United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with the National Technical Committee for Hydric Soils

US Army Corps of Engineers®
Engineer Research and Development Center

Field Indicators of Hydric Soils in the United States

A Guide for Identifying and Delineating Hydric Soils, Version 6.0 (2006)

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Edited by G.W. Hurt, Soil Scientist, NRCS, National Soil Survey Center, Gainesville, Florida, and L.M. Vasilas, Soil Scientist, NRCS, Baltimore, Maryland

Copies of this publication can be obtained from:

Director
National Soil Survey Center
USDA, NRCS, Room 152
100 Centennial Mall North
Lincoln, Nebraska 68508-3866

Information contained in this publication and additional information concerning hydric soils are maintained on the Web site at http:// soils.usda.gov/use/hydric/.

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Cover: Profiles of two Aquods, which may be hydric or nonhydric. The profile on the left is hydric and has the hydric soil indicators S6 (Stripped Matrix) and S7 (Dark Surface). The profile on the right lacks a hydric soil indicator and would therefore be considered nonhydric unless data prove it to be hydric.

Foreword

Field Indicators of Hydric Soils in the United States has been developed by soil scientists of the Natural Resources Conservation Service (NRCS) in cooperation with the U.S. Fish and Wildlife Service (FWS); the U.S. Army Corps of Engineers (COE); the Environmental Protection Agency (EPA); various regional, state, and local agencies; universities; and the private sector. The editors recognize that this guide could not have been developed without the efforts of many individuals. Included in this publication are the hydric soil indicators approved by the NRCS and the National Technical Committee for Hydric Soils (NTCHS) for use in identifying, delineating, and verifying hydric soils in the field. Also included are indicators designated as test indicators, which are not approved for use but are to be tested so that their utility can be determined.

Contents

Location of Indicators by Page

Test Indicators

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

Introduction

Field Indicators of Hydric Soils in the United States is a guide to help identify and delineate hydric soils in the field. (The indicators are hereafter referred to as "Indicators.") Indicators are not intended to replace or modify the requirements contained in the definition of a hydric soil. The list of Indicators is considered to be dynamic; changes and additions are likely to be made annually. The section "To Comment on the Indicators" provides guidance on how to recommend changes, deletions, and additions. Any modifications to the Indicators must be approved by NRCS and the NTCHS. In order to properly use the Indicators, a basic knowledge of soil-landscape relationships and soil survey procedures is necessary.

The Indicators are designed to be regionally specific. The description of each indicator identifies the land resource regions (LRRs) or major land resource areas (MLRAs) in which the indicator can be used. The geographic extent of LRRs and MLRAs is defined in U.S. Department of Agriculture Handbook 296 (USDA, SCS, 1981, as amended). See map (figure 5, page 5) and LRR specific Indicators (Appendices 1 and 2). The Indicators are used to identify the hydric soil component of wetlands; however, there are some hydric soils that lack any of the currently listed indicators. Therefore, the lack of any listed indicator does not prevent classification of the soil as hydric. Such soils should be studied and their characteristic morphologies identified for inclusion in this guide.

Concept

Hydric soils are defined as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, July 13, 1994).

Nearly all hydric soils 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 microbial activity in the soil causes a depletion of oxygen. This anaerobiosis promotes biogeochemical processes, such as the accumulation of organic matter and the reduction, translocation, and/or accumulation of iron and other reducible elements. These processes result in characteristic morphologies that persist in the soil during both wet and dry periods, making them particularly useful for identifying hydric soils.

Figure 1.—The field indicators are to be used to delineate hydric soils. The soil on the right is hydric; the Indicator S6 (Stripped Matrix) starts at a depth of about 14 cm. The soil on the left is nonhydric; the Stripped Matrix starts at a depth of about 18 cm.

Hydric soil indicators are formed predominantly by the accumulation or loss of iron, manganese, sulfur, or carbon compounds. The presence of hydrogen sulfide gas (which has rotten egg odor) is a strong indicator of a hydric soil, but this indicator occurs only on the wettest sites containing sulfur. While indicators related to Fe-Mn depletions or concentrations are the most common, they cannot form in soils that contain low amounts of Fe-Mn. Soils that formed in such materials may have low-chroma colors that are not related to saturation and reduction. For such soils, features related to accumulations of organic carbon should be used. These features are identified in this guide, in part to handle soils that may have had low amounts of Fe-Mn and soils in which hydrogen sulfide gas is not detected. Some of these carbon accumulation features, such as Indicators A1 (Histosol or Histel), A2 (Histic Epipedon), and A3 (Black Histic), are often used to identify hydric soils. Because they are maximum expressions of anaerobiosis, however, they are rarely used for delineation purposes.

Cautions

There are hydric soils with morphologies that are difficult to interpret and hydric soils that seem inconsistent with the landscape, vegetation, or hydrology. Such soils include those that formed in grayish or reddish parent materials; soils with high pH or a low content of organic matter; Mollisols and Vertisols; soils with relict redoximorphic features; and disturbed soils, such as cultivated soils and soils in filled areas. The Indicators were developed mostly to identify the boundary of hydric soil areas and generally work best on the margins. Not all of the obviously wetter hydric soils will be identified by the Indicators. Redoximorphic features are most likely to occur in soils that cycle between anaerobic (reduced) and aerobic (oxidized) conditions.

Soils that are artificially drained or protected (for instance, by levees) are hydric if they would meet the definition of hydric soils in their undisturbed state. 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 features have diffuse boundaries; relict hydric soil features have sharp boundaries. 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.

Procedure

To document a hydric soil, dig a hole and describe the soil profile to a depth of approximately 50 cm (20 inches). Using the completed soil description, specify which, if any, of the Indicators have been met. Deeper examination of soil may be required where field Indicators are not readily apparent within 50 cm (20 inches) of the surface. It is always recommended that soils be excavated and described as deep as necessary to make reliable interpretations. For example, examination to less than 50 cm (20 inches) may suffice in soils with surface horizons of organic material or mucky mineral material because these shallow organic accumulations only occur in hydric soils. Conversely, depth of excavation will often be greater than 50 cm (20 inches) in Mollisols because the upper horizons of these soils commonly have no visible redoximorphic features because of the masking effect of organic material. On many sites 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.

Many of the hydric soil indicators were developed for delineation purposes. During the development of these hydric soil indicators, observations were concentrated near the edge of wetlands and in the interior of the wetlands. There are wetlands that do not have any of the approved hydric soil indicators in their wettest parts. Delineators and other users of the hydric soil indicators should concentrate their observation efforts at the wetland edge, where these conditions are suspect.

To determine whether or not an indicator is present, it is critical to know exactly where to begin looking. Depths used in the Indicators are measured from the muck or mineral soil surface in most of the United States. We begin to look for an Indicator at the soil surface nationwide when applying indicators A1 and A2 and in LRRs F, G, H, and M if the material beneath any mucky peat and/or peat is sandy.

In LRRs R, W, X, and Y, we begin our observations at the top of the mineral surface (underneath any and all fibric, hemic, and/or sapric material), except for application of indicators A1 and A2. In the remaining LRRs and in LRRs F, G, H, and M, if the material

Figure 2.—To determine whether or not a hydric soil indicator is present, we would begin our observation of this soil at a depth of about 9 cm (below the fibric and hemic material) in all LRRs except LRRs F, G, H, and M (since the material beneath the fibric and hemic material is sandy).

beneath any mucky peat and/or peat is not sandy, we begin our observations at the top of the muck or mineral surface (underneath any fibric and/or hemic material), except for application of indicators A1 and A2.

All colors refer to moist Munsell colors. Soil colors specified in the Indicators do not have decimal points listed; however, colors do occur between Munsell chips. Soil 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 of 2 and would not meet any indicator that requires a chroma 2 or less.

Particular attention should be paid to changes in topography over short distances (microtopography).

Figure 3.—Indicator F6 (Redox Dark Surface). The left is moist, and the right is dry. Most commonly, moist soil colors are to be used when hydric soils are identified and delineated.

Small changes in elevation may result in repetitive sequences of hydric/nonhydric soils and the delineation of individual areas of hydric and nonhydric soils may be difficult.

Often the dominant condition (hydric/nonhydric) is the only reliable interpretation. The shape of the local landform can greatly affect the movement of water through the landscape. Significant changes in parent material or lithologic discontinuities in the soil can affect the hydrologic properties of the soil. If exploratory observations are sufficient for an understanding of the soil-hydrologic relationships at the site, subsequent excavations may then be shallower if identification of appropriate indicators allows.

To Comment on the Indicators

The Indicators are revised and updated as field data are collected to improve our understanding of hydric soil processes. Revisions, additions, and other comments regarding field observations of hydric soil conditions that cannot be documented using the presently recognized hydric soil indicators are welcome; however, any modifications and additions must be approved by the NTCHS. Guidelines for requesting changes to field indicators are as follows:

1. Adding indicators or changing existing indicators: Minimally, the following should accompany all requests for additions and changes to

Figure 4.—Proper installation of the right kinds of monitoring devices is important if one is to obtain approval of changes, additions, and deletions to the hydric soil indicators.

existing hydric soil indicators in *Field Indicators of Hydric Soils in the United States*:

a). Detailed descriptions of at least three pedons that document the addition or change and detailed descriptions of the neighboring nonhydric pedons.
b). Detailed vegetative data collected to represent the vegetation of the six pedons.
c). Saturation/inundation data and Eh data for a duration that captures the saturation cycle (dry-wet-dry) of at least one of the hydric pedons and one of the nonhydric pedons. Precipitation and in-situ soil-water pH data from the same sites should also be provided. Data are to be collected according to the Hydric Soil Technical Standard described in Technical Note 11 (http://www.soils.usda.gov/use/hydric/).

2. Adding or Deleting a Test Indicator: Minimally, the following should accompany all requests for adding or deleting a test indicator in *Field Indicators of Hydric Soils in the United States*:

a). Detailed descriptions of at least three pedons that document the test indicator and detailed descriptions of three neighboring nonhydric pedons.
b). Detailed vegetative data collected to represent the vegetation of the six pedons.

