon- Topsoil layer, color is from organic material

Major Horizon Designations

- E Horizon - a subsurface layer, the leached layer (Eluviated)
- Materials are removed (leached) from this layer and deposited in the B horizon
- Not found in every soil
- *Always followed by a B horizon*

- E horizon- leached layer between the A horizon and B horizon
- Note E horizon is lighter in color than the A (upper) or B lower) horizon

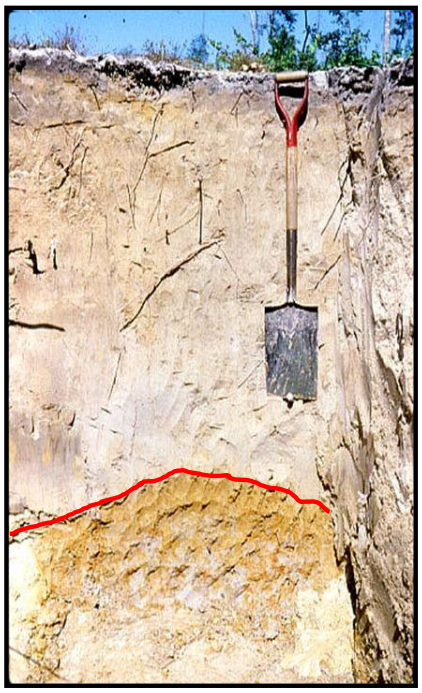


Major Horizon Designations

- B Horizon - the subsoil layer, characterized by accumulation of clays or other materials such as aluminum, iron and organic matter and greater structural development
- Can occur directly under an A horizon (e.g. a spodic layer)
- Have not formed in all soils

B horizon –

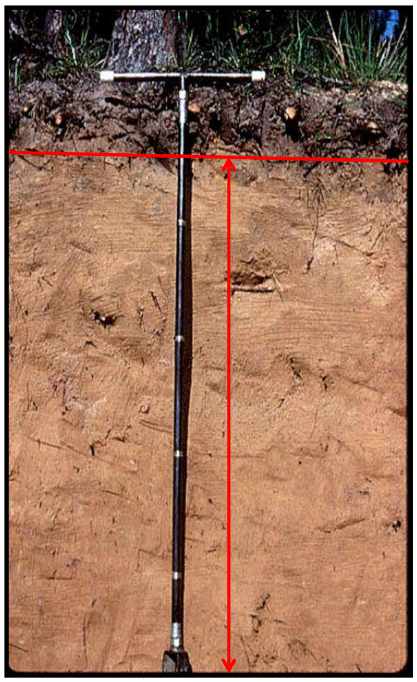
Increase in clay particles and color (iron) in this slide (below red line)



Major Horizon Designations

- C Horizon - the underlying material, unconsolidated parent material little influenced by soil-forming processes (not much going on), can occur directly under an A horizon
- R Horizon – bedrock, normally limestone in Florida

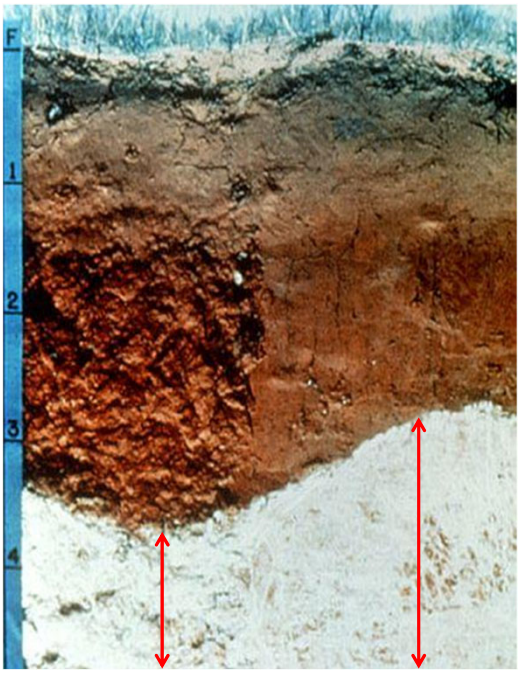
C horizon - the underlying material, unconsolidated parent material little influenced by soil-forming process



