# HYDRIC SOILS OF THE UNITED STATES: A GUIDE TO THEIR RECOGNITION

UNITED STATES DEPARTMENT OF AGRICULTURE, NATURAL RESOURCES CONSERVATION SERVICE, SOILS DIVISION and WETLANDS SCIENCE INSTITUTE
in cooperation with:
NATIONAL TECHNICAL COMMITTEE for HYDRIC SOILS
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Forward:

This guide to Hydric Soils of the United States focuses on the concerns of the National Technical Committee for Hydric Soils (NTCHS). The committee is responsible for maintaining the Hydric Soil Definition, Hydric Soil Criteria, National List of Hydric Soils, and Hydric Soil Indicators. The text and discussion contained in the guide are considered works-in-progress and reflect the current deliberations of the NTCHS. Membership of the NTCHS contains representatives of the Natural Resources Conservation Service, US Fish and Wildlife Service, US Army Corps of Engineers, Environmental Protection Agency, Bureau of Land Management, US Forest Service, universities, and the private sector.

**Figure 1:** A soil with redox concentrations as pore linings and soft masses in a low chroma matrix. All the requirements for Hydric Soil Indicator F3 (Depleted Matrix) are met and the soil is a hydric soil. F3 is an indicator commonly used to identify and delineate hydric soils in the United States. Scale is cm (left) and in. (right).

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**Figure 2:** Our intent for this guide, "Hydric Soils of the United States" is to help wetland scientist identify and delineate ecological wetlands. Some soils occupy specific landform

positions and have soil features and properties unique to soils that occur in wetlands. These soils are hydric soils (foreground). Other soils occupy specific landform positions and have features and properties unique to soils that occur in uplands such as the soils in the background with conifers. These soils are not hydric soils.

**Topic**

**Hydric Soil Terminology**

Introduction:

We use several terms, which may be new to the guide user, that are essential for the methodology needed to describe specific processes used in soil delineation. Some of these are: Hydric Soil Definition, Hydric Soil Criteria, Hydric Soil Lists, Hydric Soil Indicators, and, lastly, hydric soils. Each term has a specific meaning and use honed from numerous deliberations of the National Technical Committee for Hydric Soils (NTCHS). All hydric soils must satisfy requirements of the Hydric Soil Definition. Hydric Soil Criteria are used to generate Hydric Soil Lists. Hydric Soil Lists contain a listing of soils that have any probability of being hydric. Hydric soil lists do not delineate soils in the field; they must be delineated *in situ.* Hydric Soil Criteria and Hydric Soil Lists are used as off site assessment tools. Hydric Soil Indicators are primarily morphological indicators used for field identification of hydric soils. A hydric soil is a soil that meets the Hydric Soil Definition; presence of the Hydric Soil Indicators is evidence that the definition has been met.

Hydric Soil Definition:

The Hydric Soil Definition (Federal Register, July 13, 1994) is: "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." This definition replaced the older version (USDA, SCS, 1991) and accomplished two things. First, a soil that is artificially drained or protected (ditches, levees, etc.) is a hydric soil if the soil in its undisturbed state would meet the definition of a hydric soil. Estimated soil properties for manipulated soils are based on best professional estimates of the properties thought to exist prior to manipulation. Second, the link between the definition and criteria was removed. Criteria and lists cannot be substituted for the definition.

Hydric Soil Criteria:
The Criteria for Hydric Soils (Federal Register, February 24, 1995) are:

1. All Histosols except Folists. or
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Aquisalids, Pachic subgroups, or Cumulic subgroups that are:
    - a. somewhat poorly drained with a water table equal to 0.0 foot (ft.) from the
    - b. poorly drained or very poorly drained and have either:
        - (1) 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
        - (2) 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
        - (3) water table at less than or equal to 1.0 ft. from the surface during the growing season, if permeability is less than 6 in./h. in any layer within 20 in., or
3. Soils that are frequently ponded for long or very long duration during the growing season, or
4. Soils that are frequently flooded for long or very long duration during the growing season.

The main purpose for the criteria is to create Hydric Soil Lists. According to the NTCHS, Criteria 1, 3, and 4 can be used to document the presence of a hydric soil; however, proof that anaerobiosis exists must also be obtained. Criteria 2 cannot be used to document the presence of a hydric soil; Hydric Soils Indicators are used to document the presence of a hydric soil for these saturated soils.

Hydric Soil Lists:
Hydric Soil Lists are created by comparing estimated soil properties with the Hydric Soil Criteria.

**Figure 3**: Most commonly the interpretive rating of whether or not a soil has a probability of being hydric is obtained by comparing the estimated soil properties found in a published soil survey with the Hydric Soil Criteria.

If any portion of the range of estimated properties for a soil is within the criteria that soil appears on Hydric Soils Lists. For example, if a soil with a permeability of less than 6 in./h. has an estimated water table of 1.0 to 2.0 ft. during any portion of the growing season, that soil would be on the hydric soil list, even though most of the range in estimated water table (> 1.0 ft.) is outside the criteria.

Thus, the presence of a soil on a hydric soil list does not mean that the soil is in fact hydric. This is only an interpretive rating. Just as is the case with all interpretations based on information in a published soil survey or other sources of estimated soil properties, **hydric soil interpretations are confirmed by on-site investigations.** The Fargo series, for instance, that occurs in western Minnesota and eastern North Dakota is on hydric soil lists but less than 15% of mapped areas are hydric.

Hydric Soil Indicators:

Field indicators of hydric soils are routinely used in conjunction with the definition to confirm the presence or absence of a hydric soil. This CD is an enlarged iteration of the publication *Field Indicators of Hydric Soils in the United States* (USDA, NRCS, 1996; as revised) which is the guide that should be applied to identify and delineate hydric soils in the field. The NTCHS is responsible for revising and maintaining the Hydric Soil Indicators. The list of Hydric Soil Indicators is not static. Changes are anticipated as new knowledge of morphological, physical, chemical, and mineralogical soil properties accumulates. Revisions and additions will continue as we proceed to gain a better understanding of the relationships between the development of recognizable soil properties and anaerobic soil conditions.

Comments regarding field observations of hydric soil conditions that cannot be documented using the presently recognized Hydric Soil Indicators are welcome as are comments on the Hydric Soil Definition, Hydric Soil Criteria, and Hydric Soil Lists. Comments should be sent to:

Russ Pringle
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104 Sturgis Hall
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All modifications must be approved by the NTCHS. In order to properly use the Indicators, a basic knowledge of soils, soil landscape relationships, and soil survey procedures is necessary. Most of the Hydric Soil Indicators are landform specific. Professional soil or wetland scientists familiar with local conditions are best equipped to make an on-site hydric soil determination.

**Figure 4:** This Spodosol is in an abandoned cropped field. It shows the Hydric Soil Indicator S6 (Stripped Matrix) with the matrix stripped of organic material within 15 cm (6 in.) of the surface. Scale is cm (l.) and in. (r.).

**Figure 5:** Land Resource Region Map of the United States and Puerto Rico. The indicators are designed to be regionally specific. Each indicator states the Land Resource Regions (LRRs) or the Major Land Resource Areas (MLRAs) in which it can be used; use of other indicators is not permitted without consent of the NTCHS. The geographic extent of LRRs and MLRAs is defined in USDA Ag. Handbook 296 (USDA, SCS, 1981).

The indicators are used to identify the hydric soil component of wetlands; however, there are some hydric soils that may lack one of the currently listed indicators. Therefore, the lack of an indicator does not exclude the soil from being classed as hydric. Such soils should be investigated in detail and their characteristic morphologies documented. This documentation will serve as a basis for establishing additional Hydric Soil Indicators that are not presently recognized.

The approved indicators are being tested and refined by soil scientists in all LRRs, Some changes will occur. The approved indicators should be tested for use in LRRs other than those listed. Also, 16 Indicators for testing have been identified for specific LRRs. Users are encouraged to test these indicators and submit other morphological properties they believe indicative of hydric soils.

Summary:

The hydric soil definition has been established and tested by the NTCHS. All hydric soils must meet the definition. Hydric soil criteria are used to develop hydric soil lists. Hydric soil lists, in turn, are used for off site determination of the potential for the presence of hydric soils. **Indicators are used to identify hydric soils on site.** A hydric soil exists if an on-site determination identifies the presence of a hydric soil indicator.

**Hydric Soil Indicator Concept:**

**Figure 6:** Hydrology is easily determined during periods of high precipitation and/or high runoff; however, hydrology does not persist throughout the year and may be lacking altogether in many years.

The Hydric Soil Indicator concept is based on the premise that hydric soils develop and exhibit characteristic morphologies that result from repeated periods of saturation and/or inundation for more than a few days. Saturation or inundation when combined with anaerobic microbiological activity in the soil, causes a depletion of oxygen. This anaerobiosis promotes biogeochemical processes such as the accumulation of organic matter, loss of oxygen, and the reduction, translocation, and/or accumulation of nitrates, manganese, iron, sulfur, and even methanogenesis. These processes result in characteristic morphologies which persist in the soil during both wet and dry periods, making them particularly useful for identifying hydric soils.

Hydric soil indicators form by processes that accumulate and/or loose iron or manganese, accumulate and/or differentially remove organic carbon materials, and reduce sulfur compounds. Examples are redoximorphic features, muck accumulation, and the presence of hydrogen sulfide gas. This last indicator is found in only the wettest sites that contain sulfur.

**Figure 7:** Indicators related to Fe/Mn depletions or concentrations such as in this Aqualf are the most common indicators used. Scale is cm.

**Figure 8:** For such soils like this Aquod, features related to accumulations of organic carbon should be used. The parent materials for this soil contains low amounts of iron and manganese. Soil formed in such materials may have low chroma colors that are not related to saturation and reduction. Organic features are identified in this guide, in part to handle soils whose parent materials may have had low amounts of Fe/Mn and where hydrogen sulfide gas is not detected.

**Figure 9:** Some soils such as in this Aquult have both Fe/Mn and carbon indicators. Scale is ft.

**Figure 10**: We believe that Indicator A4 (Hydrogen Sulfide) is likely to occur in this salt marsh. Additionally, some of the carbon accumulation features such as Indicators A1 (Histosols), A2 (Histic Epipedon), and A3 (Black Histic) may occur here also. These features identify hydric soils, clearly. Because they are maximum expressions of anaerobiosis, they are rarely used for delineation purposes. They are not found on the wetland edge.

**Hydric Soil Indicator Cautions:**

**Figure 11:** There are hydric soils whose morphologies are difficult to interpret or seem inconsistent with the landscape, vegetation, or hydrology. These soils should be studied carefully. Such soils may include those formed in grayish or reddish colored parent materials, soils with high pH or low organic matter content, soils with relict redoximorphic features, and disturbed soils such as cultivated soils and filled areas.

