HYDRIC SOILS: Soil Parameters Used for Jurisdictional Delineation

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Objectives

- Introduce concepts & procedures
- Review field indicators & science
- Set up logic/nomenclature/definitions etc.…for field – "there is no substitute for field time"

Acknowledgements

- Marrett, Harley and Lee - Manuscript Lecture notes
- Tina Tong (US Army Corps of Engineers – Corps Guidance on Arid West & WMVC Supplements)
- Lenore Vasilas, USDA-NRCS
- Mike Vepraskas, David Lindbo, NC State – soil indicators sequence

Soils in the Definition of Wetlands…

Corps of Engineers (1987) Wetland Delineation Manual

"……areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support…. a prevalence of vegetation *typically adapted to life in saturated soil conditions."*

Definition - Soil

Soil Survey Staff (2006) Keys to Soil Taxonomy

- A natural body comprised of solids (minerals and organic matter), liquid and gases that occurs on the land surface, occupies space, and is characterized by or both of the following:
  - Horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers of energy and matter; or
  - The ability to support rooted plants in a natural environment.
- Upper Boundary: soil – air interface
- Lower Boundary: limit of biological activity/200cm

Non-Soil

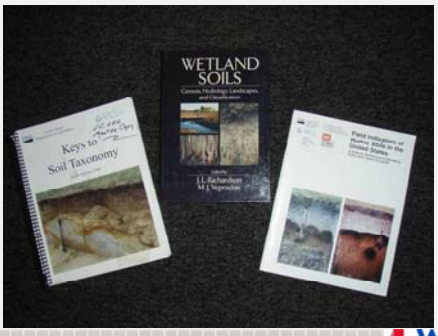
- Badlands
- Beaches
- Rubble lands
- Rock outcrops
- Glaciers
- Deepwater habitats

Definition – "Hydric Soils"

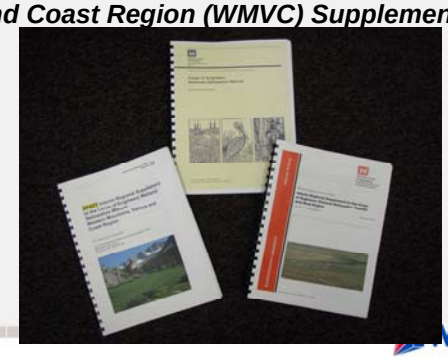
Federal Register (1994) Changes in Hydric Soils of the United States, July 13.

- Soils that formed under conditions of saturation, flooding, or ponding long enough during the *growing season* to develop *anaerobic* conditions in *the upper part.*

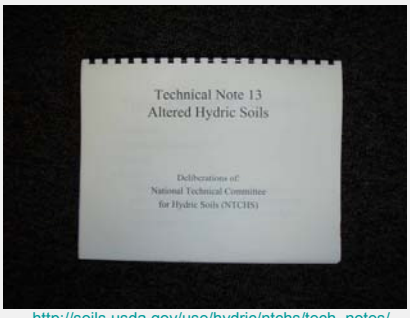
Soil Textbooks



1987 Delineation Manual / Arid West Supplement / Western Mountains, Valleys and Coast Region (WMVC) Supplement



Technical Notes



http://soils.usda.gov/use/hydric/ntchs/tech_notes/

NRCS (SCS) Soil Surveys - Monterey County

Available online through the NRCS Web Soil Survey:

http://websoilsurvey.nrcs.usda.gov/app/

Soils In the Jurisdictional Delineation Equation

- Jurisdictional delineation multiple parameter approach:
  - Vegetation: Most readily observed, easily disturbed, grow across boundaries
  - Hydrology: Hydrologic events take place over shorter time period
  - Soils reflect *long term conditions* particular to wetlands.
- Combined, all three factors provide compelling evidence of wetland conditions.

Soil Parameters Used for Jurisdictional Delineation

- Depth
- Matrix Color
- Redox Features
- Organic Matter
- Soil Texture
- Soil Color
- Mineral Determination
- Soil Taxonomy

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Where/How To Look At Soils - Soil Landscape

Landscape

- Soil variations over large areas (10^6 acres);
- Variations include soils, geology, landscape;
- Good preliminary investigation tool for identifying potential wetland locations

Catena

- Regular sequences of soils attributable to:
  - topographic position
  - drainage condition
- Scale ≈ 10-100 acres
- Useful in identifying wetland boundaries

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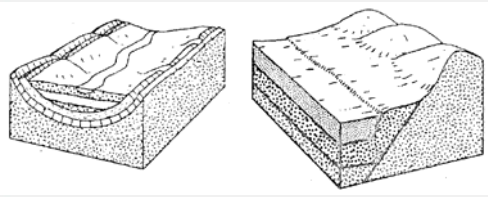
Where/How To Look At Soils – Landscape Scales