R horizon –

Rock, in Florida mostly limestone

(Note differences in colors due to smearing [right side])



Transitional Horizons

Sometimes a layer of soil is similar to two master horizons. It is written in this format

AB – more like A - some of B

BA – more like B - some of A

Examples: AE EA AC BC

E/B - Both E and B particles are present, more E than B percentage wise, but are more distinct than merged

Horizons in which distinct parts have recognizable properties of the two kinds of master horizons indicated by the capital letters. The two capital letters are separated by a virgule (/), as E/B, B/E, or B/C. Most of the individual parts of one of the components are surrounded by the other

Notes on soil horizon designation in older soil surveys

- Before about 1981, soil surveys and other documents contained profile descriptions that used a slightly different group of horizon designations
- Following is a list of some old designations and their equivalent designations in the new system

Old	New
O1	Oi or Oe
O2	Oa or Oe
A1	A
A2	E
A3	AB or EB
AC	AC
B1	AB or BA
B2	B or Bw
B3	BC or CB

- Horizon numbering in the old system is the same as in the new system, however the inclusion of numbers in old master horizon designation makes interpretation somewhat confusing
- Consider the following example:

Old	New
A11	A1
A12	A2
A21	E1
A22	E2
B21t	Bt1
B22t	Bt2

Red numbers removed

QUESTIONS?

Subhorizon-specific part of a horizon

- Subhorizon: identifiable layers that clearly differ in properties from adjacent layers
- A change in horizon designation would occur when a change in the color, texture or structure happens, or if a combination of any of the three happens

Horizon Subscripts

a.k.a. Subhorizon suffixes
(know the ones in RED)

Subhorizon Suffixes

- a –highly decomposed organic material; Sapric material (muck), O horizon only-Oa
- b – buried genetic horizon (Ab means buried A horizon)
- e –partially decomposed organic material; Hemic material (mucky peat), O horizon only-Oe

Subhorizon Suffixes

- g – *dominance of gley (gray) colors* due to wetness (lack of oxygen, reduction of Fe) (e.g. Cg); *this includes all low chroma (chroma ≤2) colors*
- h - (B horizon only-Bh) subsoil accumulation of organic acids and aluminum (spodic layer) *NOTE: Not an organic layer by definition, must be sandy*

Subhorizon Suffixes

- i –least broken down organic material, Fibric material (Peat); O horizon only-Oi
- k - accumulation of calcium carbonate ($CaCO_3$)
- m – cementation [means hard, or indurated (made hard)]

Subhorizon Suffixes

- p- This symbol is used to indicate tillage or a disturbance of the surface layer by mechanical means, pasturing, or similar uses
- q - silica accumulation - very weathered or old soil
- r - soft or weathered bedrock. C horizon only (Cr)

Subhorizon Suffixes

- t - subsoil *accumulation of clay particles,* B horizon only (Bt)
- v – B horizon only, plinthite (soft iron nodules) accumulation; (Btv)
- w- subsoil this is more intensely developed than others in color or structure, without clay accumulation or spodic development, B horizon only (Bw)

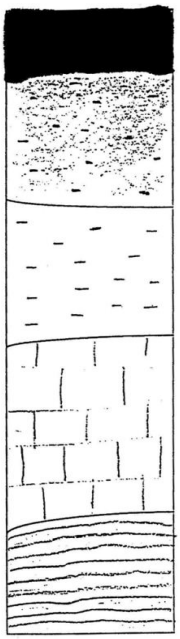
A--Topsoil. Mineral horizon colored dark by organic matter.

AE--Transitional horizon. Has characteristics similar to both the A and E horizons.

E--Horizon of maximum leaching, or loss of substances such as clay particles.

Bt or Bh--Horizon of maximum soil development, usually the accumulation of organic acids or of clay particles

C--Horizon of geologic material that is relatively unaltered by soil forming processes.