3. All requests involving 1 and 2 above require a short written plan that: a) identifies the problem, b) explains the rationale for the request and, c) provides the following—person responsible and point of contact (e-mail and postal addresses and phone number), timeline for supporting data and final report to be delivered to NTCHS, timeline needed for final NTCHS decision, and partners involved in project. Requests, plans, and data should be sent to:

Wade Hurt, Chair
NTCHS Field Indicator Subcommittee
P.O. Box 110290
University of Florida
Gainesville, FL 32611-0290
E-mail: Wade_Hurt@mail.ifas.ufl.edu

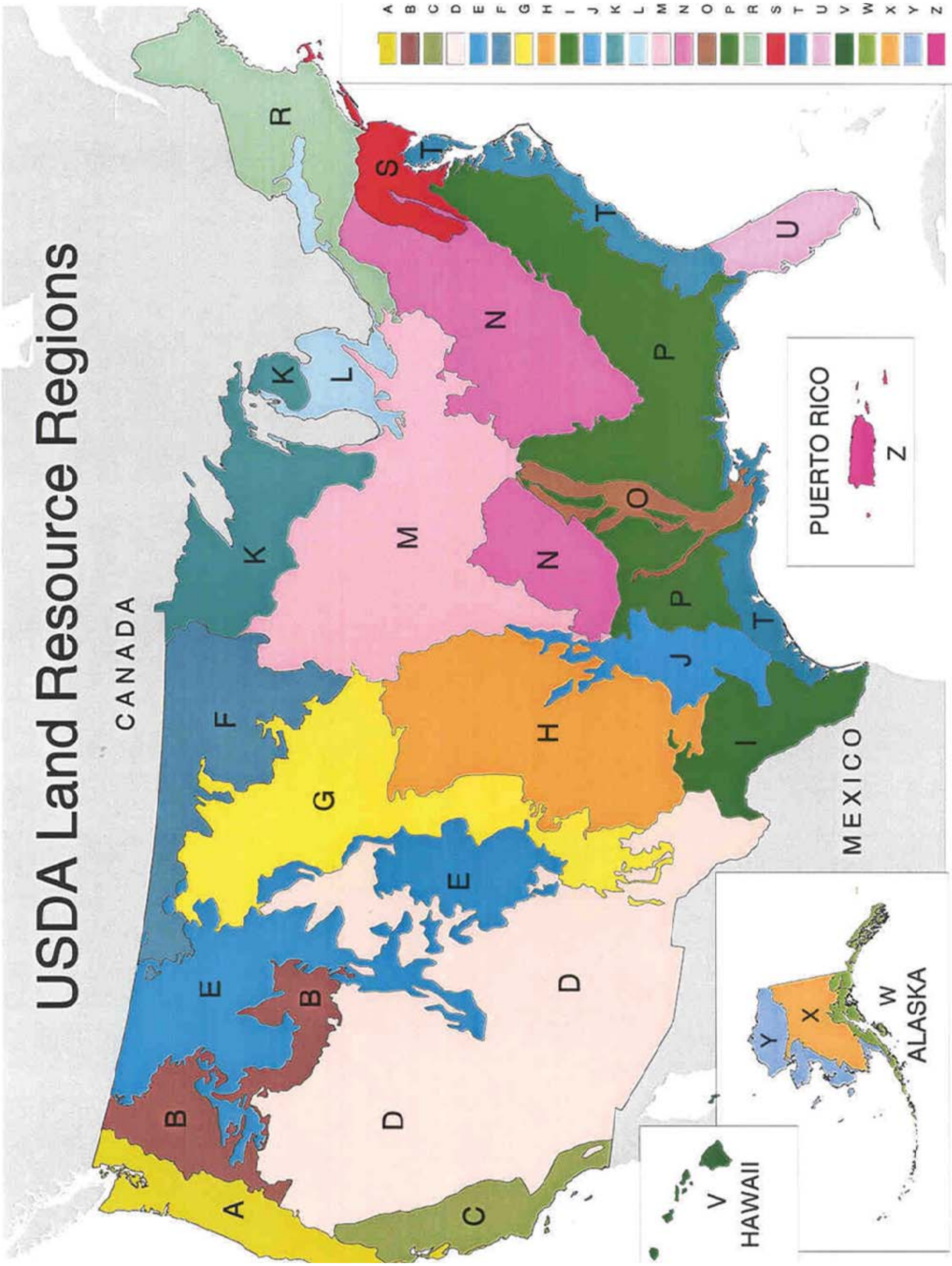

Figure 5.—Map of USDA land resource regions.

Field Indicators of Hydric Soils

The descriptions in this section are 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

For example, *A2* is the second indicator for “all soils”; the short name is *Histic Epipedon;* the indicator is for use in *all LRRs;* the description is *a histic epipedon underlain by mineral soil material with chroma of 2 or less*; helpful user notes are added.

All Soils

“All soils” refers to soils with any USDA soil texture. All mineral layers above any of the A Indicators, except for Indicator A16, have a dominant chroma of 2 or less, or the layer(s) with a dominant chroma of more than 2 is less than 15 cm (6 inches) thick. In addition, nodules and concretions are not considered to be redox concentrations. Use the following Indicators regardless of texture.

A1. Histosol *(for use in all LRRs)* **or Histel** *(for use in LRRs with permafrost)*. Classifies as a Histosol (except Folist) or as a Histel (except Folistel).

User Notes: In a Histosol, 40 cm (16 inches) or more of the upper 80 cm (32 inches) is organic soil material. Organic soil materials have an 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), and peat (fibric soil material).

A2. Histic Epipedon. *For use in all LRRs.* A histic epipedon underlain by mineral soil material with chroma of 2 or less.

User Notes: Most histic epipedons are surface horizons 20 cm (8 inches) or more thick of organic soil material. Aquic conditions or artificial drainage are required.

Figure 6.—Indicator A1 (Histosols). Muck (sapric soil material) is about ½ m thick. The shovel is about 1 m.

Figure 7.—Indicator A2 (Histic Epipedon). Proof of aquic conditions is required. Generally, Histosols have more than 40 cm of organic soil material, and histic epipedons have 20 to 40 cm of organic soil material.

A3. Black Histic. *For use in all LRRs.* A layer of peat, mucky peat, or muck 20 cm (8 inches) or more thick that starts within the upper 15 cm (6 inches) of the soil surface; has hue of 10YR or yellower, value of 3 or less, and chroma of 1 or less; and is underlain by mineral soil material with chroma of 2 or less.

User Notes: Unlike indicator A2, this indicator does not require proof of aquic conditions or artificial drainage.

Figure 8.—Indicator A3 (Black Histic). Proof of aquic conditions is not required. Scale is in inches (R) and cm (L).

A4. Hydrogen Sulfide. *For use in all LRRs.* A hydrogen sulfide odor within 30 cm (12 inches) of the soil surface.

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 occurs only when the soil is saturated and anaerobic.

A5. Stratified Layers. *For use in LRRs C, 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 inches) of the soil surface. One or more of the layers has value of 3 or less with chroma of 1 or less, and/or it is muck, mucky peat, or peat or has a mucky modified mineral texture. The remaining layers have chroma of 2 or less.

Figure 9.—Indicator A4 (Hydrogen Sulfide) is most likely to occur in salt marshes and other very wet ecosystems.

Figure 10.—Indicator A5 (Stratified Layers) in sandy material.

Figure 11.—Indicator A5 (Stratified Layers) in loamy material. Scale is in inches (R) and cm (L).

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 is slightly less than is required for indicator A7 (5 cm Mucky Mineral); at least 70 percent of the 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 inch) thick. A hand lens is an excellent tool to aid in the identification of this indicator. Many alluvial soils have strata at greater depths; these are not hydric soils. Many alluvial soils have strata at the required depths but do not have chroma of 2 or less; these do not meet the requirements for this indicator. The Stratified Layers indicator occurs in any type soil material.

A6. Organic Bodies. *For use in LRRs P, T, U, and Z.* Presence of 2 percent or more organic bodies of muck or a mucky modified mineral texture, approximately 1 to 3 cm (0.5 to 1 inch) in diameter, starting within 15 cm (6 inches) of the soil surface. In some soils the organic bodies are smaller than 1 cm.

User Notes: The concent of organic carbon in organic bodies is the same as in the Muck or Mucky Texture Indicators. The Organic Bodies 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 material (mucky peat) and/or fibric material (peat) do not meet the requirements of this indicator, nor does material consisting of partially decomposed root tissue.

Figure 12: Indicator A6 (Organic Bodies). The individual organic bodies are 1 to 3 cm in size. Scale is in inches (upper) and cm (lower).

Figure 13: The description of Indicator A6 (Organic Bodies) indicates the organic bodies is "approximately 1 to 3 cm" in size. In some cases they are smaller. Scale is in inches.

A7. 5 cm Mucky Mineral. *For use in LRRs P, T, U, and Z.* A layer of mucky modified mineral soil material 5 cm (2 inches) or more thick starting within 15 cm (6 inches) of the soil surface.

User Notes: "Mucky" is a USDA texture modifier for mineral soils. The organic carbon content is at least 5 percent 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 but not more than about 12 percent organic carbon. Another example is mucky sandy loam, which has at least 7 percent but not more than about 14 percent organic carbon.

Figure 14.—Indicator A7 (5 cm Mucky Mineral) about 10 cm thick. Indicator S7 (Dark Surface) also is present. Scale is in inches (R) and cm (L).

A8. Muck Presence. *For use in LRRs U, V and Z.* A layer of muck with value of 3 or less and chroma of 1 or less within 15 cm (6 inches) of the soil surface.

User Notes: The presence of muck of any thickness within 15 cm (6 inches) 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 inches). Muck is sapric soil material with a minimum content of organic carbon that ranges from12 to18 percent, depending on the content of clay. Organic soil material is called muck if virtually all of the material has undergone sufficient decomposition to prevent the identification of plant parts. Hemic soil material (mucky peat) and fibric soil material (peat) do not qualify. Generally, muck is black and has a "greasy" feel; sand grains should not be evident.