Western Mountains: Wide Alluvial Valleys Draining West

Western Mountains: Coastal Beaches

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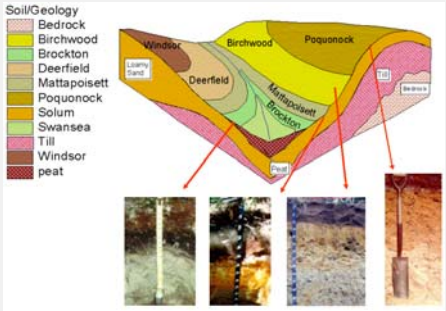
Where/How To Look At Soils – Catena Scales



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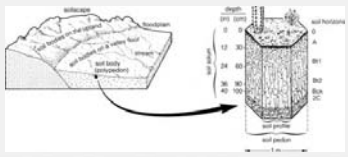
Were/How To Look At Soils – Pedon

- 3-D body of soil with lateral dimensions large enough to permit the study of horizon shapes and relations (1 to 10 m^2).
- Polypedon: A group of contiguous similar pedons



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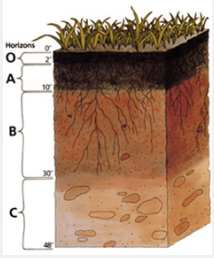
Where/How To Look At Soils – Soil Profiles and Horizons – Used In Taxonomy

- Horizons:
  - O: Organic
  - A, B, C: Mineral
- A: surface horizon
- B: subsoil
- C: substratum



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Where To Look At Soils – "Master Horizons"

Oi	Organic soil material, mostly visible litter, detritus and fiber
Oe	Organic soil material of intermediate or very mixed decomposition states
Oa	Organic soil material of mostly highly decomposed and humified, little or no recognizable fiber and detritus
A	Mineral horizons mixed with an accumulation of humified OM or with agricultural properties (e.g. cultivation, pasturing)
E	Mineral horizon characterized by loss of silicate clay, Fe, Al, leaving concentration of sand and silt particles
E/B	Transition between E and B, with predominant characteristics of the E horizon
B/E	Transition between B and E, with predominant characteristics of the B horizon
B	Zone lacking properties of overlying A and underlying C horizons; generally zone of maximum clay content and soil structure development
B/C	Transition between B and C, with predominant characteristics of the B horizon
C	A mineral layer, excluding hard bedrock, that are little affected by pedogenic processes
R	Hard bedrock.

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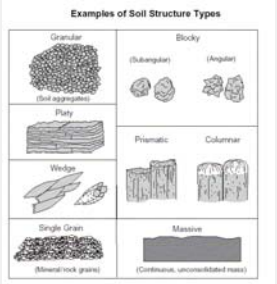
Were/How To Look At Soils – Ped

An individual natural soil aggregate, such as a granule, prism, block



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Soil Taxonomy

- Establishes hierarchies of classes to permit an understanding of the relationships among and between soils, and the factors responsible for their properties
- Hierarchy:
  - 11 orders
  - 47 suborders
  - 235 great groups
  - ≈ 1,200 subgroups
  - ≈ 5,000 families
  - ≈12,000 series

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Soil Taxonomy – 11 Soil Orders

- ALFISOL
- ANDISOL
- ARIDISOL
- ENTISOL
- HISTOSOL
- INCEPTISOL
- MOLLISOL
- OXISOL
- SPODOSOL
- ULTISOL
- VERTISOL

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Soil Taxonomy – 11 Soil Orders

ORDER	FORMATIVE ELEMENT	DERIVATION
ALFISOL	ALF	Pedalfer – AL & FE enriched
ANDISOL	AND	Andic – volcanic short-range-order compounds
ARIDISOL	ID	Arid – dry soil
ENTISOL	ENT	Recent – little or no profile development
HISTOSOL	IST	Histos – tissue; high fiber content
INCEPTISOL	EPT	Inception – young; horizons beginning to develop
MOLLISOL	OLL	Mollis – soft
OXISOL	OX	Oxide – enriched with oxides
SPODOSOL	OD	Podzol – wood ash horizon; acid leaching
ULTISOL	ULT	Ultimate – maximum leaching
VERTISOL	ERT	Invert – to turn; crack

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Soil Taxonomy

CATEGORY	NUMBER OF TAXA	DIFFERENTIATING CHARACTERISTICS
Suborder	53	Vary with order, but include: • Wetness • Soil moisture regimes • Major parent material • Vegetational effects

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What You Really Have To Know For Wetland Delineations: Organic vs Mineral Soils

- *Organic Soil*: A soil in which the sum of the thicknesses of layers containing organic soil materials is generally greater than the sum of the thicknesses of mineral layers.
- *Mineral Soil*: A soil consisting predominantly of, and having its properties determined predominantly by, mineral matter. Usually contains <200 g kg^{-1}organic carbon (< 120-180 g kg^{-1} if saturated with water), but may contain an organic surface layer up to 30 cm thick.