**Figure 12:** Soils that are artificially drained or protected (for instance, by levees) are hydric if the soils in their undisturbed state would meet the definition of a hydric soil. These soils should also have at least one of the Indicators.

Morphological features of hydric soils indicate that saturation and anaerobic conditions have existed under either contemporary or former (recent) hydrologic regimes. Features that do not reflect contemporary or recent hydrologic conditions of saturation and anaerobiosis are relict features. Typically, contemporary and recent hydric soil morphologies have diffuse boundaries; relict hydric soil features have abrupt boundaries. Additionally, active features are most often related to pores especially biopores such as root channels. Pore lining accumulations or depletions have a high probability of being active. Root pore lining accumulations have many names; oxidized rhizospheres, iron plaque, and pipe stems are a few.

**Figure 13:** This soil has concentration associated with biopores.

**Figure 14:** Where soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, it may be necessary to obtain the assistance of an experienced soil or wetland scientist to determine whether the soil is hydric. Landform position recognizance is most often the key to understanding the soils. Once a particular landform and its physical and

hydrologic relationship with other landforms is understood identification of its hydric status become easier.

**Figure 15:** This is the form we recommend for use to record soil (pedon) descriptions. Using a form such as this to record pedon descriptions organized the observations, allows for a focus on the important morphological observations needed to make delineation decisions, and reminds the wetland scientist to record all items necessary to document decisions.

## Hydric Soil Indicator Identification Procedure

In order to document soils as hydric or non hydric, first remove all loose leaf matter, needles, bark, and other easily identified plant parts (often called "duff" layer) to expose the surface. Dig a hole and describe the pedon to a depth of at least 50 cm (20 inches {in.}). Using the completed soil description just created, specify which of the Hydric Soil Indicators have been matched. Some soils require deeper examination in cases of Hydric Soil Indicators that cannot be easily seen within 50 cm (20 in.) of the surface. It is always recommended that soils be excavated and described as deep as necessary to make reliable determinations and interpretations.

**Figure 16:** Examination to less than 50 cm (20 in.) may suffice in soils with surface horizons of organic material or mucky mineral material because these shallow organic accumulations only occur in hydric soils such as in this Aquod. Little knowledge concerning the hydric status of this soil is gained by making observations beneath the spodic horizon. Scale is in.

**Figure 17:** Depth of excavation will often be greater than 50 cm (20 in.) such as for this Aquoll because the upper horizons of these soils, due to the masking effect of organic material, often contain no visible redoximorphic features. In many areas it is necessary to make exploratory observations to a meter or more. These observations should be made with the intent of documenting and understanding the variability in soil properties and hydrologic relationships on the site. Critical depths used in specific indicators are measured from the muck or mineral soil surface unless otherwise indicated. Scale is in.

**Figure 18:** All colors refer to moist Munsell colors. This Aquoll has the indicator F6 (Redox Dark Surface). The left is moist and the right is dry. Care should be taken not to saturate when moistening dry colors.

Often soil colors fall between chips on the Munsell Soil Color Charts. We emphasize that the colors specified regarding an indicator are that colors do occur between Munsell chips; however colors should not be rounded to qualify as meeting an indicator. For example, a soil matrix with a chroma between 2 and 3 should be listed as having a chroma of 2+. This soil material does not have a chroma 2 and would not meet any indicator that requires a chroma 2 or less.

**Hydric Soil Indicator Schema**:

*Each of the Hydric Soil Indicators is* structured as follows:

1. Alpha-numeric Listing
2. Short Name
3. Applicable Land Resource Regions (LRRs)
4. Description of the Field Indicator
5. User Notes

**Figure 19:** The Hydric Soil Indicators have a schema that structures each indicator as this example: 1.) *S4* indicates the forth indicator for sandy soils; 2.) *Sandy Gleyed Matrix* is the short name; 3.) the indicator is *For use in all LRRs except W, X, and Y;* 4. *Sandy Gleyed Matrix* is defined, and 5.) helpful *User Notes* are added.

## Hydric Soil Indicators for All Soils

**"All soils" refers to soils with any USDA soil texture. Unless otherwise indicated, all mineral layers above any of the Indicators have dominant chroma 2 or less, or the layer(s) with dominant chroma of more than 2 is thinner than 15 cm (6 in.) thick. Also, unless otherwise indicated, nodules and concretions are not considered to be redox concentrations. Use the following Indicators regardless of texture.**

**A1. Histosol.** ***For use in all LRRs.*** **Classifies as a Histosol, except Folists.**
Histosol User Notes: A Histosol has 40 cm (16 in.) or more of the upper 80 cm (32 in.) as organic soil material. Organic soil material has a minimum organic carbon content (by weight) of 12 to 18 percent, or more, depending on the clay content of the soil. These materials include muck (sapric soil material), mucky peat (hemic soil material), or peat (fibric soil material). See glossary for definition of muck, mucky peat, peat, and organic soil material. See Figure 53 for organic carbon requirements.

**Figure 20:** This soil is a Typic Medisaprist. It is a wet Histosol and therefore a hydric soil. Scale is m (l.) and ft. (r.).

**A2. Histic Epipedon.** ***For use in all LRRs except W, X, and Y; for testing in LRRs W, X, and Y.*** **A histic epipedon.**
Histic Epipedon User Notes: Most histic epipedons are surface horizons that have organic soil material 20 cm (8 in.) or more thick. Aquic conditions or artificial drainage needs to be present, also. See pages 3 and 4 in the Keys to Soil Taxonomy (US Department of Agriculture, Soil Survey Staff, 1994), the glossary of this document for definitions, and Figure 53 for organic carbon requirements.

**A3. Black Histic.** ***For use in all LRRs except W, X, and Y; for testing in LRRs W, X, and Y.*** **A layer of peat, mucky peat, or muck 20 cm (8 in.) or more thick starting within the upper 15 cm (6 in.) of the soil surface having hue 10YR or yellower, value 3 or less, and chroma 1 or less.**
Black Histic User Notes: Unlike indicator A2 this indicator does not require proof of aquic conditions or artificial drainage. See glossary for definitions of peat, mucky peat, and muck. See Figure 53 for organic carbon requirements.
**Figure 21:** This soil has the indicator Black Histic. Color is 2/1. Scale is cm (l.) and in. (r.).

**A4. Hydrogen Sulfide.** ***For use in all LRRs.*** **A hydrogen sulfide odor within 30 cm (12 in.) of the soil surface.**
Hydrogen Sulfide User Notes: This "rotten egg smell" indicates that sulfate-sulfur has been reduced and therefore the soil is anaerobic. In most hydric soils, the sulfidic odor is only present when the soil is saturated and anaerobic.

**A5. Stratified Layers.** ***For use in LRRs F, K, L, M, N, O, P, R, S, T, and U; for testing in LRRs V and Z .*** **Several stratified layers starting within the upper 15 cm (6 in.) 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 value 4 or more and chroma 2 or less.**
Stratified Layers User Notes: Use of this indicator may require assistance from a trained soil scientist with local experience. 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 covered, coated, or similarly masked with organic matter. An undisturbed sample must be observed. Individual strata are dominantly less than 2.5 cm (1 in.) thick. A hand lens is an excellent tool to aid in the identification of this indicator. Stratified layers in soils that fail NTCHS hydric soil criteria and fail anaerobic conditions are not indicative of hydric soils. 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.

**Figure 22:** This soil has indicator A5 (Stratified Layers) in loamy material. In many soils more than one indicator exists. Here we have A5 (Stratified Layers) above a depth of about 5 cm, A9 (1 cm Muck) between depths of about 5 to 10 cm, and F2 (Loamy Gleyed Material) below a depth of about 15 cm. Scale is cm (l.) and in. (r.).

**Figure 23:** This soil has indicator A5 (Stratified Layers) in sandy materials within the required 15 cm. Individual strata are dominantly less than 2.5 cm. Scale is in.

**A6. Organic Bodies.** *For use in LRRs P, T, U, and Z.* **Presence of 2% or more organic bodies of muck or a mucky modified mineral texture, approximately 1 to 3 cm (0.5 to 1 in.) in diameter, starting within 15 cm (6 in.) 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). Many organic bodies lack the required amount of organic carbon 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 qualify as this indicator. Material consisting of partially decomposed root tissue does not qualify as the indicator.

**Figure 24:** A soil with indicator A6 (Organic Bodies). The muck organic bodies layer occurs between 0 and 10 cm. The percent organic carbon in organic bodies is the same as in the Muck or Mucky Texture Indicators. Indicator S7 (Dark Surface) is also present. Scale is cm (l.) and in. (r.).

**Figure 25:** Individual organic bodies. From the soil in the previous slide. The organic bodies are muck 1-3 cm in size. Scale is cm (l.) and in. (r.).

**A7. 5 cm Mucky Mineral.** *For use in LRRs P, T, U, and Z.* **A mucky modified mineral surface layer 5 cm (2 in.) or more thick starting within 15 cm (6 in.) of the soil surface.**
5 cm Mucky Mineral User Notes: "Mucky" is a USDA texture modifier for mineral soils. The organic carbon content is at least 5 and ranges to as high as 18 percent. The percentage requirement is dependent upon the clay content of the soil; the higher the clay content, the higher the organic carbon requirement. An example is mucky fine sand, which has at least 5 percent organic carbon but not more than about 12 percent organic carbon. Another example is mucky sandy loam, which has at least 7 percent organic carbon but not more than about 14 percent organic carbon. See the glossary for the definition of mucky modified mineral texture. See Figure 53 for organic carbon requirements.

**Figure 26:** This soil has the indicator A7 (5 cm Mucky Mineral) about 10 cm thick. Indicator S7 (Dark Surface) is also present. Scale is cm (l.) and in. (r.).

**A8. Muck Presence.** ***For use in LRRs U, V and Z.*** **A layer of muck with value 3 or less and chroma 1 or less within 15 cm (6 in.) of the soil surface.**
Muck Presence User Notes: The presence of muck of any thickness within 15 cm (6 in.) is the only requirement. Normally this expression of anaerobiosis is at the soil surface; however, it may occur at any depth within 15 cm (6 in.). Muck is sapric soil material with at least 12 to 18 percent organic carbon. Organic soil material is called muck (sapric soil material) if virtually all of the material has undergone sufficient decomposition such that plant parts can not be identified. Hemic (mucky peat) and fibric (peat) soil materials do not qualify. In order to determine if muck is present, the investigator must remove loose leaves, needles, bark, and other easily identified plant remains from the soil surface. This is sometimes called a leaf/root mat. Then examine for decomposed organic soil material. Generally muck is black and has a "greasy" feel; sand grains should not be evident. Hydric soil indicator determinations are made below the leaf or root mat; however, root mats that meet the definition of hemic or fibric soil material are included in the

decision making process for Mucky Peat, Peat, Organic Bodies, or Histic Indicators.  See the glossary for the definition of muck.  See Figure 53 for organic carbon requirements.