A9. 1 cm Muck. *For use in LRRs D, F, G, H, P, and T; for testing in LRRs C, I, J, and O.* A layer of muck 1 cm (0.5 inch) or more thick with value of 3 or less and chroma of 1 or less and starting within 15 cm (6 inches) of the soil surface.

User Notes: Unlike Indicator A8 (Muck Presence), this indicator has 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 inches). Muck is sapric soil material with a minimum content of organic carbon that ranges from12 to18 percent, depending on the content of clay. Organic soil material is called muck (sapric soil material) if virtually all of the material has undergone sufficient decomposition to limit the recognition of plant parts. Hemic soil material (mucky peat) and fibric soil material (peat) do not qualify. Generally, muck is black and has a "greasy" feel; sand grains should not be evident

A10. 2 cm Muck. *For use in LRR M and N; for testing in LRRs A, B, E, K, L, S, W, X, and Y.* A layer of muck 2 cm (0.75 inch) or more thick with value of 3 or less and chroma of 1 or less and starting within 15 cm (6 inches) of the soil surface.

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 inches). Muck is sapric soil material with a minimum content of organic carbon that ranges from12 to18 percent, depending on the content of clay. Organic soil material is called muck if virtually all of the material has undergone sufficient decomposition to limit the recognition of plant parts. Hemic soil material (mucky peat) and fibric soil material (peat) do not qualify. Generally, muck is black and has a "greasy" feel; sand grains should not be evident.

A11. Depleted Below Dark Surface. *For use in all LRRs, except for W, X, and Y; for testing in LRRs W, X, and Y.* A layer with a depleted or gleyed matrix that has 60 or more percent chroma of 2 or less, starting within 30 cm (12 inches) of the soil surface, and having a minimum thickness of either:

a. 15 cm (6 inches), or
b. 5 cm (2 inches) if the 5 cm consists of fragmental soil material.

Loamy or clayey layer(s) above the depleted or gleyed matrix must have value of 3 or less and chroma of 2 or less. Any sandy material above the depleted or gleyed matrix must have value of 3 or less and chroma of 1 or less, and at least 70 percent of the visible soil particles must be covered, coated, or similarly masked with organic material.

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 more than 30 cm (12 inches) thick, use Indicator A12. Redox concentrations including iron-manganese soft masses and/or pore linings are required in soils with matrix colors of 4/1, 4/2, and 5/2. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings.

Figure 15.—Indicator A11 (Depleted Below Dark Surface). This indicator is similar to F3 (Depleted Matrix). Because darker colored surface horizons imply more wetness, A11 indicates hydric conditions if the depleted matrix occurs within 30 cm of the soil surface, whereas F3 indicates hydric conditions if the depleted matrix occurs within 25 cm of the soil surface.

A12. Thick Dark Surface. *For use in all LRRs.* A layer at least 15 cm (6 inches) thick with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less and starting 30 cm (12 inches) below the surface. The layer(s) above the depleted or gleyed matrix must have value of 2.5 or less and chroma of 1 or less to a depth of at least 30 cm (12 inches) and value of 3 or less and chroma of 1 or less in any remaining layers above the depleted or gleyed matrix. Any sandy material above the depleted or gleyed matrix must have at least 70 percent of the visible soil particles covered, coated, or similarly masked with organic material.

User Notes: This indicator applies to soils that have a black layer 30 cm (12 inches) or more thick and have value of 3 or less and chroma of 1 or less in any remaining layers directly above a depleted matrix or gleyed matrix. This indicator is most often associated with overthickened soils in concave landscape positions. Redox concentrations including iron-manganese soft masses and/or pore linings are required in soils with matrix colors of 4/1, 4/2, and 5/2. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings.

Figure 16.—Indicator A12 (Thick Dark Surface). Deep observation commonly is necessary.

A13. Alaska Gleyed. *For use in LRRs W, X, and Y.* A mineral layer with a dominant hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB and with value of 4 or more in more than 50 percent of the matrix. The layer starts within 30 cm (12 in) of the mineral surface and is underlain within 1.5 m (60 inches) by soil material with hue of 5Y or redder in the same type of parent material.

User Notes: This indicator can be used for all mineral soils, not just sandy soils. The indicator has two requirements. First, one or more of the specified gleyed colors occurs within 30 cm (12 inches) of the soil surface. These must be colors present on the pages of the color book that show gley colors, not simply gray colors. Second, below these gleyed colors, the color of similar soil material is 5Y or redder (2.5Y, 10YR, 7.5YR, etc.). The presence of the truly gleyed colors indicates that the soil has undergone reduction. The requirement for 5Y or redder colors lower in the profile ensures that the gleyed colors are not simply the basic color of the parent material. Tidal sediments, lacustrine sediments, loess, and some glacial tills have base colors that appear as gleyed. On closer examination, their colors will normally match any of the colors on the pages of the color book that show gley colors. This indicator proves that the near-surface gleyed colors are not natural soil material colors and that they are the result of reduced conditions. When comparing the near-surface and underlying colors, make sure that you are looking at the same type of soil material. Many soils in Alaska consist of two or more types of material (e.g., silty loess overlying gravelly glacial till or sand and gravel river deposits).

Figure 17.—Indicator A13 (Alaska Gleyed). Bluish band at approximately 20 cm (8 inches) indicates the presence of reduced soil material. The underlying material below 20 cm reflects both the color of the parent material and soil weathering under aerobic conditions.

A14. Alaska Redox. *For use in LRRs W, X, and Y.* A mineral layer that has dominant hue of 5Y with chroma of 3 or less, or a gleyed matrix, with 10 percent or more distinct or prominent redox concentrations occurring as pore linings with value and chroma of 4 or more. The layer occurs within 30 cm (12 inches) of the soil surface.

User Notes: In a soil layer that has been reduced, one of the first areas where oxygen will be reintroduced is along pores and the channels of live roots. As oxidation occurs in these areas, characteristic reddish orange redox concentrations (value and chroma of 4 or more) will be apparent along the pores and linings. These will stand out in contrast to the matrix color of the overall soil layer. First, note the dominant color(s) of the soil layer to see if it matches the gley colors indicated. Then break open pieces of the soil and look for reddish orange redox concentrations along pores and root linings. The occurence of these concentrations indicates that the soil has been reduced during periods of wetness and is now oxidizing, while in a drier state.

Figure 18: Indicator A14 (Alaska Redox). The matrix color meets the requirements of a gleyed matrix. Reddish orange redox concentrations occur along the pores and channels of living roots.

A15. Alaska Gleyed Pores. *For use in LRRs W, X, and Y.* A mineral layer that has 10 percent or more hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value of 4 or more along root channels or other pores and that starts within 30 cm (12 inches) of the soil surface. The matrix has a dominant hue of 5Y or redder.

User Notes: In a soil layer that is turning anaerobic, reduced conditions will first occur where the soil microbes have an ample supply of organic carbon. Colder soils, such as those in Alaska, normally have a low content of organic carbon, so the microbes will congregate along the channels containing dead roots. Gley colors will first appear along these channels. In a soil layer that is not already dominated by gleyed colors, break open pieces of the soil and look closely at the root channels. Many of these will be very thin or fine. See if you can observe thin coatings along the channels that match the gleyed colors listed in the indicator. If they occur, they indicate that the soil is beginning to become anaerobic.

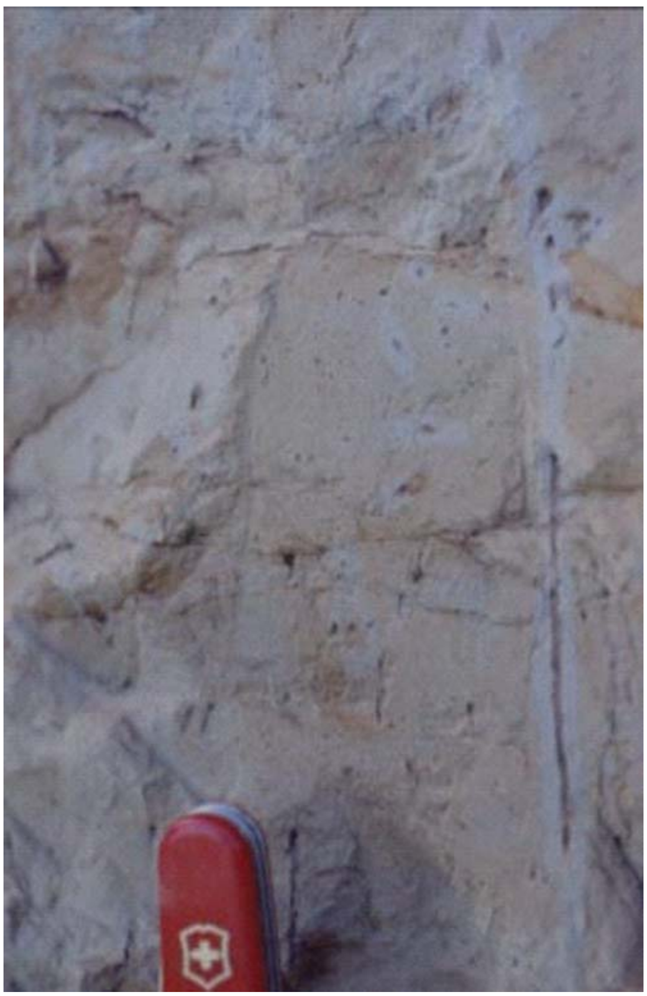

Figure 19.—A15 (Alaska Gleyed Pores). Reduction occurs first along root channels, where organic carbon is concentrated. Note the gleyed colors along the root channels.

A16. Coast Prairie Redox. *For use in MLRA 150A of LRR T.* A layer starting within 15 cm (6 inches) of the soil surface that is at least 10 cm (4 inches) thick and has a matrix chroma of 3 or less with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings.