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Soil Material

Soil Survey Staff (2006) Keys to Soil Taxonomy

Mineral soil material (less than 2.0 mm in diameter) *either:*

1. Is saturated with water for less than 30 days (cumulative) per year in normal years and contains less than 20 percent (by weight) organic carbon; *or*
2. Is saturated with water for 30 days or more cumulative in normal years (or is artificially drained) and, excluding live roots, has an organic carbon content (by weight) of:
   a. Less than 18 percent if the mineral fraction contains 60 percent or more clay; *or*
   b. Less than 12 percent if the mineral fraction contains no clay; *or*
   c. Less than 12 + (clay percentage multiplied by 0.1) percent if the mineral fraction contains less than 60 percent clay.

Organic Soil Material: Material with more organic matter than described above.

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Criteria for Hydric Soils

Federal Register (Sept. 18, 2002) Changes in Hydric Soils of the United States

1. All Histels except Folistels and all Histosols except Folists; or
2. Soils in Aquic suborders, great groups or subgroups; Albolls suborder; Historthels and Histoturbels great groups; Cumulic or Pachic subgroups that are:
   a. Somewhat poorly drained with a water table equal to 0.0' from the surface during the growing season;
   b. Poorly or very poorly drained and have either:
      i. Water table = 0.0' from the surface during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20" of the surface, or for other soils;
      ii. Water table ≤ 0.5' from the surface during the growing season if permeability is ≥ 6.0 in/hr in all layers within 20" of the surface; or
      iii. Water table ≤1.0' from the surface during the growing season if permeability is ≤ 6.0 in/hr in any layer within 20". **or**
3. Soils that are frequently ponded for long duration or very long duration during the growing season; or
4. Soils that are frequently flooded for long duration or very long duration during the growing season.

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Criteria for Hydric Soils

Federal Register (Sept. 18, 2002) Changes in Hydric Soils of the United States,

1. Organic soil criterion
2. Genesis, Drainage Characteristics & Water Table (Groundwater) criterion
3. Ponding criterion
4. Flooding criterion

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Relationship Between Criteria For Hydric Soils & Field Indicators In Arid West & WMVC Supplements

- Criteria For Hydric Soils Have Remained The Same As Articulated In the Federal Register (2002). They Could Change With New Science, etc….
- Arid West and WMVC Supplements – "*Field Indicators"* For Hydric Soil Conditions Have Been Altered/Updated To Reflect Regional Conditions & Characteristics (…they're trying to get it right at a regional level….)

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Overview/Corps Guidance Soils - Comparison

1987 Manual

- Definition of hydric soils
- 12 Indicators
- Atypical Situations and Problem Area procedures

Supplements

- Definition of hydric soils
- 18 Field Indicators in WMVC and 22 Indicators in the Arid West (see *Hydric Soil Indicator Comparison* Sheet)
- Use of NTCHS Field Indicators of Hydric Soils (see Field Guide Sheets)
- Difficult Wetland Situations procedures

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Definition – "Field Indicators" are:

Layers of soil whose
- **Thickness**
- **Depth**
- **Color characteristics**
- **Abundance and contrast of redox. features**

have been rigidly defined.

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"Field indicators" are designed to find soils that have been anaerobic in their *"upper part."*

- These soils are **saturated** and have little or **no dissolved O_2** in the water.
- Oxidation-reduction reactions have occurred in the soil to make it **anaerobic**.

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Functions Of "Field Indicators" – Are They Proof Positive?

- If a soil meets a Field Indicator it is a hydric soil,
- If it does not meet a Field Indicator it may still be a hydric soil if it meets the definition of a hydric soil.
  - Example – seasonal ponding for "long" (ie. 7-30 days) or "very long" duration (> 30 days) in young sandy floodplain soils

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Where To Look At Soils – "Upper Part"

- The term "Upper Part" is used –

  (a) In the description and characterization of <u>*all soils*</u> (Taxonomy), &

  (b) In the definition of hydric soils "…which are anaerobic in the upper part."