**Figure 27:** The presence of muck of any thickness within 15 cm (6 in.) is the only requirement. Normally this expression of anaerobiosis is at the soil surface; however, it may occur at any depth within 15 cm.  In this soil the muck thickness is about 2 cm.  Indicator S7 (Dark Surface is also present.  Scale is cm (l.) and in. (r.).

**A9.  1 cm Muck.** *For use in LRRs D, F, G, H, P, and T; for testing in LRRs I, J, and O.* **A layer of muck 1 cm (0.5 in.) or more thick with value 3 or less and chroma 1 or less starting within 15 cm (6 in.) of the soil surface.**
1 cm Muck User Notes:  Unlike Indicator A8 (Muck Presence) there is a minimum thickness requirement of 1 cm.  Normally this expression of anaerobiosis is at the soil surface; however, it may occur at any depth within 15 cm (6 in.).  Muck is sapric soil material with at least 12 to 18 percent organic carbon.  Organic soil material is called muck (sapric soil material) if virtually all of the material has undergone sufficient decomposition to limit recognition of the plant parts. Hemic (mucky peat) and fibric (peat) soil materials do not qualify.  In order to determine if muck is present, the investigator must remove loose leaves, needles, bark, and other easily identified plant remains from the soil surface.  This is sometimes called a leaf/root mat.  Then examine the material below the leaf/root mat for decomposed organic soil material.  Generally muck is black and has a “greasy” feel; sand grains should not be evident.  Hydric soil indicator determinations are made below the leaf or root mat; however, root mats that meet the definition of hemic or fibric soil material are included in the decision making process for Mucky Peat, Peat, Organic Bodies, or Histic Indicators.  See the glossary for the definition of muck.  See Figure 53 for organic carbon requirements.

**Figure 28:** This soil has about 2 cm of muck that meets the Indicator A9 (1 cm Muck).  It also has the indicator S7 (Dark Surface) about 15 cm thick.  Scale is cm (l.) and in. (r.).

**A10.  2 cm Muck.** ***For use in LRR M and N; for testing in LRRs A, B, C, E, K, L, R, S, W, X, Y, and Z.*** **A layer of muck 2 cm (0.75 in.) or more thick with value 3 or less and chroma 1 or less starting within 15 cm (6 in.) of the soil surface.**
2 cm Muck User Notes:  This Indicator requires a minimum muck thickness of 2 cm.  Normally this expression of anaerobiosis is at the soil surface; however, it may occur at any depth within 15 cm (6 in.).  Muck is sapric soil material with at least 12 to 18 percent organic carbon.  Organic soil material is called muck (sapric soil material) if virtually all of the material has undergone sufficient decomposition to limit recognition of the plant parts.  Hemic (mucky peat) and fibric (peat) soil materials do not qualify.  In order to determine if muck is present, the investigator must remove loose leaves, needles, bark, and other easily identified plant remains from the soil surface.  This is sometimes called a leaf/root mat.  Then examine the material below the leaf/root mat for decomposed organic soil material.  Generally muck is black and has a “greasy” feel; sand grains should not be evident.  Hydric soil indicator determinations are made below the leaf or root mat; however, root mats that meet the definition of hemic or fibric soil material are included in the

decision making process for Mucky Peat, Peat, Organic Bodies, or Histic Indicators. See the glossary for the definition of muck. See Figure 53 for organic carbon requirements.

## Hydric Soil Indicators for Sandy Soils

**"Sandy soils" refers to those soils with a USDA texture of loamy fine sand and coarser. Unless otherwise indicated, all mineral layers above any of the Indicators have dominant chroma 2 or less, or the layer(s) with dominant chroma of more than 2 is thinner than 15 cm (6 in.) thick. In addition, unless otherwise indicated, nodules and concretions are not considered to be redox concentrations. Use the following sandy Indicators for sandy mineral soil materials:**

**S1. Sandy Mucky Mineral.** ***For use in all LRRs except W, X, and Y.*** **A mucky modified mineral layer 5 cm (2 in.) or more thick starting within 15 cm (6 in.) of the soil surface.**
Sandy Mucky Mineral User Notes: "Mucky" is a USDA texture modifier for mineral soils. The organic carbon content is at least 5 and ranges to as high as 14 percent for sandy soils. The percentage requirement is dependent upon the clay content of the soil; the higher the clay content, the higher the organic carbon requirement. An example is mucky fine sand, which has at least 5 percent organic carbon but not more than about 12 percent organic carbon. See the glossary for the definition of mucky modified mineral texture. See Figure 53 for organic carbon requirements.

**S2. 3 cm Mucky Peat or Peat.** ***For use in LRRs G and H.*** **A layer of mucky peat or peat 2.5 cm (1 in.) or more thick with value 4 or less and chroma 3 or less starting within 15 cm (6 in.) of the soil surface.**
3 cm Mucky Peat and Peat User Notes: Mucky peat (hemic soil material) and peat (fibric soil material) having at least 12 to 18 percent organic carbon. Organic soil material is called peat if virtually all of the plant remains are sufficiently intact to permit identification of plant remains. Mucky peat is an intermediate stage of decomposition between peat and highly decomposed muck. To determine if mucky peat and/or peat are present, first remove loose leaves, needles, bark, and other easily identified plant remains. This is sometimes called a leaf/root mat. Next examine for undecomposed to partly decomposed organic soil material. See the glossary for the definitions of mucky peat and peat.

**S3. 5 cm Mucky Peat or Peat.** ***For use in LRRs F, and M; for testing in LRR R.*** **A layer of mucky peat or peat 5 cm (2 in.) or more thick with value 3 or less and chroma 2 or less starting within 15 cm (6 in.) of the soil surface.**
5 cm Mucky Peat and Peat User Notes: Mucky peat (hemic soil material) and peat (fibric soil material) have at least 12 to 18 percent organic carbon. Organic soil material is called peat if virtually all of the plant remains are sufficiently intact to permit identification of plant remains. Mucky peat is an intermediate stage of decomposition between peat and highly decomposed muck. To determine if mucky peat and/or peat are present, first remove loose leaves, needles, bark, and other easily identified plant remains. This is sometimes called a leaf/root mat. Next

examine for undecomposed to partly decomposed organic soil material. See the glossary for the definitions of mucky peat and peat.

**S4. Sandy Gleyed Matrix.** ***For use in all LRRs except W, X, and Y.*** **A gleyed matrix which occupies 60% or more of a layer starting within 15 cm (6 in.) of the soil surface.**
Sandy Gleyed Matrix User Notes: Gley colors are not synonymous with gray colors. Gley colors are those colors that are found on the gley pages of Munsell Soil Color Charts (Kollmorgen Instruments Corporation, 1994). They have hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more. The gleyed matrix only has to be present within 15 cm (6 in.) of the surface. Soils with gleyed matrices are saturated for a significant duration; this is why no thickness of the layer is required. See the glossary for the definition of gleyed matrix.

**Figure 29:** This soil has the indicator S4 (Sandy Gleyed Matrix) starting at the soil surface. Scale is cm (l.) and in. (r.).

**S5. Sandy Redox.** ***For use in all LRRs except V, W, X, and Y.*** **A layer starting within 15 cm (6 in.) of the soil surface at least 10 cm (4 in.) thick that has a matrix with 60 % 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 and manganese masses (reddish mottles) and pore linings (Vepraskas, 1994). Included within this concept of redox concentrations are iron/manganese bodies as soft masses with diffuse boundaries. The iron/manganese masses are 2 to 5 mm in size and have a value 3 or less and a chroma 3 or less; most commonly they are black. Iron/manganese masses should not be confused with concretions and nodules (US Department of Agriculture, Soil Survey Staff, 1993) associated with plinthitic soils or relict concretions. Common to many redox concentrations (US Department of Agriculture, Soil Survey Division Staff, 1993) are required.

**Figure 30:** This soil has the indicator S5 (Sandy Redox). The required redox concentrations occur below a depth of about 10 cm. Scale is in.

**Figure 31:** This soil also has the indicator S5 (Sandy Redox). The redox concentrations occur less prominently but more abundantly than in Figure 28. Scale is in.

**S6. Stripped Matrix.** ***For use in all LRRs except V, W, X, and Y.*** **A layer starting within 15 cm (6 in.) 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 diffuse splotchy pattern of two or more colors. The stripped zones are 10% or more of the volume; they are rounded and approximately 1 to 3 cm (0.5 to 1 in.) in diameter.**
Stripped Matrix User Notes: The process that is important here is the mobilization and transportation of the oxides and/or organic matter. The results should always be splotchy coated and uncoated soil areas. Common to many areas of stripped (uncoated) soil material 1-3 cm

(0.5-1 in.) in size constitutes a positive indication. 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. This indicator has been previously named “polychromatic matrix” (Florida Soil Survey Staff, 1992) and “streaking” (Environmental Laboratory, 1987).

**Figure 32:** This soil has the indicator S6 (Stripped Matrix). The matrix is stripped of organic matter beneath the surface layer. Scale is in.

**Figure 33:** This soil has the indicator S6 (Stripped Matrix). The matrix is stripped of iron oxides below a depth of about 10 cm. Scale is cm (l.) and in. (r.).

**Figure 34:** This is a stripped matrix that shows the required areas of stripped (uncoated) areas approximately 1 to 3 cm in size. The mobilization and translocation of the oxides or organic matter is the important process and should result in a splotchy pattern of coated and uncoated areas. Scale is in.

**S7. Dark Surface**. *For use in LRRs N, P, R, S, T, U, V, and Z.* **A layer 10 cm (4 in.) or more thick starting within the upper 15 cm (6 in.) 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 covered, coated, or similarly masked with organic material. The matrix color of the layer immediately below the dark layer must have 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. To identify the coatings necessary with this indicator, a 10X or 15X hand lens is often necessary and an excellent tool. Many wet soils have a ratio of about 50 percent soil particles that are covered or coated with organic matter and about 50 percent uncoated or uncovered 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.

**Figure 35:** This soil has the indicator S7 (Dark Surface). The thickness is about 15 cm. Indicator S8 (Polyvalue Below Surface) occurs between 15 and 22 cm. Scale is in.