User Notes: These hydric soils occur mainly on depressional landforms and portions of the intermound landforms on the Lissie Formation. Redox concentrations occur mainly as iron-dominated pore linings. Common or many redox concentrations are required. Chroma 3 matrices are allowed because they may be the color of stripped sand grains or because few or common sand-sized reddish chert particles occur and may prevent obtaining chroma of 2 or less.

Sandy Soils

Sandy soils have a USDA texture of loamy fine sand and coarser. All mineral layers above any of the S Indicators, except for Indicator S6, have a dominant chroma of 2 or less, or the layer(s) with a dominant chroma of more than 2 is less than 15 cm (6 inches) thick. In addition, 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 for W, X, and Y, and those LRRs that use Indicator A7 (P, T, U, and Z).* A layer of mucky modified sandy soil material 5 cm (2 inches) or more thick starting within 15 cm (6 inches) of the soil surface.

User Notes: "Mucky" is a USDA texture modifier for mineral soils. The content of organic carbon is at least 5 percent 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 but not more than about 12 percent organic carbon.

S2. 2.5 cm Mucky Peat or Peat. *For use in LRRs G and H.* A layer of mucky peat or peat 2.5 cm (1 inch) or more thick with value of 4 or less and chroma of 3 or less, starting within 15 cm (6 inches) of the soil surface, and underlain by sandy soil material.

User Notes: Mucky peat (hemic soil material) and peat (fibric soil material) have a minimum organic carbon content of 12 to 18 percent, depending on the content of clay. 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 at an intermediate stage of decomposition between peat and highly decomposed muck. To determine if mucky peat and/or peat are present, determine the percentage of rubbed and unrubbed fibers.

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 inches) or more thick with value 3 of or less and chroma of 2 or less, starting within 15 cm (6 inches) of the soil surface, and underlain by sandy soil material.

User Notes: Mucky peat (hemic soil material) and peat (fibric soil material) have a minimum organic carbon content of 12 to 18 percent, depending on the content of clay. 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 at an intermediate stage of decomposition between peat and highly decomposed muck. To determine if mucky peat and/or peat are present, determine the percentage of rubbed and unrubbed fibers.

S4. Sandy Gleyed Matrix. *For use in all LRRs, except for W, X, and Y.* A gleyed matrix that occupies 60 percent or more of a layer starting within 15 cm (6 inches) of the soil surface.

User Notes: Gley colors are not synonymous with gray colors. They are those colors that are on the gley color page (Gretag-Macbeth, 2000). They have hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB and value of 4 or more. The gleyed matrix only has to be present within 15 cm (6 inches) of the surface. Soils with gleyed matrices are saturated for periods of a significant duration; as a result, there is no thickness requirement for the layer.

S5. Sandy Redox. *For use in all LRRs, except for V, W, X, and Y.* A layer starting within 15 cm (6 inches) of the soil surface that is at least 10 cm (4 inches) thick and has a matrix with 60 percent or more chroma of 2 or less with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings.

User Notes: "Distinct" and "prominent" are defined

Figure 20.—Indicator S4 (Sandy Gleyed Matrix). The gleyed matrix begins at the soil surface. Scale is in inches (R) and cm (L).

Figure 21.—Indicator S5 (Sandy Redox). The redox masses occur below a depth of about 10 cm. Scale is in inches.

Figure 22.—Indicator S5 (Sandy Redox). The redox masses occur almost to the surface. The soil slice is about 40 cm. Indicator S6 (Stripped Matrix) also occurs in this soil.

in the Glossary. Redox concentrations include iron and manganese masses (reddish mottles) and pore linings. Included within this concept of redox concentrations are iron-manganese bodies occurring as soft masses with diffuse boundaries. The iron-manganese masses are 2 to 5 mm in size and have value and chroma of 3 or less. Most commonly, they are black. Iron-manganese masses should not be confused with concretions and nodules associated with plinthitic or relict concretions. Common or many redox concentrations are required.

S6. Stripped Matrix. *For use in all LRRs, except for V, W, X, and Y.* A layer starting within 15 cm (6 inches) of the soil surface in which iron-manganese oxides and/or organic matter have been stripped from the matrix and the primary base color of the soil material has been exposed. The stripped areas and translocated oxides and/or organic matter form a faint, diffuse splotchy pattern of two or more colors. The stripped zones are 10 percent or more of the volume; they are rounded and approximately 1 to 3 cm (0.5 to 1 inch) in diameter.

User Notes: This indicator includes the indicator previously named "polychromatic matrix" as well as the term "streaking." Common or many areas of stripped (uncoated) soil materials are required. The stripped areas are approximately 1 to 3 cm (0.5 to 1 inch) in size; they may be smaller. Commonly, the splotches of color have value of 5 or more and have chroma of 1 and/or 2 (stripped) and chroma of 3 and/or 4 (unstripped). The matrix may not have the material with 3 and/or 4 chroma. The mobilization and translocation of oxides and/or organic matter is the important process and should result in splotchy coated and uncoated soil areas.

Figure 23.—Indicator S6 (Stripped Matrix). Diffuse splotches, such as those shown in this photo, are a requirement.

Figure 24.—A soil that does not meet the requirements for Indicator S6 (Stripped Matrix) because the splotches are distinct rather than diffuse.

S7. Dark Surface. *For use in LRRs N, P, R, S, T, U, V, and Z.* A layer 10 cm (4 inches) or more thick starting within the upper 15 cm (6 inches) of the soil surface and with a matrix value of 3 or less and chroma of 1 or less. At least 70 percent of the visible soil particles must be covered, coated, or similarly masked with organic material. The matrix color of the layer directly below the dark layer must have chroma of 2 or less.

User Notes: For this indicator, the content of organic carbon is slightly less than is required for “mucky.” An undisturbed sample must be observed. A 10X or 15X hand lens is an excellent tool to aid in this observation. 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 coverage is less than 70 percent, a Dark Surface Indicator is not present.

Figure 25.—Indicator S7 (Dark Surface). The dark surface layer is about 15 cm thick. The material below 15 cm meets the intent of Indicator S8 (Polyvalue Below Surface). Scale is in inches.

S8. Polyvalue Below Surface. *For use in LRRs R, S, T, and U; for testing in LRRs K and L.* A layer with value of 3 or less and chroma of 1 or less, starting within 15 cm (6 inches) of the soil surface, and underlain by a layer(s) in which translocated organic matter unevenly covers the soil material, forming a diffuse splotchy pattern. At least 70 percent of the visible soil particles in the upper layer must be covered, coated, or masked with organic material. Directly below this layer, the organic coating occupies 5 percent or more of the soil volume and has value of 3 or less and chroma of 1 or less. The rest of the soil volume has value of 4 or more and chroma of 1 or less to a depth of 30 cm (12 inches) or to the spodic horizon, whichever is less.

User Notes: This indicator applies to soils with a very dark gray or black surface or near-surface layer that is less than 10 cm (4 inches) thick and is underlain by a layer in which organic matter has been differentially distributed within the soils by water movement. The mobilization and translocation of organic matter result 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 of 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.”

Figure 26.—Indicator S8 (Polyvalue Below Surface, on the right) and Indicator S9 (Thin Dark Surface, on the left). Organic matter has been mobilized and translocated. A spodic horizon is not required but commonly occurs in soils with these indicators. Scale is in inches.

S9. Thin Dark Surface. *For use in LRRs R, S, T and U; for testing in LRRs K and L.* A layer 5 cm (2 inches) or more thick within the upper 15 cm (6 inches) of the soil, with value of 3 or less and chroma of 1 or less. At least 70 percent of the visible soil particles in this layer must be covered, coated, or masked with organic material. This layer is underlain by a layer(s) with value of 4 or less and chroma of 1 or less to a depth of 30 cm (12 inches) or to the spodic horizon, whichever is less.

User Notes: This indicator applies to soils with a very dark gray or black near-surface layer that is at least 5 cm (2 inches) thick and is underlain by a layer in which organic matter has been carried downward by flowing water. The mobilization and translocation of organic matter result in an even distribution of organic matter in the eluvial (E) horizon. The chroma of 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, a spodic horizon is not required.

S10. Alaska Gleyed. This Indicator is now Indicator A13 (Alaska Gleyed).

Loamy and Clayey Soils

These soils have USDA textures of loamy very fine sand and finer. All mineral layers above any of the F Indicators, except for Indicators F8, F12, F19, and F20, have a dominant chroma of 2 or less, or the layer(s) with a dominant chroma of more than 2 is less than 15 cm (6 inches) thick. Also, except for Indicator F16, 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 for N, R, S, V, W, X, and Y, those using A7 (LRRs P, T, U, and Z), and MLRA 1 of LRR A.* A layer of mucky modified loamy or clayey soil material 10 cm (4 inches) or more thick starting within 15 cm (6 inches) of the soil surface.

User Notes: "Mucky" is a USDA texture modifier for mineral soils. The content of organic carbon is at least 8 percent but can range to as high as 18 percent. The percentage requirement depends on 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 but not more than about 14 percent organic carbon.

F2. Loamy Gleyed Matrix. *For use in all LRRs, except for W, X, and Y.* A gleyed matrix that occupies

Figure 27: Indicator F2 (Loamy Gleyed Matrix). The gleyed matrix begins at a depth of about 18 cm. Indicator F3 (Depleted Matrix) is between the gleyed matrix and the surface layer.

Figure 28.—Indicator F2 (Loamy Gleyed Matrix). The gleyed matrix starts at the soil surface. Scale is in inches.

60 percent or more of a layer starting within 30 cm (12 inches) of the soil surface.

User Notes: Gley colors are not synonymous with gray colors. They are the colors on the pages of the color book that show gley colors (Gretag-Macbeth, 2000). They have hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB and value of 4 or more. The gleyed matrix only has to be present within 30 cm (12 inches) of the surface. Soils with gleyed matrices are saturated for periods of a significant duration; as a result, there is no thickness requirement for the layer.