Surface layer.

Subsurface layer.

Subsurface layer.

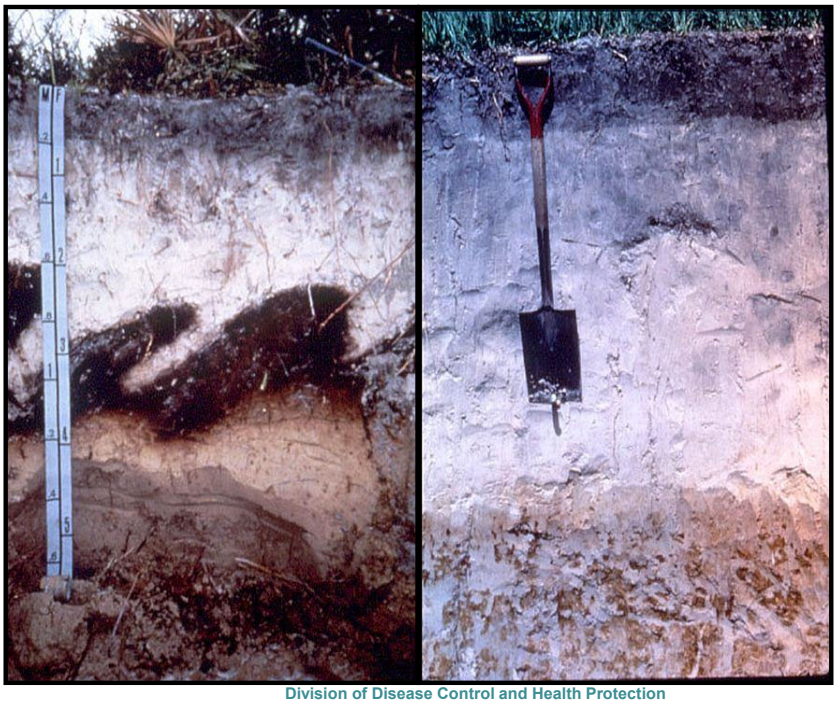
Subsoil layer.

Substratum or underlying layer.

Classic Soil Profile

Representative Profile Schematic

Examples of Horizons in Florida Soils



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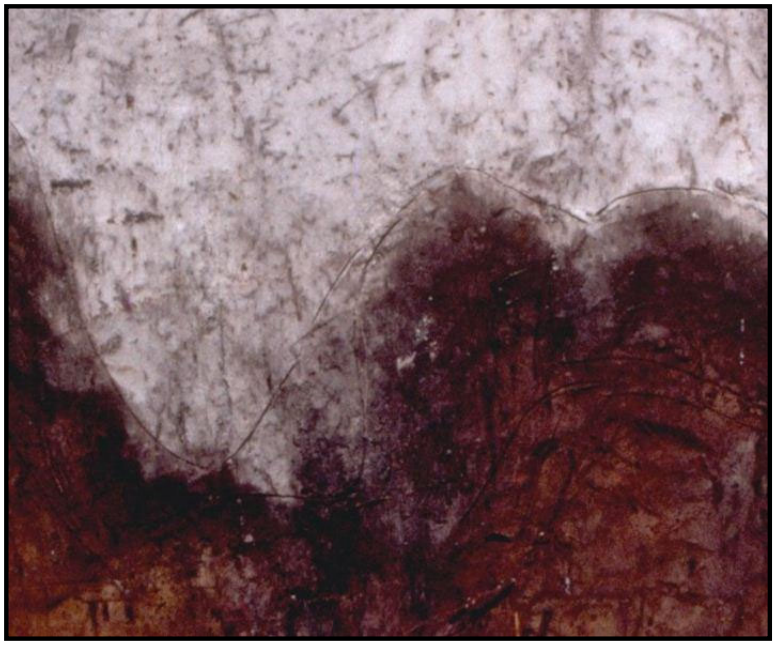
Soil Horizons in a "spodosol"

A, AE, E horizons



E and Bh horizon interface

End of presentation
QUESTIONS?