- The definition of "upper part" changes with soil texture.
  (a) Sands: upper 6 inches of soil
  (b) Loams and clays: upper 12 inches of soil

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Where To Look At Soils – "Upper 20 Inches"

- Criterion "2"refers to upper 20 inchesof the Soil Profile
- Anaerobic conditions need to be observed somewhere within the upper 20" - which is *not necessarily in the "upper part".*

2. Soils in Aquic suborders, great groups or subgroups; Albolls suborder; Historthels and Histoturbels great groups; Cumulic or Pachic subgroups that are:
   a. Somewhat poorly drained with a water table equal to 0.0' from the surface during the growing season;
   b. Poorly or very poorly drained and have either:
      i. Water table = 0.0' from the surface during the growing season if textures are coalse sand, sand, or fine sand in all layers within 20" of the surface, or for other soils,
      ii. Water table ≤ 0.5' from the surface during the growing season if permeability is ≥ 6.0 in/hr in all layers within 20" of the surface; or
      iii. Water table ≤1.0' from the surface during the growing season if permeability is ≥ 6.0 in/hr in any layer within 20". Or

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1987 Manual Hydric Soil "Field Indicators" (Pages 24 – 28)

- Non sandy soils:
  - Histosols
  - Histic epipedon
  - Sulfidic material
  - Aquic/paraquic moisture regime
  - Reducing soil conditions
  - Soil color (gleyed soils/bright mottles and/or low matrix
  - Soils appearing on hydric soils list
  - Iron and manganese concretions
- Sandy soil:
  - High organic matter content in surface horizon;
  - Streaking of subsurface horizons by organic matter;
  - Organic pans

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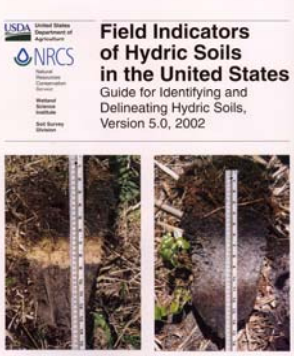


Current Field Indicators Used In the Arid West and WMVC Supplements (Version 6.0 can be downloaded from the NTCHS website)

Types and Annotations For Field Indicators Of Hydric Soils

(Page VI in "Field Indicators Of Hydric Soils in the United States")

- All Soils "A"
- Sandy Soils "S"
- Loamy and Clayey Soils "F"
- Test Indicators
  - All Soils "TA"
  - Loamy & Clayey Soils "TF"

Hydric Soil Field Indicators Comparison 1987 Corps Manual / Arid West / WMVC

USDA Field Indicators of Hydric Soils in the United States, Version 6.0 (2006), Appendix 3

Nonsandy soils	
1987 Manual	**Arid West and WMVC Supplements**
a. Organic soils (Histosols)	A1 Histosol or histel
	A3 Black histic
b. Histic epipedon	A2 Histic epipedon
	A3 Black histic
c. Sulfidic material	A4 Hydrogen sulfide
d. Aquic or peraquic moisture regime	None
e. Reducing soil conditions	F18 Reduced vertic
f.1. Gleyed soils	F2 Loamy gleyed matrix
f.2. Soils with bright mottles and/or low matrix chroma	F3 Depleted matrix
	F9 Vernal pools
g. Soils on Hydric soil list	None
h. Iron and manganese concretions	None

Hydric Soil Field Indicators Comparison 1987 Corps Manual / Arid West / WMVC

USDA Field Indicators of Hydric Soils in the United States, Version 6.0 (2006), Appendix 3

Sandy soils	
1987 Manual	**Arid West and WMVC Supplements**
a. Organic soils (Histosols)	A1 Histosol or histel
b. Histic epipedon	A2 Histic epipedon
	A3 Black histic
c. Sulfidic material	A4 Hydrogen sulfide
d. Aquic or peraquic moisture regime	None
e. Reducing soil conditions	None
f. Iron and manganese concretions	None
g. High organic matter content in the surface horizon	A9 1 cm muck
	A10 2 cm muck
	S1 Sandy mucky mineral
h. Streaking of subsurface horizons by organic matter	S6 Stripped matrix
i. Organic pan	None
j. Soils on Hydric soil list	None

Hydric Soil Field Indicators Comparison 1987 Corps Manual / Arid West / WMVC

USDA Field Indicators of Hydric Soils in the United States, Version 6.0 (2006), Appendix 3

Sandy soils	
1987 Manual	**Arid West and WMVC Supplements**
Sandy soils	S4 Sandy gleyed matrix
	S5 Sandy redox
	S6 Stripped matrix
Soils with thick dark A horizons	A11 Depleted below dark surface
	A12 Thick dark surface
	F6 Redox dark surface
	F7 Depleted dark surface
Soils with red parent material	F8 Redox depressions
	F9 Vernal pools
	TF2 Red parent material
Soils with low-chroma parent material	S4 Sandy gleyed matrix

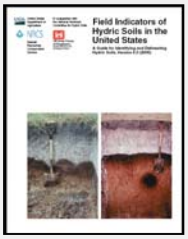
Supplement Data Form

- Both Arid West and WMVC Supplements Do Not Ask You To Look At/Characterize Soil "Horizons" *per se* – Instead, They Ask You To Characterize The Soil Profile By Depth And Look For Field Indicators

Supplements -Utilizing the Hydric Soil Field Indicators (HSFI)

To facilitate use of HSFI:

- See Field Guide Sheet *for HSFI*
- Dig hole to at least 20 inches
- Determine thickness of each layer within top 20 inches
- Determine precise percentage of redox (2, 5, 10, 20) in each layer
- Determine percentage of matrix in each layer
- Determine if soil layer is loamy fine sand (or coarser), organic, or neither
- Read Field Indicator pamphlet (check for updates) and User Notes in Supplements
- Note: These indicators are only "test positive", meaning the *lack* of an indicator does not necessarily mean you do not have a hydric soil (see Difficult Wetland Situations)



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Supplements - How to utilize HSFI Field Guides

1. Identify if any of the soil layers have a matrix that is gleyed or depleted
2. Go through the "All Soils" list
3. If soils are loamy fine sand or coarser, go through the "Sandy Soils" list
4. If soils are not loamy fine sand or coarser, go through the "Loamy and Clayey Soils" list
5. Note: All indicators are equally weighted and you can have multiple indicators for a soil profile.
6. If no HSFI present but you have wetland hydrology and hydrophytic vegetation, proceed to Difficult Wetland Situations procedures

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Organic Criteria

- *Criterion 1:* All Histels except Folistels and all Histosols except Folists
- *Hydric Soil Indicator A1*: Histosol or histel

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Organic Criteria

- Organic Matter: Undecayed plant and animal matter
- Types:
  - Fibric: Poorly decomposed
  - Hemic: Partly decomposed
  - Sapric: Highly decomposed

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Hydric Indicator A1: Histosol or Histel

- Thickness criteria
- Histosols (all LLR):
  - 60cm (25") for Fibric
  - 40cm (15") for Hemic, Sapric
- Histels (LRR with permafrost):
  - >50cm (20") anerobicly formed organic matter

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Hydric Soil Indicators A2: Histic Epipedon

- Epipedon: Diagnostic Surface Horizon;
- Characteristics:
  - Darkened by organic matter;
  - Evidence of eluviation (leaching); or
  - Both.
- Layer that may consist of one or more horizons.

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Hydric Epipedons

Soil Survey Staff (2006) Keys to Soil Taxonomy

- Organic Soils:
  - Histic
- Mineral Soils:
  - Mollic
  - Umbric

Histic Epipedon

Required Characteristics:

- A layer characterized by saturation (for 30 days or more, cumulative) and reduction for some time during normal years (or is artificially drained) and *either*:
  1. Consists of organic soil material that:
     a. Is 20 to 60 cm thick and either contains 75 percent or more (by volume) *Sphagnum* fibers or has a bulk density, moist, of less than 0.1; *or*
     b. Is 20 to 40 cm thick; *or*
  2. Is an Ap horizon that, when mixed to a depth of 25 cm, has an organic-carbon content (by weight) of:
     a. 16 percent or more if the mineral fraction contains 60 percent or more clay; *or*
     b. 8 percent or more if the mineral fraction contains no clay; *or*
     c. 8 + (clay percentage divided by 7.5) percent or more if the mineral fraction contains less than 60 percent clay.
- Requires proof of aquic conditions or artificial drainage

Histic Epipedons

Hydric Soil Indicators: Muck

- A9: 1cm Muck
- A10: 2cm Muck
- S1: Sandy Mucky Mineral

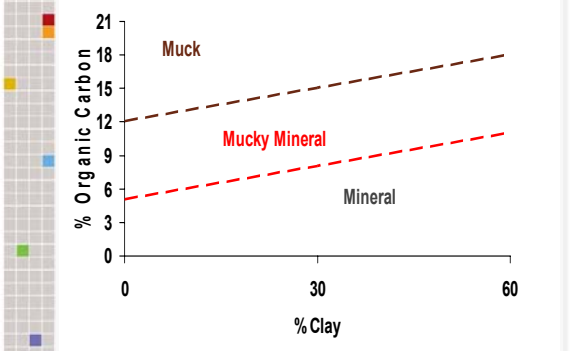
Hydric Soil Indicators

- Muck – sapric material
- Mucky peat – hemic material
- Peat – fibric material

Horizon Descriptor	Horizon Symbol	Proportion of Fibers Visible with Hand Lens	
		Unrubbed	Rubbed
Fibric	Oi	>2/3	>2/5
Hemic	Oe	1/3-2/3	1/6-2/5
Sapric	Oa	<1/3	<1/6

Mucky Modified Texture

- Mucky modified mineral soil has:
  - 0% clay and between 5 and 12% organic carbon,
  - 60% clay and between 12 and 18% organic carbon, or
  - intermediate amounts of clay and intermediate amounts of organic carbon.