F3. Depleted Matrix. *For use in all LRRs, except for W, X, and Y.* A layer that has a depleted matrix with 60 percent or more chroma of 2 or less and that has a minimum thickness of either:

a. 5 cm (2 inches) if the 5 cm is entirely within the upper 15 cm (6 inches) of the soil, or

b. 15 cm (6 inches), starting within 25 cm (10 inches) of the soil surface.

Figure 29.—Indicator F3 (Depleted Matrix). Chroma is 2 below a depth of about 15 cm. Redox concentrations are present. Scale is in inches.

User Notes: Redox concentrations, including iron-manganese soft masses and/or pore linings, are required in soils with matrix colors of 4/1, 4/2, and 5/2. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings. The low-chroma matrix must be the result of wetness and not a relict or parent material feature.

Figure 30.—Indicator F3 (Depleted Matrix). The chroma is 1 within a depth of about 10 to 15 cm. Redox concentrations do not occur. Scale is in inches.

F4. Depleted Below Dark Surface. This Indicator is now Indicator A11 (Depleted Below Dark Surface).

F5. Thick Dark Surface. This Indicator is now Indicator A12 (Thick Dark Surface).

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

a. Matrix value of 3 or less and chroma of 1 or less and 2 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings, or

b. Matrix value of 3 or less and chroma of 2 or less and 5 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings.

User Notes: Redox concentrations in mineral soils that are high in content of organic matter and have a dark surface layer commonly are 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 some instances, drying of the samples makes the concentrations (if they occur) 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. In soils that are wet because of subsurface saturation, the layer directly below the dark epipedon should have a depleted or gleyed matrix. Soils that are wet because of ponding or a shallow perched layer of saturation may not always have a depleted/gleyed matrix below the dark surface layer. It is recommended that delineators evaluate the hydrologic source and examine and describe the layer below the dark colored epipedon when applying this indicator. Redox concentrations, including iron-manganese soft masses and/or pore linings, are required in soils with matrix colors of 4/1, 4/2, and 5/2.

Figure 31.—Indicator F6 (Redox Dark Surface). Prominent redox concentrations occur as soft masses and pore linings. Below the dark epipedon is indicator A11 (Depleted Below Dark Surface). Scale is in cm.

Figure 32.—Indicator F6 (Redox Dark Surface). Often, as in this soil, the redox concentrations are small (fine).

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 the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings.

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

a. Matrix value of 3 or less and chroma 1 or less and 10 percent or more redox depletions, or
b. Matrix value of 3 or less and chroma of 2 or less and 20 percent or more redox depletions.

User Notes: Care should be taken not to mistake mixing of an E or calcic horizon into the surface layer for 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 that are wet because of subsurface saturation, the layer directly below the dark surface layer should have a depleted or gleyed matrix. Redox depletions should have associated microsite redox concentrations that occur as Fe pore linings or masses within the depletion(s) or surrounding the depletion(s).

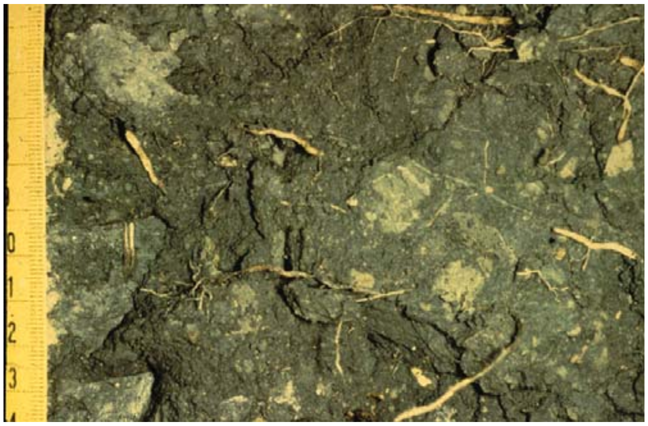

Figure 33.—Indicator F7 (Depleted Dark Surface). Depletions as they occur within a dark surface layer. Scale is in inches. Depletions are sometimes more readily apparent if the soil is allowed to dry.

F8. Redox Depressions. *For use in all LRRs, except for LRRs W, X, and Y; for testing in LRRs W, X, and Y.* In closed depressions subject to ponding, 5 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings in a layer that is 5 cm (2 inches) or more thick and is entirely within the upper 15 cm (6 inches) of the soil.

User Notes: This indicator occurs on depressional landforms, such as vernal pools, playa lakes, rainwater basins, “Grady” ponds, and potholes. It does not occur in microdepressions on convex or plane landscapes.

Figure 34.—Indicator F8 (Redox Depressions). This soil has mainly iron redox concentrations in the upper part and iron-manganese in the lower part. Scale is in cm (L) and inches (R).

Figure 35.—Indicator F8 (Redox Depressions). This soil meets the intent of this indicator by having slightly more than 5 percent redox concentrations in a layer slightly more than 2 inches thick.

F9. Vernal Pools. *For use in LRRs B, C and D.* In closed depressions that are subject to ponding, presence of a depleted matrix with 60 percent or more chroma of 2 or less in a layer 5 cm (2 inches) thick entirely within the upper 15 cm (6 inches) of the soil.

User Notes: Most often, soils are ponded because they occur in landscape positions that collect water or because they have a restrictive layer(s) that keeps water from moving downward through the soils. Normally, this indicator occurs at the soil surface. Redox concentrations, including iron-manganese soft masses and/or pore linings, are required in soils with matrix colors of 4/1, 4/2, and 5/2. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings.

Figure 36.—Indicator F9 (Vernal Pools). A depleted matrix only 2 inches thick is required. Scale is in inches.

F10. Marl. *For use in LRR U.* A layer of marl with a value of 5 or more and starting within 10 cm (4 inches) of the soil surface.

User Notes: Marl is a limnic material deposited in water by precipitation of $CaCO_3$ by algae as defined in *Soil Taxonomy* (USDA, NRCS, 1999). It has a Munsell value of 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 of the properties of marl, except for 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.

F11. Depleted Ochric. *For use in MLRA 151 of LRR T.* A layer(s) 10 cm (4 inches) or more thick in which 60 percent or more of the matrix has value of 4 or more and chroma of 1 or less. The layer is entirely within the upper 25 cm (10 inches) of the soil.

User Notes: This indicator is applicable in accreting deltaic areas along the Mississippi River.

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 inches) or more thick with 40 percent or more chroma of 2 or less and 2 percent or more distinct or prominent redox concentrations occurring as soft iron/manganese masses with diffuse boundaries. The layer occurs entirely within 30 cm (12 inches) of the soil surface. Iron-manganese masses have value and chroma of 3 or less. Most commonly, they are black. The thickness requirement is waived if the layer is the mineral surface layer.

User Notes: These iron-manganese masses generally are small (2 to 5 mm in size) and have value and chroma of 3 or less. They can be dominated by manganese and therefore have a color approaching black. The low matrix chroma must be the result of wetness and not be a relict or parent material feature. Iron-manganese masses should not be confused with the larger and redder iron nodules associated with plinthite or with concretions that have sharp boundaries. This indicator occurs on flood plains along rivers, such as the Apalachicola, Congaree, Mobile, Savannah, and Tennessee Rivers.

Figure 37.—Indicator F12 (Iron-Manganese Masses) in a 40 percent depleted matrix. Scale is in inches.

F13. Umbric Surface. *For use in LRRs P, T, and U and MLRA 122 of LRR N.* In depressions and other concave landforms, a layer 25 cm (10 inches) or more thick starting within 15 cm (6 inches) of the soil surface in which the upper 15 cm (6 inches) has value of 3 or less and chroma of 1 or less and in which the lower 10 cm (4 inches) has the same colors as those described above or any other color that has chroma of 2 or less.

User Notes: The thickness requirements may be slightly less than those for an umbric epipedon. Microlows are not considered to be concave landforms. Umbric surfaces in the higher landscape positions, such as side slopes dominated by Humic Dystrudepts, are excluded.

Figure 38.—Indicator F13 (Umbric Surface). This umbric surface is about 20 cm thick. Scale is in inches.

F14. Alaska Redox Gleyed. This Indicator is now Indicator A14 (Alaska Redox).

F15. Alaska Gleyed Pores. This Indicator is now Indicator A15 (Alaska Gleyed Pores).

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 that are subject to ponding, a mineral soil that has chroma of 1 or less to a depth of at least 35 cm (13.5 inches) and a layer at least 10 cm (4 inches) thick within the upper 35 cm (13.5 inches) of the mineral soil that has either:

a. 1 percent or more redox concentrations occurring as nodules or concretions, or
b. Redox concentrations occurring as nodules or concretions with distinct or prominent corona.

User Notes: This indicator is for closed depressions (FSA "playas") in western Kansas, southwestern Nebraska, eastern Colorado, and southeastern Wyoming. It occurs in such soils as those on the Ness and Pleasant series. The matrix color of the 35-cm (13.5-inch) layer must have chroma of 1 or less; chroma 2 matrix colors are excluded; value generally is 3. The nodules and concretions are rounded, are hard or very hard, range in size from less than 1 mm to 3 mm, and most commonly are black or reddish black. The corona (halos) generally are reddish brown, strong brown, or yellowish brown. The nodules and concretions can be removed from the soil, and the corona 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.

F17. Delta Ochric. *For use in MLRA 151 of LRR T.* A layer 10 cm (4 inches) or more thick in which 60 percent or more of the matrix has value of 4 or more and chroma of 2 or less and there are no redox concentrations. This layer occurs entirely within the upper 30 cm (12 inches) of the soil.

User Notes: This indicator is applicable in accreting areas of the Mississippi River Delta.