**S8. Polyvalue Below Surface.** *For use in LRRs R, S, and T; for testing in LRRs K and L.* **A layer with value 3 or less and chroma 1 or less starting within 15 cm (6 in.) of the soil surface underlain by a layer(s) where translocated organic matter unevenly covers the soil material forming a diffuse splotchy pattern. At least 70% of the visible soil particles in the upper layer must be covered, coated, or masked with organic material. Immediately below this layer, the organic coating occupies 5% or more of the soil volume and has value 3 or less and chroma 1 or less. The remainder of the soil volume has value 4 or more and chroma 1 or less.**
Polyvalue Below Surface User Notes: This indicator describes soils with a very dark gray or black surface or near surface layer less than 10 cm (4 in.) thick underlain by a layer where organic matter has been differentially distributed within the soil by water movement. The mobilization

and translocation of organic matter results in splotchy coated and uncoated soil areas as described in the Sandy Redox and Stripped Matrix Indicators except that for S8 the whole soil is in shades of black and gray. The chroma 1 or less is critical because it limits application of this indicator to only those soils that are depleted of iron. This indicator includes the indicator previously termed "streaking" (Environmental Laboratory, 1987).

**Figure 36:** This soil has the indicator S8 (Polyvalue Below Surface) beneath the surface layer and the layer with the indicator is chroma 1. Scale is in.

**S9. Thin Dark Surface.** ***For use in LRRs R, S, and T; for testing in LRRs K and L.*** **A layer 5 cm (2 in.) or more thick within the upper 15 cm (6 in.) of the surface, with value 3 or less and chroma 1 or less. At least 70% of the visible soil particles in this layer must be covered, coated, or masked with organic material. This layer is underlain by layer(s) with value 4 or less and chroma 1 or less to a depth of 30 cm (12 in.) or to the spodic horizon, whichever is less.**
Thin Dark Surface User Notes: This indicator describes soils with a very dark gray or black near-surface layer at least 5 cm (2 in.) thick underlain by a layer where organic matter has been carried downward by flowing water. The mobilization and translocation of organic matter results in an even distribution of organic matter in the eluvial (E) horizon. The chroma 1 or less is critical because it limits application of this indicator to only those soils that are depleted of iron. This indicator commonly occurs in hydric Spodosols; however, the identification of a spodic horizon is not required.

**S10. Alaska Gleyed.** ***For use in LRRs W, X, and Y.*** **Dominant hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with value 4 or more in the matrix, within 30 cm (12 in.) of the mineral surface, and underlain by hue 5Y or redder in the same type of parent material.**
Alaska Gleyed User Notes: Gley colors are not synonymous with gray colors. Gley colors are those colors that are found on the gley pages of Munsell Soil Color Charts (Kollmorgen Instruments Corporation, 1994). They have hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with value 4 or more. Color comparison to underlying material must be based on material of the same type or lithology.

## Hydric Soil Indicators for Loamy and Clayey Soils

**"Loamy and clayey soils" refers to those soils with USDA textures of loamy very fine sand and finer. Unless otherwise indicated, all mineral layers above any of the Indicators have dominant chroma 2 or less, or the layer(s) with dominant chroma of more than 2 is thinner than 15 cm (6 in.) thick. In addition, unless otherwise indicated, nodules and concretions are not considered to be redox concentrations. Use the following loamy and clayey Indicators for loamy or clayey mineral soil materials:**

**F1. Loamy Mucky Mineral. *For use in all LRRs except V, W, X, and Y.* A mucky modified mineral layer 10 cm (4 in.) or more thick starting within 15 cm (6 in.) of the soil surface.**
Loamy Mucky Mineral User Notes: "Mucky" is a USDA texture modifier for mineral soils. The organic carbon is at least 8 percent but can range to as high as 18 percent. The percentage requirement is dependent upon the clay content of the soil; the higher the clay content, the higher the organic carbon requirement. An example is mucky sandy loam, which has at least 8 percent organic carbon but not more than about 14 percent organic carbon. See the glossary for the definition of mucky modified mineral texture. See Figure 53 for organic carbon requirements.

**F2. Loamy Gleyed Matrix. *For use in all LRRs except W, X, and Y.* A gleyed matrix that occupies 60% or more of a layer starting within 30 cm (12 in.) of the soil surface.**
Loamy Gleyed Matrix User Notes: Gley colors are not synonymous with gray colors. Gley colors are those colors that are found on the gley pages of Munsell Soil Color Charts (Kollmorgen Instruments Corporation, 1994). They have hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with value 4 or more. The gleyed matrix only has to be present within 30 cm (12 in.) of the surface. Soils with gleyed matrices are saturated for a significant duration, this is why no thickness of the layer is required. See glossary for the definition of gleyed matrix.

**Figure 37:** Indicator F2 (Loamy Gleyed Matrix) occurs within the required depth of 30 cm in this soil. Additionally, indicator S6 (Stripped Matrix) is above the gleyed matrix. Sandy indicators occur in sandy materials. Loamy and clayey indicators occur in loamy and clayey materials.

**Figure 38:** Indicator F2 (Loamy Gleyed Matrix) occurs in this soil with the indicator F3 (Depleted Matrix). The Depleted Matrix occurs between the gleyed matrix and the surface layer.

**F3. Depleted Matrix.** *For use in all LRRs except W, X, and Y.* **A layer at least 15 cm (6 in.) thick with a depleted matrix that has 60% or more chroma 2 or less starting within 25 cm (10 in.) of the surface.**
Depleted Matrix User Notes: The depleted matrix must begin within 25 cm (10 in.) and continue for at least 15 cm (6 in.) The minimum thickness requirement is 5 cm (2 in.) if the depleted matrix is within the upper 15 cm (6 in.) of the mineral surface layer. Redox concentrations including iron and manganese masses (reddish mottles) 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.

**Figure 39:** Indicator F3 (Depleted Matrix) occurs in this soil with the required redox concentrations in a chroma 2 matrix below a depth of about 15 cm. Scale is in.

**Figure 40:** Indicator F3 (Depleted Matrix) is present in this soil and has a chroma 1 matrix below a depth of about 10 cm. With the presence of chroma 1, redox concentrations are not required. Scale is in.

**F4. Depleted Below Dark Surface.** *For use in all LRRs except LRRs W, X, and Y; for testing in LRRs W, X, and Y.* **A layer at least 15 cm (6 in.) thick with a depleted matrix that has 60% or more chroma 2 or less starting within 30 cm (12 in.) of the surface. The layer(s) above the depleted matrix have value 3 or less and chroma 2 or less.**
Depleted Below Dark Surface User Notes: This indicator often occurs in Mollisols but also applies to soils with umbric epipedons and dark colored ochric epipedons. For soils with dark colored epipedons greater than 30 cm (12 in.) thick, use Indicator F5. Redox concentrations including iron and manganese masses (reddish mottles) 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 definition of depleted matrix.

**F5. Thick Dark Surface.** ***For use in all LRRs except LRRs W, X, and, Y; for testing in LRRs W, X, and Y.*** **A layer at least 15 cm (6 in.) thick with a depleted matrix that has 60% or more chroma 2 or less (or a gleyed matrix) starting below 30 cm (12 in.) of the surface. The layer(s) above the depleted or gleyed matrix have hue N and value 3 or less to a depth of 30 cm (12 in.) and value 3 or less and chroma 1 or less in the remainder of the epipedon.**
Thick Dark Surface User Notes: The soil has a black or very dark gray surface layer 30 cm (12 in.) or more thick. The dark colored subsoil has value 3 or less, chroma 1 or less. Below the dark colored epipedon is a depleted matrix or gleyed matrix. This indicator is most often associated with over thickened soils in concave landscape positions. Redox concentrations including iron and manganese masses (reddish mottles) 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 definition of depleted matrix.

**Figure 41:** Indicator F5 (Thick Dark Surface), present in this soil, has a depleted matrix below the mollic epipedon.

**Figure 42:** Indicator F5 (Thick Dark Surface), present in this soil, has a gleyed matrix below the mollic epipedon.

**F6. Redox Dark Surface.** ***For use in all LRRs except LRRs W, X, and Y; for testing in LRRs W, X, and Y.*** **A layer at least 10 cm (4 in.) thick entirely within the upper 30 cm (12 in.) of the mineral soil that has:**

**a. matrix value 3 or less and chroma 1 or less and 2% or more distinct or prominent redox concentrations as soft masses or pore linings, or**

**b. matrix value 3 or less and chroma 2 or less and 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. It is recommended that delineators evaluate the hydrologic source and examine and describe the layer below the dark colored epipedon when applying this indicator. In some instances, drying of the samples makes the concentrations (if present) easier to see. Dried colors, if used, need to have matrix chromas of 1 or 2 and the redox concentrations need to be distinct or prominent. Plowed soils have the coloration from the iron material churned from ped faces to the ped interior. The drying procedure is especially warranted in these circumstances. The iron coloration occurs because ground water that temporarily discharges into the soil and the surface contains enough trapped oxygen to oxidize the iron.

**Figure 43:** Prominent redox concentrations as soft masses and pore linings are present and this soil has indicator F6 (Redox Dark Surface).

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**Figure 44:** This soil has the indicator F6 (Redox Dark Surface) and a depleted matrix beneath the Redox Dark Surface. The presence of both the redox dark surface and the depleted matrix is typical of soils that are wet due to subsurface saturation. Soils which are wet due to ponding or shallow perched layer of saturation may not have a depleted matrix below the dark surface. Scale is cm.

**F7. Depleted Dark Surface.** ***For use in all LRRs except LRRs W, X, and Y; for testing in LRRs W, X, and Y.*** **Redox depletions, with value 5 or more and chroma 2 or less, in a layer at least 10 cm (4 in.) thick entirely within the upper 30 cm (12 in.) of the mineral soil that has:**

**a. matrix value 3 or less and chroma 1 or less and 10% or more redox depletions, or**

**b. matrix value 3 or less and chroma 2 or less and 20% or more redox depletions.**

Depleted Dark Surface User Notes: Care should be taken not to mistake mixing of an E or calcic horizon into the surface layer as depletions. The "pieces" of E and calcic horizons are not redox depletions. Knowledge of local conditions is required in areas where E and/or calcic horizons may be present. In soils which are wet due to subsurface saturation, the layer immediately below the dark surface should have a depleted or gleyed matrix. Redox depletions should have associated micro sites redox concentrations that occur as Fe pore linings or masses within the depletion(s) or surrounding the depletion(s). We worry about the application of this indicator. It has been used successfully in the Mollisols of the prairie where all else fails. The chance for mistaking E and Bk (calcic) horizons for a depleted dark surface requires the delineator to know what E and Bk horizons are before attempting to use this indicator.

**F8. Redox Depressions.** ***For use in all LRRs except LRRs W, X, and Y; for testing in LRRs W, X, and Y.*** **In closed depressions subject to ponding, 5% or more distinct or prominent redox concentrations as soft masses or pore linings in a layer 5 cm (2 in.) or more thick entirely within the upper 15 cm (6 in.) of the soil surface.**
Redox Depressions User Notes: This indicator occurs on landforms such as vernal pools, playa lakes, rainwater basins, "Grady" ponds, and potholes: not micro-depressions on convex or plane landscapes.