Non-Organic Criteria

- *Criterion 2:* Genesis, Drainage Characteristics & Water Table (Groundwater)
- *Criterion 3*: Ponding
- *Criterion 4*: Flooding

Soil Texture Parameters for Hydric Soils

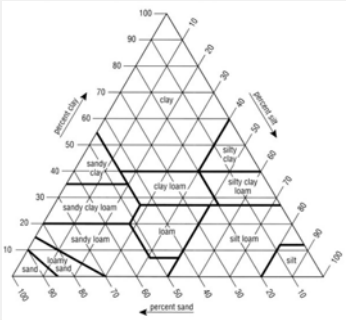
- Supplements include field indicators based on texture
- Texture can provide a line of evidence for ponding or reduction conditions.

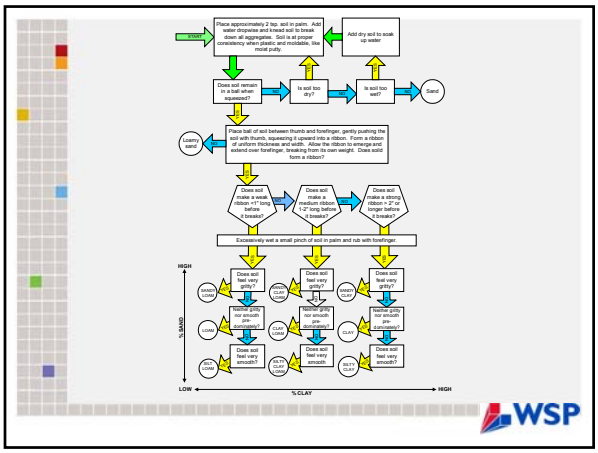
Mineral Matter: Soil Texture

- Controls much of soil's behavior
- Relative weight proportions of mineral grains of different sizes;
- Main group sizes <2mm:

Clay	<0.002mm
Silt	0.002 to 0.05 mm
Sand	0.05 to 2 mm

Main Soil Textural Classes





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Soil Physical Properties

- Porosity
- Permeability
- Soil Water Characteristics/Moisture Regime

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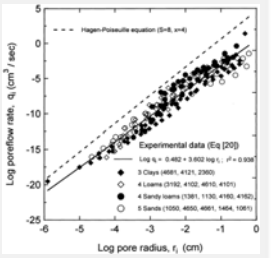
Porosity

- Porosity
  - Percentage of soil occupied by pores
  - Not directly measured in wetland soils; important in flow calculations.



Aryaa et al (1999)

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Permeability

- Permeability
  - The ease with which gases, liquids, or plant roots penetrate or pass through a bulk mass of soil or a layer of soil;
  - Property of a porous medium itself that expresses the ease with which gases, liquids, or other substances can flow through it, and is the same as intrinsic permeability k.

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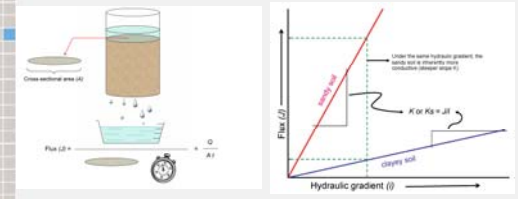
Permeability



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Hydric Soils Criterion 2

2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Andic, Vitrandic, and Pachic subgroups, or Cumulic subgroups that are:

a. Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or

b. Poorly drained or very poorly drained and have either:

i. Water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils

ii. Water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or

iii. Water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in

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Hydraulic Conductivity

K (cm/s)	10^{2}	10^{1}	$10^{0}=1$	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-10}
K (ft/day)	10^{3}	10.000	1.000	100	10	1	0.1	0.01	0.001	0.0001	10^{-5}	10^{-6}	10^{-7}
Relative Permeability	Pervious			Semi-Pervious				Impervious					
Aquifer	Good					Poor		None					
Unconsolidated Sand & Gravel	Well Sorted Gravel		Well Sorted Sand or Sand & Gravel			Very Fine Sand, Silt, Loess, Loam							
Unconsolidated Clay & Organic					Peat		Layered Clay		Fat / Unweathered Clay				
Consolidated Rocks	Highly Fractured Rocks				Oil Reservoir Rocks		Fresh Sandstone		Fresh Limestone, Dolomite		Fresh Granite		

WSP

Hydric Soils Moisture Regimes

- Aquic Condition:
  - Currently undergoing continuous or periodic saturation and reduction
  - Characteristics:
    - Presence of free water/saturation (field indicators)
    - Direct measurement of redox potential
    - Redoximorphic features – (field indicators)

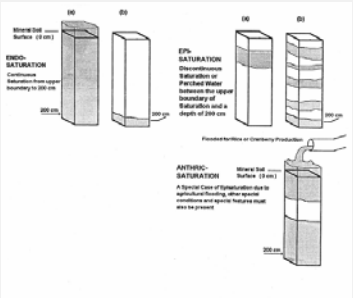
WSP

Hydric Soils Moisture Regimes

- Saturation:
  - Endosaturation:
    - Saturated in all layers from surface to 200cm
  - Episaturation:
    - Saturated in 1≥ layers within 200cm perched on an impermeable layer
  - Anthric saturation:
    - Cultivated and irrigated soil