F18. Reduced Vertic. *For use in MLRA 150 of LRR T; for testing in all LRRs with Vertisols and Vertic intergrades.* In Vertisols and Vertic intergrades, a positive reaction to alpha-alpha-dipyridyl that: a.) is the dominant (60 percent or more) condition of a layer at least 4 inches thick within the upper 12 inches (or at least 2 inches thick within the upper 6 inches) of the mineral or muck soil surface, b.) occurs for at least 7 continuous days and 28 cumulative days, and c.) occurs during a normal or drier season and month (within 16 to 84 percent of probable precipitation).

User Notes: The time requirements for this indicator were identified from research in MLRA 150A in LRR T (Gulf Coastal Prairies). These requirements or slightly modified time requirements may be found to identify wetland Vertisols and Vertic Intergrades in other parts of the Nation. These soils generally have thick dark surface horizons, but Indicators F4, F5, and F6 commonly are not evident, possibly because of masking of redoximorphic features by organic carbon. The soils are a special case of the Problem Soils with Thick, Dark A Horizons listed in the 1987 *Corps of*

Engineers Wetlands Delineation Manual. Follow the procedures and note the considerations in Hydric Soil Tech. Note 8 (use of alpha-alpha-dipyridyl).

F19. Piedmont Flood Plain Soils. *For use in MLRAs 149A and 148 of LRR S; for testing on flood plains subject to Piedmont deposition throughout LRRs P, S, and T.* On active flood plains, a mineral layer at least 15 cm (6 inches) thick starting within 25 cm (10 inches) of the soil surface with a matrix (60 percent or more of the volume) chroma of less than 4 and 20 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings.

User Notes: This indicator is for use or testing in soils on active flood plains in the Mid-Atlantic and Southern Piedmont provinces and in areas where sediments derived from the Piedmont are being deposited on flood plains on the Coastal Plain.

F20. Anomalous Bright Loamy Soils. *For use in MLRA 149A of LRR S and MLRAs 153C and 153D of LRR T; for testing in MLRA 153B of LRR T.* Within 200 m (656 feet) of estuarine marshes or waters and within 1 m (3.28 feet) of mean high water, a mineral layer at least 10 cm (4 inches) thick starting within 20 cm (8 inches) of the soil surface with a matrix (60 percent or more of the volume) chroma of less than 5 and 10 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings and/or depletions.

User Notes: These soils are expected to occur on linear or convex landforms that are adjacent to estuarine marshes or waters.

Figure 39.—Indicator F19 (Piedmont Flood Plain Soils). This indicator is restricted to flood plains actively receiving sediments. Scale is in 10-cm increments.

Figure 40.—Indicator F20 (Anomalous Bright Loamy Soils). This indicator is restricted to areas near estuarine marshes or water. Scale is in 10-cm increments.

Test Indicators of Hydric Soils

The Indicators listed under the heading "Field Incicators of Hydric Soils" should be tested for use in LRRs other than those listed. Other Indicators for testing are listed below. The test indicators are not to be used for the purpose of delineating hydric soils. Users of the Indicators are encouraged to submit descriptions of other soil morphologies that they think are indicative of hydric soils along with supporting data for inclusion in subsequent editions of *Field Indicators of Hydric Soils in the United States.*

All Soils

TA1. Playa Rim Stratified Layers. This test Indicator has been deleted.

TA2. Structureless Muck. This test Indicator has been deleted.

TA3. Coast Prairie Redox. This test Indicator has been approved for use and is now A16 (Coast Prairie Redox).

TA4. Alaska Color Change. *For testing in LRRs W, X, and Y.* A mineral layer 10 cm (4 inches) or more thick starting within 30 cm of the surface (12 inches) that has a matrix value of 4 or more and chroma of 2 or less and that within 30 minutes becomes redder by one or more Munsell unit in hue and/or chroma when exposed to air.

User Notes: The soil should be at or near saturation when examined. Care must be taken to immediately obtain an accurate color of the soil sample upon excavation. The colors should then be closely examined again after several minutes. Do not allow the sample to begin drying, as drying will result in a color change. Care must be taken to closely observe the colors. As always, do not obtain colors while wearing sunglasses. Colors must be obtained in the field under natural lighting and not under artificial light. Also, look for the presence of other indicators.

TA5. Alaska Alpine Swales. *For testing in LRRs W, X, and Y.* On concave landforms, the presence of a surface mineral layer 10 cm (4 inches) or more thick having hue of 10YR or yellower, value of 2.5 or less, and chroma of 2 or less. The dark surface layer is at least twice as thick as the mineral surface layer of soils in the adjacent convex micro-positions.

User Notes: Soils with this indicator occur in concave areas where moisture accumulates. In these areas the source of the hydrology is meltwater from adjacent snowpacks that persist well into the growing season. The landscape generally is a complex micro-topography of concave depressions and adjacent convex "micro-highs." Soils should be examined in both landscape positions and compared. If both positions have a mineral surface layer of the same color, but the layer is a least twice as thick in the concave position, the soil in the concave position is considered hydric. Make sure that there is reasonable evidence of the hydrology source. This includes either direct observation of the melting snowpack or aerial imagery that shows snowpack at that location earlier in the growing season.

Sandy Soils

TS1. Iron Staining. This test Indicator has been deleted.

TS2. Thick Sandy Dark Surface. This test Indicator has been deleted. Its concepts have been approved for use and are now included with Indicator A12 (Thick Dark Surface).

TS3. Dark Surface 2. This test Indicator has been deleted. This is the same Indicator as Indicator S7 (Dark Surface).

TS4. Sandy Neutral Surface. This test Indicator has been deleted. Most of its concepts have been approved for use and are now included with Indicator A11 (Depleted Below Dark Surface).

TS5. Chroma 3 Sandy Redox. This test Indicator has been deleted. It has been approved for use as Indicator A16 (Coast Prairie Redox).

Loamy and Clayey Soils

TF1. ? cm Mucky Peat or Peat. This test Indicator has been deleted.

TF2. Red Parent Material. *For testing in LRRs with red parent material.* In parent material with hue of 7.5YR or redder, a layer at least 10 cm (4 inches) thick with a matrix value and chroma of 4 or less and 2 percent or more redox depletions and/or redox concentrations occurring as soft masses and/or pore linings. The layer is entirely within 30 cm (12 inches) of the soil surface. The minimum thickness requirement is 5 cm (2 inches) if the layer is the mineral surface layer.

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 those along the Chattahoochee, Congaree, Red, and Tennessee Rivers. The most noticeable redox features in red materials are redox depletions and soft manganese masses that are black or dark reddish black.

Figure 41.—Indicator TF2 (Red Parent Material). This soil has common or many redox concentrations and soft iron-manganese masses.

TF3. Alaska Concretions. This test Indicator has been deleted.

TF4. 2.5Y/5Y Below Dark Surface. This test Indicator has been deleted.

TF5. 2.5Y/5Y Below Thick Dark Surface. This test Indicator has been deleted.

TF6. Calcic Dark Surface. This test Indicator has been deleted**.**

TF7. Thick Dark Surface 2/1. This test Indicator has been deleted. Its concepts have been approved for use and are now included with Indicator A12 (Thick Dark Surface).

TF8. Redox Spring Seeps. This test Indicator has been deleted.

TF9. Delta Ochric. This test Indicator has been approved for use and is now Indicator F17 (Delta Ochric).

TF10. Alluvial Depleted Matrix. This test Indicator has been deleted

TF11. Reduced Vertic. This test Indicator has been approved for use and is now Indicator F18 (Reduced Vertic).

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Unless otherwise noted, the following references include definitions of terms used throughout this document. They also provide additional information concerning the terms in the Glossary of this document.

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Glossary

As defined in this Glossary, terms marked with an asterisk (*) have definitions that are slightly different from the definitions in the referenced materials. The definitions in the Glossary are intended to assist users of this document and are not intended to add to or replace definitions in the referenced materials.

A horizon. A mineral soil horizon that formed at the surface or below an O horizon where organic material is accumulating. See *Soil Taxonomy* (1999) for a complete definition.

Accreting areas. Landscape positions in which soil material accumulates through deposition from higher elevations or upstream positions more rapidly than the rate at which soil material 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 *Soil Taxonomy* (1999) for a complete definition.

***Artificial drainage.** The use of human efforts and devices to remove free water from the soil surface or from the soil profile. The hydrology may also be modified by the use of levees and dams, which keep water from entering a site.

Figure 42.—Artificial drainage does not alter the hydric status of a soil.

$CaCO_3$ equivalent. The acid neutralizing capacity of a soil expressed as a weight percentage of $CaCO_3$ (molecular weight of $CaCO_3$ equals 100).

Calcic horizon. An illuvial horizon in which carbonates have accumulated to a significant extent. See *Soil Taxonomy* (1999) for a complete definition.

Calcium carbonate. Calcium carbonate has the chemical formula of $CaCO_3$. It effervesces when treated with cold hydrochloric acid.

Closed depressions. Low-lying areas that are surrounded by higher ground and have no natural outlet for surface drainage.

COE. U.S. 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. Landscapes in which the surface curves downward.

***Covered, coated, masked.** These are terms used to describe all of the redoximorphic processes by which the color of soil particles is hidden by organic material, silicate clay, iron, aluminum, or some combination of these.

***Depleted matrix.** For loamy and clayey material, a depleted matrix refers to the volume of a soil horizon or subhorizon in which the processes of reduction and translocation have removed or transformed iron, creating 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 the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings. In some areas the depleted matrix may change color upon exposure to air (See Reduced matrix); this phenomenon is included in the concept of depleted matrix. The following combinations of value and chroma identify a depleted matrix:

1. Matrix value of 5 or more and chroma of 1 or less with or without redox concentrations occurring as soft masses and/or pore linings; or
2. Matrix value of 6 or more and chroma of 2 or less with or without redox concentrations occurring as soft masses and/or pore linings; or
3. Matrix value of 4 or 5 and chroma of 2 and 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings; or
4. Matrix value of 4 and chroma of 1 and 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings.

Diffuse boundary. Used to describe redoximorphic features that grade gradually from one color to another (figure 43). The color grade is commonly more than 2 mm wide. “Clear” is used to describe boundary color gradations intermediate between sharp and diffuse.