**F9. Vernal Pools.** ***For use in LRRs C and D.*** **In closed depressions subject to ponding, presence of a depleted matrix in a layer 5 cm (2 in.) thick entirely within the upper 15 cm (6 in.) of the soil surface.**
Vernal Pools User Notes: Most often soils pond water for two reasons: they occur on landscape positions that collect water and they have a restrictive layer(s) that prevents water from moving downward through the soil. Redox concentrations including iron and manganese masses (reddish mottles) 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. Normally this indicator occurs at the soil surface.

**F10. Marl.** ***For use in LRR U.*** **A layer of marl with a value 5 or more starting within 10 cm (4 in.) 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 (US Department of Agriculture Soil Survey Staff. 1975 and 1994). 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 this indicator occurs at the soil surface.

**Figure 45:** This soil has the indicator F10 (Marl) which is usually precipitated by algae such as those in the genus *Chara*. Scale is ft.

**F11. Depleted Ochric.** ***For use in LRR O.*** **A layer(s) 10 cm (4 in.) or more thick that has 60% or more of the matrix with value 4 or more and chroma 1 or less. The layer is entirely within the upper 25 cm (10 in.) of the soil surface.**
Depleted Ochric User Notes: This indicator is most applicable on backswamps, meander troughs, and oxbows of the Mississippi River Delta.

**F12. Iron/Manganese Masses.** ***For use in LRRs N, O, P, and T; for testing in LRR M.*** **On flood plains, a layer 10 cm (4 in.) or more thick with 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 in.) 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.**
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 (US Department of Agriculture, Soil Survey Staff, 1993) associated with plinthitic soils or with concretions that have abrupt boundaries. This indicator occurs on flood plains of rivers such as the Apalachicola, Congaree, Mobile, Savannah, and Tennessee Rivers.

**Figure 46:** This soil has the indicator F12 (Iron/Manganese Masses) in a 40% depleted matrix. The masses are the black to dark brown areas. Scale is in.

**F13. Umbric Surface.** ***For use in LRRs P and T.*** **In depressions and other concave positions, a layer 15 cm (6 in.) or more thick starting within the upper 15 cm (6 in.) of the soil surface with value 3 or less and chroma 1 or less immediately underlain by a layer 10 cm (4 in.) or more thick with chroma 2 or less.**
Umbric Surface User Notes: Thickness requirements are slightly less that those required for an umbric epipedon. Umbric surfaces on higher landscape positions, such as Umbrepts, are excluded.

**Figure 47:** Indicator F13 (Umbric Surface) is about 35 cm thick in this illustration. Scale is in.

**F14. Alaska Redox Gleyed.** ***For use in LRRs W, X, and Y.*** **A layer that has dominant matrix hue 5Y with chroma 3 or less, or hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with 10% or more redox concentrations as pore linings with value and chroma 4 or more. The layer occurs within 30 cm (12 in.) of the soil surface.**
Alaska Redox Gleyed User Notes: Presence of 10 percent redox concentrations as pore linings in a dominantly gleyed matrix (hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more); or hue 5Y with chroma 3 or less is required. Pore linings must have value and chroma 4 or more.

**F15. Alaska Gleyed Pores.** ***For use in LRRs W, X, and Y.*** **Presence of 10% hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more in the matrix or along channels containing dead roots or no roots within 30 cm (12 in.) of the soil surface. The matrix has dominant chroma 2 or less.**
Alaska Gleyed Pores User Notes: Presence of 10 percent gleyed root channels within a low chroma matrix is required.

**F16. High Plains Depressions.** ***For use in MLRAs 72 and 73 of LRR H; for testing in other MLRAs of LRR H.*** **In closed depressions subject to ponding, the presence of a layer at least 10 cm (4 in.) thick within the upper 35 cm (13.5 in.) of the mineral soil: the entire 35 cm (13.5 in.) has chroma 1 or less and:**

**a. 1% or more redox concentrations as nodules or concretions, or**

**b. redox concentrations as nodules or concretions with distinct or prominent corona.**

High Plains Depressions User Notes: This indicator is for closed depressions (FSA "playas") in western Kansas, southwestern Nebraska, eastern Colorado, and southeastern Wyoming. It occurs in soils such as the Ness and Pleasant series. The matrix color of the 35 cm (13.5 in.) layer must be a chroma 1 or less; chroma 2 matrix colors are excluded; value is usually 3. The nodules/concretions are rounded, hard to very hard, range in size from < 1 mm to 3 mm, and most commonly are black or reddish black. The corona usually are reddish brown, strong brown, or yellowish brown. The nodules/concretions can be removed from the soil and the corona (halos) will occur as coatings on the concentration or will remain attached to the soil matrix. Use of 10X to 15X magnification aids in the identification of these features.

## TEST INDICATORS OF HYDRIC SOILS:

The Indicators listed above should be tested for use in LRRs other than those listed. Other Indicators for testing are listed below. This list of Test Indicators is not extensive. Users of the Indicators are encouraged to submit descriptions of other soil morphologies they think indicative of hydric soils along with supporting data for inclusion in subsequent editions of *Field Indicators of Hydric Soils in the United States.*

### Test Hydric Soil Indicators for All Soils

**TA1. Playa Rim Stratified Layers.** *For testing in LRR D.* **Stratified layers starting within the upper 15 cm (6 in.) of the soil surface. At least one layer has value 3 or less and chroma 1 or it has value 2 or more and chroma 2 or less with 2% or more distinct or prominent redox concentrations as soft masses or pore linings. The upper 15 cm (6 in.) has dominant chroma 2 or less.**

Playa Rim Stratified Layers User Notes. This indicator is for the sparsely vegetated playas of the western United States. Unlike indicator A5 (Stratified Layer), this indicator does not require continuous chroma 2 or less. Thin layers of chroma 3 or higher may occur as long as the upper 15 cm (6 in.) is dominantly chroma 2 or less. A minimum amount of organic carbon is not required. A layer with redox concentrations is substitutional for the dark layer. As inferred, this indicator occurs on sparsely vegetated playas and playa rims adjacent to the non-vegetated playas.

**Figure 48:** This soil has the indicator TA1 (Playa Rim Stratified Layers). This is a maximum expression of this indicator. Strata are prominent.

**Figure 49:** This soil has the indicator TA1 (Playa Rim Stratified Layers). This is a minimum expression for this indicator. Strata are faint. Scale is cm.

## Test Hydric Soil Indicators for Sandy Soils

**TS1. Iron Staining.** *For testing in LRRs W, X, and Y.* **A continuous zone, 3 cm (1 in.) or more thick, of iron staining with value 4 or more and chroma 6 or more within 15 cm (6 in.) of the soil surface. The zone is immediately below a horizon in which iron/manganese oxides have been removed from the matrix and exposed the primary base color of the silt and sand grains.**

**TS2. Thick Sandy Dark Surface.** *For testing in LRR F.* **A layer at least 15 cm (6 in.) thick with a depleted matrix that has 60% or more chroma 2 or less or a gleyed matrix starting below 30 cm (12 in.) of the soil surface. The layer(s) above the depleted or gleyed matrix have hue N and value 3 or less; or hue 10YR or yellower with value 2 or less and chroma 1 to a depth of 30 cm (12 in.) and chroma 1 or less in the remainder of the epipedon.**

**TS3. Dark Surface 2.** *For testing in LRR G.* **A layer 10 cm (4 in.) or more thick starting within 15 cm (6 in.) of the soil surface with matrix value 2 or less and chroma 1 or less. At least 70% of the soil materials are covered, coated, or masked with organic material. The matrix color of the layer immediately below the dark surface must have value 4 or more and chroma 2 or less.**

**TS4. Sandy Neutral Surface.** *For testing in LRR M.* **A layer at least 10 cm (4 in.) thick with a depleted matrix that has 60% or more chroma 2 or less or a gleyed matrix starting within 30 cm (12 in.) of the soil surface. The layer(s) above the depleted or gleyed matrix have hue N and value 3 or less.**

**TS5. Chroma 3 Sandy Redox .** *For testing in LRRs F, G, H, K, L, and M.* **A layer starting within 15 cm (6 in.) of the soil surface that is at least 10 cm (4 in.) thick and has a matrix chroma 3 or less with 2% or more distinct or prominent redox concentrations as soft masses and/or pore linings.**
Chroma 3 Sandy Redox User Notes: Redox concentrations include iron and manganese masses (reddish mottles) and pore linings (Vepraskas, 1994). Included within this concept as redox concentrations are iron/manganese bodies as soft masses with diffuse boundaries. The iron/manganese masses are 2 to 5 mm in size and have a value 3 or less and a chroma 3 or less; most commonly they are black. Iron/manganese masses should not be confused with the larger and redder iron nodules (US Department of Agriculture, Soil Survey Staff, 1993) associated with plinthitic soils or relict concretions. Common to many redox concentrations are required.

## Test Hydric Soil Indicators for Loamy and Clayey Soils

**TF1. ? cm Mucky Peat or Peat.** *For testing in LRRs F, G, H, and M.* **A layer of mucky peat or peat ? cm thick with value 4 or less and chroma 3 or less starting within 15 cm (6 in.) of the soil surface.**
? cm Mucky Peat or Peat User Notes: Testing from 1994 indicates that the diagnostic hydric soil thickness for mucky peat and for peat is 1 to 5 cm. Further testing is needed to find the definitive thickness.

**TF2. Red Parent Material.** *For testing in LRRs with red parent material.* **In parent material with a hue of 7.5YR or redder, a layer at least 10 cm (4 in.) thick with a matrix value 4 or less and chroma 4 or less and 2% or more redox depletions and/or redox concentrations as soft masses and/or pore linings. The layer is entirely within 30 cm (12 in.) of the soil surface. The minimum thickness requirement is 5 cm (2 in.) if the layer is the mineral surface layer.**
Red Parent Material User Notes: This indicator was developed for use in areas of red parent material such as: Triassic/Jurassic sediments in the Connecticut River valley, Permian "red beds" in Kansas, clayey red till and associated lacustrine deposits around the Great Lakes, and Jurassic sediments associated with "hogbacks" on the eastern edge of the Rocky mountains. This indicator also occurs on "Red River" flood plains such as the Chattahoochee, Congaree, Red, and Tennessee Rivers. Redox features most noticeable in red materials include redox depletions and soft manganese masses which are black or dark reddish black.

**Figure 50:** This soil has the indicator TF2 (Red Parent Material). Common to many redox depletions and soft masses of iron/manganese are present in a reddish matrix.