WSP

Hydric Soils Moisture Regimes



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Effect of Saturation on Soil Properties

- A flooded wetland soil is characterized by the absence of O_2 in the soil profile;
- Slow O_2 replenishment rate;
- O_2 consumed by microorganisms;
- Soil moves from aerobic to anaerobic;
- Changes in chemical process, characterized by distinct features within soil

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Oxidation-Reduction Reactions

- Oxidation: Electron loss
- Reduction: Electron gain
- Redox potential is a measure of the electron availability in solution.
- Flooded soils are reduced (<400mV)
- Iron (Fe) most important in wetland soils

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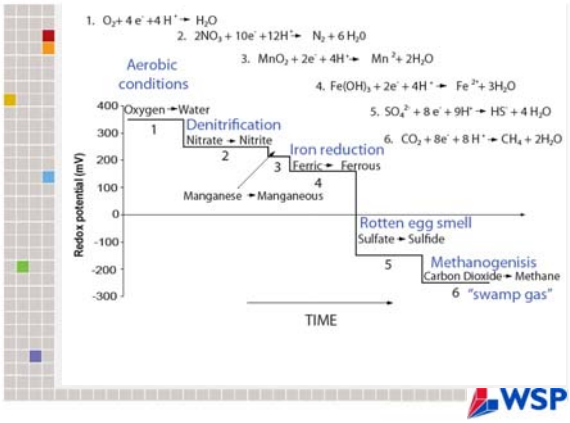


Field Measurement

- α,α-dipyridyl test for ferrous Fe:
  - Strong red color on freshly broken surfaces
  - An instantaneous indicator of whether ferrous Fe is present in the soil

Soil Color

- Color in wetland soil predominantly due to:
  - Soil organic matter
  - Iron oxides
- Secondary color due to:
  - Manganese minerals;
  - Carbonates;
  - Silica;
  - Soluble salts

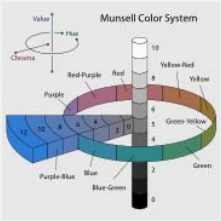
Redoximorphic Features

- Develop in fluctuating water regime
- Reduced conditions during saturation mobilizes Fe and Mn;
- Produces certain patterns and features within soil
- Characteristic colors:
  - Mn reduced more rapidly then Fe;
  - Fe oxidized more rapidly than Mn.

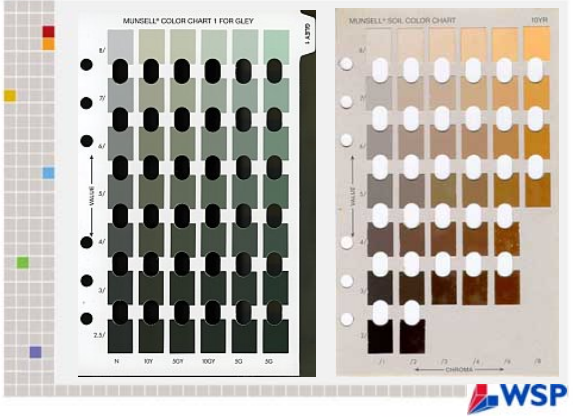
Redoximorphic Features

- Redox concentrations (Fe, Mn accumulations indicated by high chroma):
  - Nodules and concretions
  - Masses
  - Pore linings
- Redox depletions (Fe, Mn removal indicated by low chroma):
  - Iron depletions;
  - Clay depletions
- Reduced matrix

Soil Color: Color System



- **Hue**: Spectral color
- **Value**: Grey scale
- **Chroma**: Degree of brightness or color saturation
- Indirect indication of soil process.



Typical Soil Colors of Mineral Hydric Soils

- Measured immediately below the A-horizon or at 10 inches, whichever is shallower
- Matrix (predominant color of a soil horizon);
  - chroma of 1 or less in uncontrasted soils
  - chroma of 2 or less in contrasted soils

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Hydric Soil Indicators: Color

- F2: Loamy Gleyed Matrix
- F3: Depleted Matrix (Non sandy soils)
- S6: Stripped Matrix (Sandy soils)
- A3: Black Histic

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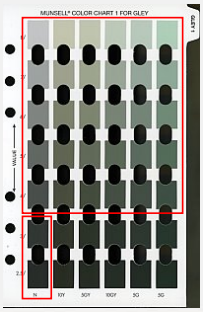
F2: Loamy Gleyed Matrix

Determine if a layer has a gleyed matrix

- 10Y, 5GY, 10GY, 10G, 5BG, 10BG, 5B or 5PB with value of 4 or more and chroma of 1
- 5G with value of 4 or more and chroma of 1 or 2
- N with value of 4 or more