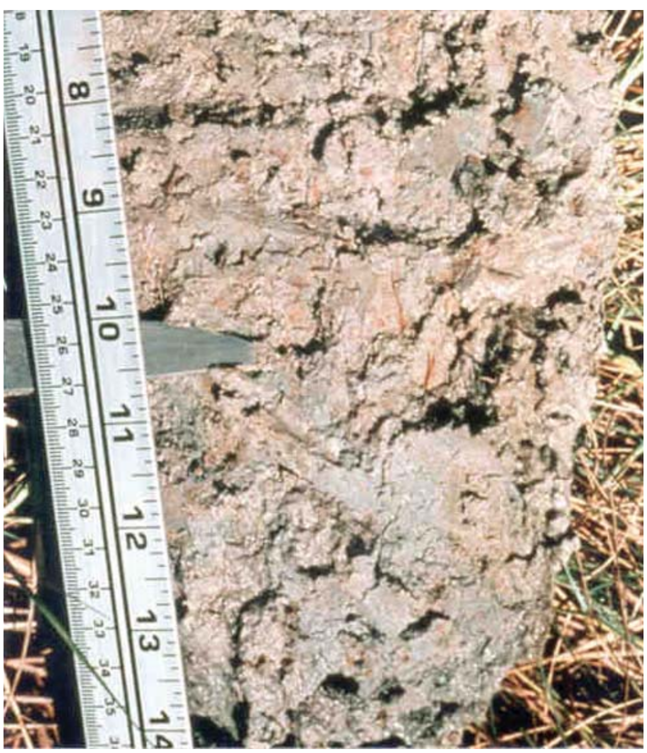

Figure 43.—Redox concentrations that occur as pore linings and have diffuse boundaries.

Distinct.[1] Readily seen but contrast only moderately with the color to which compared. The contrast is distinct if:

1. delta hue = 0, then
   a.) delta value ≤ 2 and delta chroma >1 to <4, or
   b.) delta value >2 to <4 and delta chroma <4.
2. delta hue = 1, then
   a.) delta value ≤ 1 and delta chroma >1 to <3, or
   b.) delta value >1 to <3 and delta chroma <3.
3. delta hue = 2, then
   a.) delta value = 0 and delta chroma >0 to <2, or
   b.) delta value >0 to <2 and delta chroma <2.

[1] Regardless of the magnitude of hue difference, where both colors have value ≤ 3 and chroma ≤ 2, the contrast is faint.

E horizon. A mineral horizon in which the dominant process is loss of silicate clay, iron, and/or aluminum, leaving a concentration of sand and silt particles. See *Soil Taxonomy* (1999) for a complete definition.

EPA. U.S. Environmental Protection Agency.

Epipedon. A horizon that has developed at the soil surface. See *Soil Taxonomy* (1999) for a complete definition.

Faint. Evident only on close examination. The contrast is faint if:

1. delta hue = 0, then delta value ≤ 2 and delta chroma ≤ 1, or
2. delta hue = 1, then delta value ≤ 1 and delta chroma ≤ 1, or
3. delta hue = 2, then delta value = 0 and delta chroma = 0, or

any delta hue if both colors have value ≤ 3 and chroma ≤ 2.

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 a 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 a complete discussion.

Few. When referring to redox concentrations and/or depletions, “few” represents less than 2 percent of the observed surface.

Fibric. See Peat.

Fragmental soil material. Soil material that consists of 90 percent or more rock fragments. Less than 10 percent of the soil consists of particles 2 mm or smaller.

Frequently flooded or ponded. A frequency class in which flooding or ponding is likely to occur often under usual weather conditions (a chance of more than 50 percent in any year, or more than 50 times in 100 years).

FWS. U.S. Department of the Interior, Fish and Wildlife Service.

***g.** A horizon suffix indicating that the horizon is gray because of wetness but not necessarily that it is gleyed. All gleyed matrices (defined below) should have the suffix "g"; however, all horizons with the "g" suffix are not gleyed. For example, a horizon with the color 10YR 6/2 that is at least seasonally wet, with or without other redoximorphic features, should have the "g" suffix.

Glauconitic. Refers to a mineral aggregate that contains a 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 (the soils are not glauconitic):

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

In some places the gleyed matrix may change color upon exposure to air. (See Reduced matrix). This phenomenon is included in the concept of gleyed matrix.

***Hemic.** See Mucky peat.

Histels. Organic soils that overlie permafrost and show evidence of cryoturbation. See *Soil Taxonomy* (1999) for a complete definition.

Histic epipedon. A thick (20- to 60-cm, or 8- to 24-inch) organic soil horizon that is saturated with water at some period of the year (unless the soil is artificially drained) and that is at or near the surface of a mineral soil.

Histosols. Organic soils that have organic soil materials in more than half of the upper 80 cm (32 inches) or that have organic materials of any thickness if they overlie rock or fragmental materials that have interstices filled with organic soil materials. See *Soil Taxonomy* (1999) for a 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 *Soil Taxonomy* (1999) for a complete definition.

Hydric soil criteria, 2002 (used only for database sorting, not for field delineation):

1. All Histels except for Folistels, and Histosols except for Folists, or
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Aquisalids, Historthels, and Histoturbels great groups, and Cumulic or Pachic subgroups that:
   a. are somewhat poorly drained and have a water table at the surface (0.0 feet) during the growing season, or
   b. are poorly drained or very poorly drained and have either:
      (1) a water table at the surface (0.0 feet) during the growing season if textures are coarse sand, sand, or fine sand in all layers within a depth of 20 inches, or
      (2) a water table at a depth of 0.5 foot or less during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within a depth of 20 inches, or
      (3) a water table at a depth of 1.0 foot or less during the growing season if permeability is less than 6.0 in/hr in any layer within a depth of 20 inches, or
3. Soils that are frequently ponded for periods of long or very long duration during the growing season, or
4. Soils that are frequently flooded for periods of 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. The odor of H_2S. It is similar to the smell of rotten eggs.

Hydromorphic features. Features in the soil caused or formed by water.

Layer(s). A horizon, subhorizon, or combination of contiguous horizons or subhorizons sharing at least one property 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 is assigned a different letter of the alphabet (A-Z). LRRs are defined in U.S. Department of Agriculture 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 freshwater lacustrine conditions. See *Soil Taxonomy* (1999) for a complete definition.

Matrix. The dominant soil volume that is continuous in appearance and envelops microsites. When three colors occur, 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 U.S. Department of Agriculture Handbook 296.

Mollic epipedon. A mineral surface horizon that is relatively thick, dark colored, and humus rich and has high base saturation. See *Soil Taxonomy* (1999) for a complete definition.

Mollisols. Mineral soils that have a mollic epipedon. See *Soil Taxonomy* (1999) for a complete definition.

***Muck.** Sapric organic soil material in which virtually all of the organic material is so decomposed that identification of plant forms is not possible. Bulk density is normally 0.2 or more. Muck has less than one-sixth fibers after rubbing, and its sodium pyrophosphate solution extract color has lower value and chroma than 5/1, 6/2, and 7/3.

***Mucky modified mineral soil material.** A USDA soil texture modifier, e.g., mucky sand. Mucky modified mineral soil material that has 0 percent clay has between 5 and 12 percent organic carbon. Mucky modified mineral soil material that has 60 percent clay has between 12 and 18 percent organic carbon. Soils with an intermediate amount of clay have intermediate amounts of organic carbon. Where the organic component is peat (fibric material) or mucky peat (hemic material), mucky mineral soil material does not occur.

***Mucky peat.** Hemic organic material, which is characterized by decomposition that is intermediate between that of fibric material and that of sapric material. Bulk density is normally between 0.1 and 0.2 g/cm^3. Mucky peat does not meet the 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 18 percent or more organic carbon 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 44).

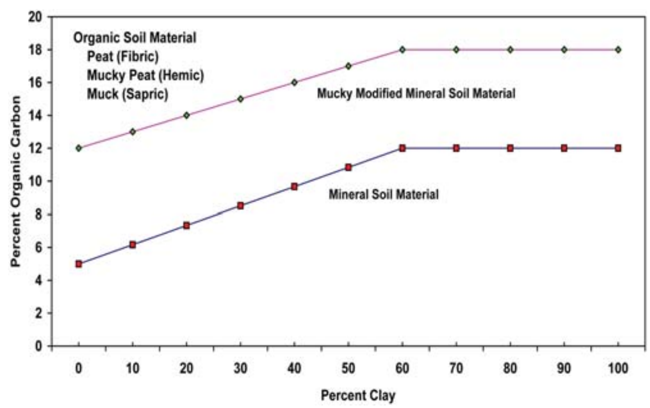

Figure 44.—Percent organic carbon required for organic soil material, mucky modified mineral soil material, and mineral soil material as it is related to content of clay.

***Peat.** Fibric organic soil material. The plant forms can be identified in virtually all of the organic material. Bulk density is normally <0.1. Peat has three-fourths or more fibers after rubbing, or it has two-fifths or more fibers after rubbing and has 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 *Soil Taxonomy* (1999) for a complete discussion.

Ponding. Standing water in a closed depression that is removed only by percolation, evaporation, or transpiration. The ponding lasts for more than 7 days.

Pore linings. Zones of accumulation that may be either coatings on a ped or pore surface or impregnations of the matrix adjacent to the pore or ped. See Vepraskas (1994) for a complete discussion.

Prominent. Contrasts strongly in color. Color contrasts more contrasting than faint and distinct are 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 a complete discussion.

Redox depletions. Bodies of low chroma (2 or less) having value of 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 a 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 (figure 45). See Vepraskas (1994) for a complete discussion.

Figure 45.—Redoximorphic features as required in many of the Indicators. These redox concentrations occur as pore linings along root channels and ped faces.

Relict features. Soil morphological features that do not reflect recent hydrologic conditions of saturation and anaerobiosis (figure 46). See Vepraskas (1994) for a complete discussion.