**TF3. Alaska Concretions.** *For testing in W, X, and Y.* **Within 30 cm (12 in.) of the soil surface redox concentrations as nodules or concretions greater than 2 mm in diameter that occupy more than approximately 2% of the soil volume in a layer 10 cm (4 in.) or more thick with a matrix chroma 2 or less.**

**TF4. 2.5Y/5Y Below Dark surface.** *For testing in LRRs F, M, N, P, S, and T.* **A layer at least 15 cm (6 in.) thick with 60% or more hue 2.5 Y or yellower, value 4 or more, and chroma 1; or hue 5Y or yellower, value 4 or more, and chroma 2 or less starting within 30 cm (12 in.) of the soil surface. The layer(s) above the 2.5Y/5Y layer have value 3 or less and chroma 2 or less.**
2.5Y/5Y Below Dark Surface User Notes: Further testing is required to investigate whether these colors below a Mollic epipedon are indicative of wetness.

**TF5. 2.5Y/5Y Below Thick Dark Surface.** *For testing in LRRs D, F, and M.* **A layer at least 15 cm (6 in.) thick with 60% or more hue 2.5Y or yellower, value 4 or more, and chroma 1;**

**or hue 5Y or yellower, value 4 or more, and chroma 2 or less starting below 30 cm (12 in.) of the soil surface. The layer(s) above the 2.5Y/5Y layer have hue N and value 3 or less; or have hue 10YR or yellower with value 2 or less and chroma 1 or less to a depth of 30 cm (12 in.) and value 3 or less and chroma 1 or less in the remaining of the epipedon.**

**TF6. Calcic Dark Surface.** *For testing in LRRs F, G, and M.* **A layer with an accumulation of calcium carbonate ($CaCO_3$), or calcium carbonate equivalent, occurs within 40 cm (16 in.) of the soil surface. It is overlain by a layer(s) with value 3 or less and chroma 1 or less. The layer of $CaCO_3$ accumulation is underlain by a layer within 75 cm (30 in.) of the surface 15 cm (6 in.) or more thick having 60% or more by volume one or more of the following:**

a. **depleted matrix, or**
b. **gleyed matrix, or**
c. **hue 2.5Y or yellower value 4 and chroma 1.**

Calcic Dark Surface User Notes: This indicator is the Soil Taxonomy criterion that separates Aeric Calciaquolls from Typic Calciaquolls, with an additional requirement of black or very dark gray surface layers. In the Midwest, the hydric/non-hydric boundary has generally been accepted as the “line” between Aeric and Typic Calciaquolls. Typic Calciaquolls (Vallers series and others) are documented to occur on upland plant communities on convex slopes (evaporative “rims” of potholes). Further documentation is needed to determine what soil morphological features can be used to separate hydric Typic Calciaquolls from non-hydric.

**TF7. Thick Dark Surface 2/1.** *For testing in all LRRs except LRRs O, P, T, and U.* **A layer at least 15 cm (6 in.) thick with a depleted matrix that has 60% or more chroma 2 or less (or a gleyed matrix) starting below 30 cm (12 in.) of the soil surface. The layer(s) above the depleted or gleyed matrix have hue 10YR or yellower, value 2.5 or less to a depth of 30 cm (12 in.) and value 3 or less and chroma 1 or less in the remainder of the epipedon.**

Thick Dark Surface 2/1 User Notes: The soil has a black surface layer 30 cm (12 in.) or more thick. The dark colored subsoil has value 3 or less and chroma 1. Below the mollic (umbric) epipedon is a depleted matrix or gleyed matrix. This indicator is most often associated with over thickened soils in concave landscape positions. Further testing is needed to determine if cumulic soils with surface hues of 10YR or yellower are hydric. Testing notes need to indicate on what landscape position this indicator “fails”. It may be necessary to limit this indicator to concave landscapes.

**TF8. Redox Spring Seeps**. *For testing in LRR D.* **A layer with value 5 or more and chroma 3 or less with 2 percent or more distinct or prominent redox concentrations as soft masses or pore linings. The layer is at least 5 cm (2 in.) thick and is within the upper 15 cm (6 in.) of the soil surface.**

Redox Spring Seeps User Notes: This indicator is similar to Indicator F9 (Vernal Pools). However, in order to more fully correlate hydric soils to wetland vegetation, chroma 3 is included in this indicator as well as the redox concentrations portions of the depleted matrix concept. This indicator is not unique to depressional landscapes; therefore, that requirement is dropped. As inferred, this indicator may occur in seeps and flow-through areas adjacent to springs and up-slope end of drainageways as well as depressional seeps surrounded by uplands.

**Figure 51:** This soil has the indicator TF8 (Redox Spring Seeps)). Redox concentrations are present in a chroma 2 and 3 matrix. Scale is cm.

**TF9. Delta Ochric**. *For testing in LRR O.* **A layer 10 cm (4 in.) or more thick that has 60% or more of the matrix with value 4 or more and chroma 2 or less with no redox concentrations. This layer occurs entirely within the upper 30 cm (12 in.) of the soil surface.**
Delta Ochric User Notes: This indicator is applicable in accreting areas of the Mississippi River Delta.

**TF10. Alluvial Depleted Matrix.** *For testing in LRRs M, N, and S.* **On frequently flooded flood plains, a layer with a matrix that has 60% or more chroma 3 or less with 2% redox concentrations as soft iron masses, starting within 15 cm (6 in.) of the soil surface and extending to a depth of more than 30 cm (12 in.).**

**Table 1: Hydric Soil Indicators By Land Resource Region (LRR). The indicators approved for use or testing by the National Technical Committee for Hydric Soils are as follows:**

| **LRR** | **Indicators** |
|---|---|
| **A** | A1, A2, A3, A4, A10, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF2, TF7. |
| **B** | A1, A2, A3, A4, A10, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF2, TF7. |
| **C** | A1, A2, A3, A4, A10, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F9, TF2, TF7. |
| **D** | A1, A2, A3, A4, A9, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F9, TA1, TF2, TF5, TF7, TF8. |
| **E** | A1, A2, A3, A4, A10, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF2, TF7. |
| **F** | A1, A2, A3, A4, A5, A9, S1, S3, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TS2, TS5, TF1, TF2, TF4, TF5, TF6, TF7. |
| **G** | A1, A2, A3, A4, A9, S1, S2, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TS3, TS5, TF1, TF2, TF6, TF7. |
| **H** | A1, A2, A3, A4, A9, S1, S2, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F16, TS5, TF1, TF2, TF7. |
| **I** | A1, A2, A3, A4, A9, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF2, TF7. |
| **J** | A1, A2, A3, A4, A9, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF2, TF7. |
| **K** | A1, A2, A3, A4, A5, A10, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TS5, TF2, TF7. |
| **L** | A1, A2, A3, A4, A5, A10, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TS5, TF2, TF7. |

**M** A1, A2, A3, A4, A5, A10, S1, S3, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F12, TS4, TS5, TF1, TF2, TF4, TF5, TF6, TF7, TF10.
**N** A1, A2, A3, A4, A5, A10, S1, S4, S5, S6, S7, F1, F2, F3, F4, F5, F6, F7, F8, F12, TF2, TF7, TF10.
**O** A1, A2, A3, A4, A5, A9, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F11, F12, TF2, TF9.
**P** A1, A2, A3, A4, A5, A6, A7, A9, S4, S5, S6, S7, F2, F3, F8, F12, F13.
**R** A1, A2, A3, A4, A5, A10, S1, S3, S4, S5, S6, S7, S8, S9, F1, F2, F3, F4, F5, F6, F7, F8, TF2, TF7.
**S** A1, A2, A3, A4, A5, A10, S1, S4, S5, S6, S7, S8, S9, F1, F2, F3, F4, F5, F6, F7, F8, TF2, TF4, TF10.
**T** A1, A2, A3, A4, A5, A6, A7, A9, S4, S5, S6, S7, S8, S9, F2, F3, F8, F12, F13, TF2.
**U** A1, A2, A3, A4, A5, A6, A7, A8, S4, S5, S6, S7, F2, F3, F5, F10, F13.
**V** A1, A2, A3, A4, A5, A6, A7, A8, S4, S5, S6, S7, F2, F3, F4, F5, F7, F8, TF2, TF7.
**W** A1, A2, A3, A4, A10, S10, F4, F5, F6, F7, F8, F14, F15, TS1, TF2, TF3, TF7.
**X** A1, A2, A3, A4, A10, S10, F4, F5, F6, F7, F8, F14, F15, TS1, TF2, TF3, TF7.
**Y** A1, A2, A3, A4, A10, S10, F4, F5, F6, F7, F8, F14, F15, TS1, TF2, TF3, TF7.
**Z** A1, A2, A3, A4, A5, A6, A7, A8, S4, S5, S6, S7, F2, F3, F4, F5, F6, F7, F8, TF2, TF7.

**Table 2: Hydric Soil Indicator Correlations. The correlations between the NTCHS indicators and the 1987 COE Manual indicators are as follows:**

| 1987 Manual Indicator | NTCHS Indicator |
|---|---|
| **NON-SANDY SOILS:** | |
| a. Organic soils (Histosols) | A1 (Histosols) |
| b. Histic Epipedon | A2 (Histic Epipedon) |
| | A3 (Black Histic) |
| c. Sulfidic material | A4 (Hydrogen sulfide) |
| d. Aquic or peraquic moisture regime | ---------------------------- |
| e. Reducing soil conditions | ---------------------------- |
| f (1). Gleyed soils (gray color) | F2 (Loamy Gleyed Matrix) |
| | F14 (Alaska Redox Gleyed |
| | F15 (Alaska Gleyed Pores) |
| f (2). Soils with bright mottles and/or low matrix chroma | F3 (Depleted Matrix) |
| | F8 (Redox Depressions) |
| | F9 (Vernal Pools) |
| | F11 (Depleted Ochric) |
| | F16 (High Plains Depressions) |
| | TF8 (Redox Spring Seeps) |
| | TF9 (Delta Ochric) |

| | |
|---|---|
| | TF10 (Alluvial Depleted Matrix) |
| g. Soil appearing on the hydric soils list | ---------------------------- |
| h. Iron and Manganese concretions | F12 (Iron/Manganese Masses) |
| | TF3 (Alaska Concretions) |
| Not listed in the 1987 Manual | A5 (Stratified Layers) |
| | A6 (Organic Bodies) |
| | A7 (5 cm Mucky Mineral) |
| | A8 (Muck Presence) |
| | A9 (1 cm Muck) |
| | A10 (2 cm Muck) |
| | F1 (Loamy Mucky Mineral) |
| | F4 (Dep. Below Dark Surface) |
| | F5 (Thick Dark Surface) |
| | F6 (Redox Dark Surface) |
| | F7 (Depleted Dark Surface) |
| | F10 (Marl) |
| | F13 (Umbric Surface) |
| | TA1 (Playa Rim Stratified Layers) |
| | TF1 (? cm Mucky Peat or Peat) |
| | TF2 (Red Parent Material) |
| | TF4 (Y Below Dark Surface.) |
| | TF5 (Y Below Thick Dark Sur.) |
| | TF6 (Calcic Dark Surface) |
| | TF7 (Thick Dark Surface 2/1) |