Depleted (F3)/Stripped (S6) Matrix

- Horizon from which Fe has been removed or transformed by the processes of reduction and translocation;
- Creates colors of low chroma and high value

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Depleted (F3)/Stripped (S6) Matrix

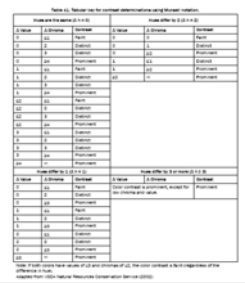
- Matrix value ≥5 and chroma ≤1, ± redox concentrations as soft masses and/or pore linings;
- Matrix value ≥6 and chroma ≤2, ± redox concentrations as soft masses and/or pore linings
- Matrix value 4 or 5 and chroma ≤2, with ≥2% distinct or prominent redox concentrations as soft masses and/or pore linings
- Matrix value 4 and chroma 1, with ≥2% distinct or prominent redox concentrations as soft masses and/or pore linings

Contrasted Soil: Redoximorphic Concentrations

Contrast refers to the degree of visual distinction between associated colors.

- Faint – evident only on close examination
- Distinct – readily seen
- Prominent – contrast strongly

Contrast of Redoximorphic Concentrations

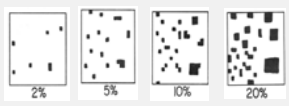


Contrast of Redoximorphic Concentrations

	Hues on Same Chart	Hue Difference of 1 Chart	Hue Difference of ≥2 Charts
Faint	≤2 value units and ≤1 chroma unit	≤1 value units and ≤1 chroma unit	--
Distinct	Between faint & prominent		<2 value units and/or <2 chroma units
Prominent	≥4 value units and/or ≥4 chroma units	≥3 value units and/or ≥3 chroma units	≥2 value units and/or ≥2 chroma units

Abundance of Contrasts

- Few – less than 2%
- Common – 2 to 20%
- Many – more than 20%



Size of Contrasts

- Fine – smaller than 5 mm
- Medium – 5 to 15 mm
- Coarse – larger than 15 mm

Hydric Soil Indicators
A3: Black Histic

- Peat, mucky peat or muck 20cm+ thick;
- Starts within upper 15cm
- Hue 10YR+, value ≤3, chroma ≤1
- Underlain by mineral soil with chroma ≤2
- Does not require proof of aquic conditions/artificial drainage

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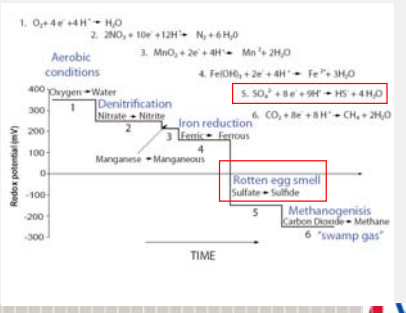
Hydric Indicator A4: Hydrogen Sulfide



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Hydric Indicator A4: Hydrogen Sulfide

- Contain oxidizable sulfur compounds
- Accumulate as a permanently saturated soil/sediment in coastal marshes
- Exposure to aerobic conditions oxidizes sulfides to sulfates, forming sulfuric acid
- Identified by both mineral observations and field peroxide tests.

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Difficult Wetland Situations in the AW and WMVC Regions

Problematic Soil Types

Volcanic Ash

Recently Developed Wetlands

Seasonally Ponded Soils

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Problematic Soil Situations

Difficult Wetland Situations in the AW and WMVC Regions

- *Moderately to Very Strongly Alkaline Soils* -Identifiable redoximorphic features do not readily form in saturated soils with a pH of 7.9 or higher
- *Volcanic Ash or Diatomaceous Earth* - Soils with high levels of silica that naturally have high value and low chroma; redoximorphic features do not form in these soils
- *Vegetated Sand and Gravel Bars within Floodplains* - Coarse textured soils on vegetated bars above the active channel of rivers and streams
- *Recently Developed Wetlands* - Wetlands were intentionally or unintentionally produced by human by human activities and have not been in place long enough to develop hydric soil characteristics
- *Seasonally Ponded Soils* – Seasonally ponded depressional wetlands; most are perched systems; lack hydric soil characteristics due to limited saturation depth, saline or other conditions
- *Dark Parent Material (WMVC only)* – Dark nature due to parent materials not hydric conditions; redoximorphic features difficult to see

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Difficult Wetland Situations

Problematic Soils

Initial Procedure:

- Verify presence of *hydrophytic vegetation* and *wetland hydrology*
- Verify area is in a *landscape position* that is likely to collect or concentrate water
- Document the *soil conditions* (including the pH of the soil, if appropriate)
- Reference the "*problematic soil situation*" or explain rationale why the soil is a hydric soil

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