Figure 46.—Sharp boundaries, such as those shown here, may indicate that the redoximorphic features are relict.

Reduced matrix. A soil matrix that has low chroma and high value, but in which the color changes in hue or chroma when the soil is exposed to air. See Vepraskas (1994) for a complete discussion.

***Reduction.** For the purpose of the Indicators, reduction occurs 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 (figure 47).

Figure 47.—Reduction would probably occur in this salt march throughout the year. The Indicator A4 (Hydrogen Sulfide) would most likely occur here.

***Sapric.** See Muck.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Almost all of the soil pores are filled with water.

Sharp boundary. Used to describe redoximorphic features that grade sharply from one color to another. The color grade is commonly less than 0.1 mm wide.

Soft masses. Noncemented redox concentrations, frequently within the soil matrix, that are of various shapes and cannot be removed as discrete units.

Soil texture. The relative proportions, by weight, of sand, silt, and clay particles in the soil material less than 2 mm in size.

Spodic horizon. A mineral soil horizon that is characterized by the illuvial accumulation of amorphous materials consisting of aluminum and organic carbon with or without iron. The spodic horizon has a minimum thickness, a minimum quantity of oxalate extractable carbon plus aluminum, and/or specific color requirements.

Umbric epipedon. A thick, dark mineral surface horizon with base saturation of less than 50 percent. See *Soil Taxonomy* (1999) for a 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 *Soil Taxonomy* (1999) for a complete definition.

Wetland. An area that has hydrophytic vegetation, hydric soils, and wetland hydrology, as per the "National Food Security Act Manual" and the 1987 *Corps of Engineers Wetlands Delineation Manual* (figure 48).

Within. When referring to specific indicator depth requirements, "within" means not beyond in depth. "Within a depth of 15 cm," for example, indicates that the depth is less than or equal to 15 cm.

Figure 48.—If the area that this soil represents has hydrophytic vegetation and wetland hydrology, it would be in a wetland. This soil has the Indicator F2 (Loamy Gleyed Matrix).

Appendices

Appendix 1: Use Indicators by Land Resource Regions (LRRs) and Certain Major Land Resource Areas (MLRAs)

LRR	Indicators
A	A1, A2, A3, A4, A11, A12, S1, S4, S5, S6, F1 (except MLRA 1), F2, F3, F6, F7, F8
B	A1, A2, A3, A4, A10, A11, A12, S1, S4, S5, S6, F1, F2, F3, F6, F7, F8, F9
C	A1, A2, A3, A4, A5, A11, A12, S1, S4, S5, S6, F1, F2, F3, F6, F7, F8, F9
D	A1, A2, A3, A4, A9, A11, A12, S1, S4, S5, S6, F1, F2, F3, F6, F7, F8, F9
E	A1, A2, A3, A4, A11, A12, S1, S4, S5, S6, F1, F2, F3, F6, F7, F8
F	A1, A2, A3, A4, A5, A9, A11, A12, S1, S3, S4, S5, S6, F1, F2, F3, F6, F7, F8
G	A1, A2, A3, A4, A9, A11, A12, S1, S2, S4, S5, S6, F1, F2, F3, F6, F7, F8
H	A1, A2, A3, A4, A9, A11, A12, S1, S2, S4, S5, S6, F1, F2, F3, F6, F7, F8, F16 (MLRAs 72 & 73)
I	A1, A2, A3, A4, A11, A12, S1, S4, S5, S6, F1, F2, F3, F6, F7, F8
J	A1, A2, A3, A4, A11, A12, S1, S4, S5, S6, F1, F2, F3, F6, F7, F8
K	A1, A2, A3, A4, A5, A11, A12, S1, S4, S5, S6, F1, F2, F3, F6, F7, F8
L	A1, A2, A3, A4, A5, A11, A12, S1, S4, S5, S6, F1, F2, F3, F6, F7, F8
M	A1, A2, A3, A4, A5, A10, A11, A12, S1, S3, S4, S5, S6, F1, F2, F3, F6, F7, F8
N	A1, A2, A3, A4, A5, A10, A11, A12, S1, S4, S5, S6, S7, F1, F2, F3, F6, F7, F8, F12, F13 (MLRA 122)
O	A1, A2, A3, A4, A5, A11, A12, S1, S4, S5, S6, F1, F2, F3, F6, F7, F8, F12
P	A1, A2, A3, A4, A5, A6, A7, A9, A11, A12, S4, S5, S6, S7, S9, F2, F3, F6, F8, F12, F13
R	A1, A2, A3, A4, A5, A11, A12, S1, S3, S4, S5, S6, S7, S8, S9, F2, F3, F6, F7, F8
S	A1, A2, A3, A4, A5, A11, A12, S1, S4, S5, S6, S7, S8, S9, F2, F3, F6, F7, F8, F19 (MLRAs 148 and 149A), F20 (MLRA 149A)
T	A1, A2, A3, A4, A5, A6, A7, A9, A11, A12, A16 (MLRA 150A), S4, S5, S6, S7, S8, S9, F2, F3, F6, F8, F11 (MLRA 151), F12, F13, F17 (MLRA 151) F18 (MLRA 150), F20 (MLRAs 153C and 153D)
U	A1, A2, A3, A4, A5, A6, A7, A8, A11, A12, S4, S5, S6, S7, S8, S9, F2, F3, F6, F10, F13
V	A1, A2, A3, A4, A5, A8, A11, A12, S4, S7, F2, F3, F6, F7, F8
W	A1, A2, A3, A4, A12, A13, A14, A15, F14, F15
X	A1, A2, A3, A4, A12, A13, A14, A15, F14, F15
Y	A1, A2, A3, A4, A12, A13, A14, A15, F14, F15
Z	A1, A2, A3, A4, A5, A6, A7, A8, A11, A12, S4, S5, S6, S7, F2, F3, F6, F7, F8

Appendix 2: Test Indicators by Land Resource Regions (LRRs) and Certain Major Land Resource Areas (MLRAs)

LRR	Indicators
A	A10
B	A10, F18
C	A9, F18 (MLRA 14)
D	S1
E	A10
F	A16, TF2, F18 (MLRA 56)
G	A16, S7, TF2
H	A16, TF2
I	A9
J	A9, F18 (MLRA 86)
K	A10, A16, S8, S9, TF2
L	A10, A16, S8, S9, TF2
M	F12, A16
N	TF2
O	A9, F18 (MLRA 131)
P	F18 (MLRA 135), F19
R	A16, F19, S3, TF2
S	A10, F19, TF2
T	F19, F20 (MLRA 153B), TF2
U	None
V	A5, TF2
W	A10, A11, F6, F7, F8, TA4, TA5
X	A10, A11, F6, F7, F8, TA4, TA5
Y	A10, A11, F6, F7, F8, TA4, TA5
Z	A5, TF2

Appendix 3: Indicator Correlations

1987 COE Manual	Regional Indicators
Nonsandy soils:	
a. Organic soils (Histosols)	A1 (Histosol or Histel) A3 (Black Histic)
b. Histic epipedon	A2 (Histic Epipedon) A3 (Black Histic)
c. Sulfidic material	A4 (Hydrogen Sulfide)
d. Aquic or peraquic moisture regime	None
e. Reducing soil conditions	F18 (Reduced Vertic)
f (1). Gleyed soils (gray color)	A13 (Alaska Gleyed) A14 (Alaska Redox) A15 (Alaska Gleyed Pores) F2 (Loamy Gleyed Matrix)
f (2). Soils with bright mottles and/or low matrix chroma	F3 (Depleted Matrix) F9 (Vernal Pools) F11 (Depleted Ochric) F16 (High Plains Depressions) F17 (Delta Ochric)
g. Soils appearing on the hydric soils list	None
h. Iron and manganese concretions	F12 (Iron-Manganese Masses)
Sandy soils:	
a. Organic soils (Histosols)	A1 (Histosol or Histel) A3 (Black Histic)
b. Histic epipedon	A2 (Histic Epipedon) A3 (Black Histic)
c. Sulfidic material	A4 (Hydrogen sulfide)
d. Aquic or peraquic moisture regime	None
e. Reducing soil conditions	None
f. Iron and Manganese concretions	None

Appendix 3: Indicator Correlations—Continued

1987 COE Manual	Regional Indicators
Sandy soils—continued	
g. High organic matter content in the surface horizon	A7 (5 cm Mucky Mineral) A8 (Muck Presence) A9 (1 cm Muck) A10 (2 cm Muck) S1 (Sandy Mucky Mineral) S2 (2.5 cm Mucky Peat or Peat) S3 (5 cm Mucky Peat or Peat) S7 (Dark Surface)
h. Streaking of subsurface horizons by organic matter	S6 (Stripped Matrix) S8 (Polyvalue Below Surface)
i. Organic pan	S8 (Polyvalue Below Surface) S9 (Thin Dark Surface)
j. Soils appearing on the hydric soils list	None
Problem soils:	
Sandy soils	A5 (Stratified Layers) A6 (Organic Bodies) A16 (Coast Prairie Redox) S4 (Sandy Gleyed Matrix) S5 (Sandy Redox) S6 (Stripped Matrix) S8 (Polyvalue Below Surface) S9 (Thin Dark Surface)
Soils with thick dark A horizons	A11 (Depleted Below Dark Surface) A12 (Thick Dark Surface) F6 (Redox Dark Surface) F7 (Depleted Dark Surface) F13 (Umbric Surface) F16 (High Plains Depressions) F18 (Reduced Vertic) TA5 (Alaska Alpine Swales)
Soils with red parent material	A16 (Coast Prairie Redox) F8 (Redox Depressions) F9 (Vernal Pools) F12 (Iron-Manganese Masses) F19 (Piedmont Flood Plain Soils) F20 (Anomalous Bright Loamy Soils) TA4 (Alaska Color Change) TF2 (Red Parent Material)
Soils with low-chroma parent material	A13 (Alaska Gleyed) S4 (Sandy Gleyed Matrix) F10 (Marl)

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