**SANDY SOILS**

| | |
|---|---|
| a. Organic soils (Histosols) | A1 (Histosols) |
| b. Histic Epipedon | A2 (Histic Epipedon) |
| | A3 (Black Histic) |
| c. Sulfidic material | A4 (Hydrogen sulfide) |
| d. Aquic or peraquic moisture regime | -------------------------- |
| e. Reducing soil conditions | -------------------------- |
| f. Iron and Manganese concretions | S5 (Sandy Redox) |
| | TS5 (Chroma 3 Sandy Redox) |
| g. High organic matter content in the surface horizon | A6 (Organic Bodies) |
| | A7 (5 cm Mucky Mineral) |
| | A8 (Muck Presence) |
| | A9 (1 cm Muck) |
| | A10 (2 cm Muck) |
| | S1 (Sandy Mucky Mineral) |
| | S2 (3 cm Mucky Peat or Peat) |
| | S3 (5 cm Mucky Peat or Peat) |
| | S7 (Dark Surface) |

| | |
|---|---|
| | TS2 (Tk. Sandy Dark Surface) |
| h. Streaking of subsurface horizons by organic matter | S6 (Stripped Matrix) |
| | S8 (Polyvalue Below Surface) |
| i. Organic pan | S9 (Thin Dark Surface) |
| j. Soils appearing on the hydric soils list | -------------------------- |
| Not listed in the 1987 Manual | A5 (Stratified Layers) |
| | S4 (Sandy Gleyed Matrix) |
| | S10 (Alaska Gleyed) |
| | TA1 (Playa Rim Stratified Layers) |
| | TS1 (Iron Staining) |
| | TS4 (Sandy Neutral Surface) |
| **PROBLEM SOILS** | |
| Recently deposited sandy materials | A5 (Stratified Layers) |
| | S6 (Stripped Matrix) |
| | S8 (Polyvalue Below Surface) |
| | TA1 (Playa Rim Stratified Layers) |
| Soils with thick dark A horizons | F4 (Dep. Below Dark Surface) |
| | F5 (Thick Dark Surface) |
| | F6 (Redox Dark Surface) |
| | F7 (Depleted Dark Surface) |
| | F13 (Umbric Surface) |
| | F16 (High Plains Depressions) |
| | TF4 (Y Below Dark Surface) |
| | TF5 (Y Below Tk. Dark Sur.) |
| | TF6 (Calcic Dark Surface) |
| | TS2 (Tk. Sandy Dark Surface) |
| | TF7 (Thick Dark Surface 2/1) |
| Soils with red parent material | F8 (Redox Depressions) |
| | F9 (Vernal Pools) |
| | TS1 (Iron Staining) |
| | TF2 (Red Parent Material) |
| | TF8 (Redox Spring Seeps) |
| Soils with low chroma parent material | S4 (Sandy Gleyed Matrix) |
| | S10 (Alaska Gleyed) |
| | F10 (Marl) |
| | TS4 (Sandy Neutral Surface) |

**Table 3: Guidance for the Use of Hydric Soil Indicators for Hydrologic Evidence. In the absence of hydrologic modifications hydric soil indicators give evidence of saturation[1] or inundation[2] as follows**:

| Hydric Soil Indicator | Expected Range of Seasonal High Saturation or Inundation[3] |
|---|---|
| A1 Histosols | Saturation at or inundation above the soil surface |
| A2 Histic Epipedon | Saturation at or inundation above the soil surface |
| A3 Black Histic | Saturation at or inundation above the soil surface |
| A4 Hydrogen Sulfide | Saturation at or inundation above the soil surface |
| A5 Stratified Layers | Saturation within 6 inches of the soil surface |
| A6 Organic Bodies | Saturation within 6 inches of the soil surface |
| A7 5 cm Mucky Mineral | Saturation within 6 inches of the soil surface |
| A8 Muck Presence | Saturation at or inundation above the soil surface |
| A9 1 cm Muck | Saturation at or inundation above the soil surface |
| A10 2 cm Muck | Saturation at or inundation above the soil surface |
| | |
| S1 Sandy Mucky Mineral | Saturation at or inundation above the soil surface |
| S2 3 cm Mucky Peat or Peat | Saturation within 6 inches of the soil surface |
| S3 5 cm Mucky Peat or Peat | Saturation within 6 inches of the soil surface |
| S4 Sandy Gleyed Matrix | Saturation within 6 inches of the soil surface |
| S5 Sandy Redox | Saturation within 6 inches of the soil surface |
| S6 Stripped Matrix | Saturation within 6 inches of the soil surface |
| S7 Dark Surface | Saturation within 6 inches of the soil surface |
| S8 Polyvalue Below Surface | Saturation within 6 inches of the soil surface |
| S9 Thin Dark Surface | Saturation within 6 inches of the soil surface |
| S10 Alaska Gleyed | Saturation within 12 inches of the soil surface |
| | |
| F1 Loamy Mucky Mineral | Saturation within 6 inches of the soil surface |
| F2 Loamy Gleyed Matrix | Saturation within 12 inches of the soil surface |
| F3 Depleted Matrix | Saturation within 12 inches of the soil surface |
| F4 Depleted Below Dark Surface | Saturation within 12 inches of the soil surface |
| F5 Thick Dark Surface | Saturation at or inundation above the soil surface |
| F6 Redox Dark Surface | Saturation within 12 inches of the soil surface |
| F7 Depleted Dark Surface | Saturation within 12 inches of the soil surface |
| F8 Redox Depressions | Inundation above the soil surface |
| F9 Vernal Pools | Inundation above the soil surface |
| F10 Marl | Saturation at or inundation above the soil surface |
| F11 Depleted Ochric | Saturation within 12 inches of the soil surface |
| F12 Iron/Manganese Masses | Inundation above the soil surface |
| F13 Umbric Surface | Saturation within 6 inches of the soil surface |
| F14 Alaska Redox Gleyed | Saturation within 12 inches of the soil surface |
| F15 Alaska Gleyed Pores | Saturation within 12 inches of the soil surface |
| F16 High Plains Depressions | Saturation at or inundation above the soil surface |

[1] Saturation exists where soil water pressure is zero or positive; the above depths are the deepest expected normal depth to seasonal high saturation; duration is long enough to produce anaerobic conditions.
[2] Inundation exists where free water occurs above the soil surface; duration is long enough to produce anaerobic conditions.
[3] Technology based on principles in: Florida Soil Survey Staff. 1992, as revised. Soil and Water Relationships of Florida's Ecological Communities. G.W. Hurt (ed.). USDA, Soil Conservation Service, Gainesville, FL. and Hurt, G.W. and R.B. Brown, 1995. Development and Application of Hydric Soil Indicators in Florida. Wetlands 15-1, 32-40. Lawrence, KS.

**GLOSSARY: *These terms, as defined in this glossary, are either defined for the first time or they have definitions that are slightly different from the definitions in the referenced materials. These definitions are to assist users of this document and are not intended to add to or replace definitions in the referenced materials.**

**A Horizon** - A mineral horizon that formed at the surface or below an O horizon where organic material is accumulating. See Keys to Soil Taxonomy (1994) for complete definition.

***Abrupt Boundary** - Used to describe redoximorphic features that grade sharply from one color to another. The color grade is commonly less than 0.5 mm wide. Clear and gradual are used to describe boundary color gradations intermediate between abrupt and diffuse.

**Accreting Areas** - Landscape positions where soil material accumulates through deposition from higher elevations or upstream positions more rapidly than is being lost through erosion.

**Anaerobic** - A condition in which molecular oxygen is virtually absent from the soil.

**Anaerobiosis** - Microbiological activity under anaerobic conditions.

**Aquic Conditions** - Conditions in the soil represented by: depth of saturation, occurrence of reduction, and redoximorphic features. See Keys to Soil Taxonomy (1994) for complete definition.

**Calcic Horizon** - An illuvial horizon in which carbonates have accumulated to a significant extent. See Keys to Soil Taxonomy (1994) for complete definition.

**Calcium Carbonate** - Chemical formula of $CaCO_3$. Calcium carbonate effervesces when treated with cold hydrochloric acid.

**$CaCO_3$ Equivalent** - Is the acid neutralizing capacity of a soil expressed as a weight percentage of $CaCO_3$ (molecular weight of $CaCO_3$ equals 100).

**Closed Depressions** - A low-lying area surrounded by higher ground with no natural outlet for surface drainage.

**COE** - US Army Corps of Engineers.

**Common** - When referring to redox concentrations and/or depletions common represents 2 to 20 percent of the observed surface.

**Concave Landscapes** - A landscape whose surface curves downward.

***Covered, Coated, Masked** - These are terms used to describe all of the redoximorphic processes by which the color of soil particles are hidden by organic material, silicate clay, iron, aluminum, or some combination of these.
***Depleted Matrix -** A depleted matrix refers to the volume of a soil horizon or subhorizon from which iron has been removed or transformed by processes of reduction and translocation to create colors of low chroma and high value. 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 places the depleted matrix may change color upon exposure to air (reduced Matrix), this phenomena is included in the concept of depleted matrix. The following combinations of value and chroma identify a depleted matrix:
1. Matrix value 5 or more and chroma 1 or less with or without redox concentrations as soft masses and/or pore linings; or
2. Matrix value 6 or more and chroma 2 or less with or without redox concentrations as soft masses and/or pore linings; or
3. Matrix value 4 or 5 and chroma 2 and has 2 percent or more distinct or prominent redox concentrations as soft masses and/or pore linings; or
4. Matrix value 4 and chroma 1 and has 2 percent or more distinct or prominent redox concentrations as soft masses and/or pore linings.
***Diffuse Boundary** - Used to describe redoximorphic features that grade gradually from one color to another. The color grade is commonly more than 2 mm wide. Clear and gradual are used to describe boundary color gradations intermediate between abrupt and diffuse.

**Figure 52:** This soil has redox concentrations. Are the boundaries abrupt or diffuse? Is this an example of contemporary or relict hydrology?

***Distinct** - Readily seen but contrast only moderately with the color to which compared; a class of contrast intermediate between faint and prominent. In the same hue or a difference in hue of one color chart (e.g. 10YR to 7.5YR or 10YR to 2.5Y), a change of 2 or 3 units in chroma and/or a change of 3 units of value, or a change of 2 or 3 units of value and a change of 1 or 2 units of chroma, or a change of 1 unit of value and 2 units of chroma. With a change of 2 color charts of hues (e.g. 10YR to 5Y or 10YR to 5YR), a change of 0 to 2 units of value and/or a change of 0 to 2 units of chroma is distinct.
**E Horizon -** A mineral horizon in which the main dominant process is loss of silicate clay, iron, and/or aluminum, leaving a concentration of sand and silt particles. See Keys to Soil Taxonomy (1994) for complete definition.
*EPA - US Environmental Protection Agency.
**Epipedon** - A horizon that has developed at the soil surface. See Keys to Soil Taxonomy (1994) for complete definition.
***Faint -** Evident only on close examination. In the same hue or 1 hue change (e.g. 10YR to 7.5YR or 10YR to 2.5Y) a change of 1 unit in chroma, or 1 to 2 units in value, or 1 unit of chroma and 1 unit of value.

**Fe/Mn Concretions** - Firm to extremely firm irregularly shaped bodies with sharp to diffuse boundaries. When broken in half concretions have concentric layers. See Vepraskas (1994) for complete discussion.
**Fe/Mn Nodules** - Firm to extremely firm irregularly shaped bodies with sharp to diffuse boundaries. When broken in half nodules do not have visibly organized internal structure. See Vepraskas (1994) for complete discussion.
**Few** - When referring to redox concentrations and/or depletions few represents less than 2 percent of the observed surface.
**Fibric** - See peat.
**Frequently Flooded or Ponded** - A frequency class in which flooding or ponding is likely to occur often under usual weather conditions (more than 50 percent chance in any year, or more than 50 times in 100 years).
**FWS** - US Department of Interior, Fish and Wildlife Service.
**Glauconitic -** A mineral aggregate that contains micaceous mineral resulting in a characteristic green color, e.g. glauconitic shale or clay.
***Gleyed Matrix -** Soils with a gleyed matrix have the following combinations of hue, value, and chroma and the soils are not glauconitic:
1. 10Y, 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more and chroma is 1; or
2. 5G with value 4 or more and chroma is 1 or 2; or
3. N with value 4 or more; or
4. (for testing only) 5Y, value 4, and chroma 1.
In some places the gleyed matrix may change color upon exposure to air (reduced matrix). This phenomena is included in the concept of gleyed matrix.
***Hemic** - See Mucky peat.
**Histic Epipedon** - A thick (20-60 cm {8-24 in.}) organic soil horizon that is saturated with water at some period of the year unless artificially drained and that is at or near the surface of a mineral soil. See Keys to Soil Taxonomy (1994) for complete definition.
**Histosols** - Organic soils that have organic soil materials in more than half of the upper 80 cm (32 in.), or that are of any thickness if they overly rock or fragmental materials that have interstices filled with organic soil materials. See Keys to Soil Taxonomy (1994) for complete definition.
**Horizon** - A layer, approximately parallel to the surface of the soil, distinguishable from adjacent layers by a distinctive set of properties produced by soil forming processes. See Keys to Soil Taxonomy (1994) for complete definition.
**Hydric Soil Criteria (1995):**
1. All Histosols except Folists. or
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Aquisalids, 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:
    (1) 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, or

(2) 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

(3) 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., or

3. Soils that are frequently ponded for long or very long duration during the growing season, or
4. Soils that are frequently flooded for long or very long duration during the growing season.

**Hydric Soil Definition (1994)** - 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.

**Hydrogen Sulfide Odor** - An odor similar to rotten eggs.

**Hydromorphic** - Features in the soil caused or formed by water.

**Layer(s)** - A horizon, subhorizon, or combination of contiguous horizons or subhorizons that share a property(s) referred to in the Indicators.

**Lithologic Discontinuity** - Occurs in a soil that has developed in more than one type of parent material. Commonly determined by a significant change in particle-size distribution, mineralogy, etc. that indicates a difference in material from which the horizons formed.

**LRR** - Land Resource Region. LRRs are geographic areas characterized by a particular pattern of soils, climates, water resources, and land use. Each LRR has a different letter of the alphabet (A-Z). LRRs are defined in USDA Ag. Handbook 296.

**Many** - When referring to redox concentrations and/or depletions many represents more than 20 percent of the observed surface.

**Marl** - An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under fresh water lacustrine conditions. See Keys to Soil Taxonomy (1994) for complete definition.

**Matrix** - The dominant soil volume which is continuous in appearance and envelops micro sites. When three colors exist, such as when a matrix, depletions, and concentrations are present, the matrix may represent less than 50 percent of the total soil volume.

**MLRA** - Major Land Resource Areas. MLRAs are geographically associated divisions of Land Resource Regions. MLRAs are defined in USDA Ag. Handbook 296.

**Mollic Epipedon** - A mineral surface horizon that is relatively thick, dark colored, humus rich, and has high base saturation. See Keys to Soil Taxonomy (1994) for complete definition.

**Mollisols** - Mineral soils that have a mollic epipedon. See Keys to Soil Taxonomy (1994) for complete definition.

***Muck** - A sapric organic soil material in which virtually all of the organic material is decomposed not allowing for identification of plant forms. Bulk density is normally 0.2 or more. Muck has <1/6 fibers after rubbing, and sodium pyrophosphate solution extract color has lower value and chroma than 5/1, 6/2, and 7/3.

***Mucky Modified Texture** - A USDA soil texture modifier, e.g. mucky sand. Mucky modified mineral soil with 0 percent clay has between 5 and 12 percent organic carbon. Mucky modified mineral soil with 60 percent clay has between 12 and 18 percent organic carbon. Soils with an intermediate amount of clay have intermediate amounts of organic carbon.

***Mucky Peat** - A hemic organic material with decomposition intermediate between that of fibric and sapric organic material. Bulk density is normally between 0.1 and 0.2 $g/cm^3$. Mucky peat

does not meet fiber content (after rubbing) or sodium pyrophosphate solution extract color requirements for either fibric or sapric soil material.
**Nodules** - See Fe/Mn nodules.
**NRCS** - USDA - Natural Resources Conservation Service (formerly Soil Conservation Service).
**NTCHS** - National Technical Committee for Hydric Soils.
**Organic Matter** - Plant and animal residue in the soil in various stages of decomposition.
**Organic Soil Material** - Soil material that is saturated with water for long periods or artificially drained and, excluding live roots, has an organic carbon content of: 18 percent or more with 60 percent or more clay, or 12 percent or more organic carbon with 0 percent clay. Soils with an intermediate amount of clay have an intermediate amount of organic carbon. If the soil is never saturated for more than a few days, it contains 20 percent or more organic carbon. Organic soil material includes *Muck, *Mucky Peat, and *Peat.

**Figure 53:** Percent organic carbon required for organic soil material, mucky mineral soil material, and mineral soil material as it relates to percent clay content.

***Peat** - A fibric organic soil material with virtually all of the organic material allowing for identification of plant forms. Bulk density is normally <0.1. Peat has 3/4 or more fibers after rubbing, or 2/5 or more fibers after rubbing and sodium pyrophosphate solution extract color of 7/1, 7/2, 8/2, or 8/3.
**Plinthite** - The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. See Keys to Soil Taxonomy (1994) for a complete discussion of plinthite.
**Ponding** - Standing water in a closed depression that is removed only by percolation, evaporation, or transpiration. Duration is greater than seven days.
**Pore Linings** - Zones of accumulation that may be either coatings on a pore surface or impregnations of the matrix adjacent to the pore. See Vepraskas (1994) for complete discussion.
***Prominent** - Contrasts strongly with the color to which they are compared. In the same hue or a 1 hue change (e.g. 10YR to 2.5Y or 10YR to 7.5YR), a change of 4 units in chroma and/or 4 units in value. With a change of 2 hues (e.g. 10YR to 5Y or 10YR to 5YR) a change of 3 or more units of value and/or a change of 3 or more units of chroma is prominent.
**Redox Concentrations** - Bodies of apparent accumulation of Fe/Mn oxides. Redox concentrations include soft masses, pore linings, nodules, and concretions. For the purposes of the Indicators nodules and concretions are excluded from the concept of redox concentrations unless otherwise specified by specific Indicators. See Vepraskas (1994) for complete discussion.

**Figure 54:** This soil has redox concentrations as pore linings. Are the boundaries abrupt or diffuse? Is this an example of contemporary or relict hydrology?

**Redox Depletions** - Bodies of low chroma (2 or less) having value 4 or more where Fe-Mn oxides have been stripped or where both Fe-Mn oxides and clay have been stripped. Redox

deletions contrast distinctly or prominently with the matrix.  See Vepraskas (1994) for complete discussion.
**Redoximorphic Features** - Features formed by the processes of reduction, translocation, and/or oxidation of Fe and Mn oxides.  Formerly called mottles and low chroma colors.  See Vepraskas (1994) for complete discussion.
**Reduced Matrix** - Soil matrices that have low chroma and high value, but whose color changes in hue or chroma when exposed to air.  See Vepraskas (1994) for complete discussion.
***Reduction** - For the purpose of the Indicators, when the redox potential (Eh) is below the ferric/ferrous iron threshold as adjusted for pH.  In hydric soils, this is the point when the transformation of ferric iron (Fe+++) to ferrous iron (Fe++) occurs.
**Relict Features** - Soil morphological features that do not reflect recent hydrologic conditions of saturation and anaerobiosis.  See Vepraskas, M. J. (1994) for complete discussion.
***Sapric -** See muck.
**Saturation** - When the soil water pressure is zero or positive.  Most all the soil pores are filled with water.
**SCS** - USDA - Soil Conservation Service (now Natural Resources Conservation Service.)
**Soft Masses** - Redox concentrations, that are not hard, frequently within the matrix, whose shape is variable.  See Vepraskas, M. J. (1994) for complete discussion.
**Soil Texture -** The weight proportion of the soil separates for particles less than 2 mm.
**Spodic Horizon** - A mineral soil horizon that is characterized by the illuvial accumulation of amorphous materials composed of aluminum and organic carbon with or without iron.  The spodic horizon has certain minimum thickness, and a minimum quantity of oxalate extractable carbon plus aluminum. It also has specific color requirements.  See Keys to Soil Taxonomy (1994) for complete definition.
**Umbric Epipedon** - A thick, dark mineral surface horizon with base saturation of less than 50 percent.  See Keys to Soil Taxonomy (1994) for complete definition.
**Vertisol** - A mineral soil with 30 percent or more clay in all layers.  These soils expand and shrink depending on moisture content and contain slickensides or wedge-shaped peds.  See Keys to Soil Taxonomy (1994) for complete definition.
**Wetland** - An area that has hydrophytic vegetation, hydric soils, and wetland hydrology, per the FSA Manual and the Corps of Engineers 1987 Wetlands Delineation Manual.

## REFERENCES:

***Unless otherwise noted the following references contain definitions of terms used throughout this document.  They also contain additional information concerning the terms in the glossary of this document.***


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