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FIELD INDICATORS OF HYDRIC SOILS IN THE UNITED STATES

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FIELD INDICATORS OF HYDRIC SOILS IN THE UNITED STATES

by: UNITED STATES DEPARTMENT OF AGRICULTURE.
NATURAL RESOURCES CONSERVATION SERVICE

in cooperation with:

Environmental Protection Agency,
U.S. Fish and Wildlife Service,
U.S. Army Corps of Engineers, and
North Carolina State University

Forward: Field Indicators of Hydric Soils in the United States have been developed by Natural Resources Conservation Service (NRCS) soil scientists in cooperation with soil and other scientists from the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, the Environmental Protection Agency, various regional, state, and local agencies, universities, and the private sector. Included are the official hydric soil-indicators for use by NRCS and others identifying and verifying the pressence of hydric soils in the field.

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FIELD INDICATORS OF HYDRIC SOILS IN THE UNITED STATES
VER. 2.0, June, 1995)

INTRODUCTION:

The "Field Indicators of Hydric Soils in the United States (Indicators)" is a tool to help identify and delineate hydric soils in the field. The Indicators are designed to meet the requirements contained in the definition and criteria of hydric soils. The Indicators are used to identify the hydric soil component of wetlands, however, there may be some hydric soils that lack one of the currently listed Indicators. Therefore, these indicators are considered to be dynamic and changes and additions are anticipated. The section *To Comment on the Indicators* provides guidance to recommend changes, deletions, and additions. Any changes, deletions, or additions to the Indicators must be approved by the Interagency Field Indicator Committee. In order to properly use the Indicators, a basic knowledge of soil landscape relationships and soil survey procedures is necessary.

CONCEPT:

Nearly all hydric soils exhibit characteristic morphologies as a result of having undergone repeated periods of saturation for more than just a few days. The combination of this saturation and/or inundation along with microbiological activity in the soil results in a depletion of oxygen. This anaerobiosis promotes biogeochemical processes such as the accumulation and differential decomposition of organic matter and the reduction, translocation, and accumulation of iron and other elements. These processes result in characteristic morphologies which reflect the periodic cycles of saturation and/or inundation, reduction, and oxidation in soil. These morphologies persist in the soil during both wet and dry periods, making them particularly use for identifying hydric soils.

Hydric soil indicators reflect predominately the accumulation or loss of materials composed of iron/manganese, sulfur, and carbon. The presence of hydrogen sulfide gas (rotten egg odor) is a strong indicator of a hydric soil, but the indicator often found in only the wettest of sites. While indicators related to Fe/Mn depletions or concentrations are (the most) common, they cannot form in soils whose parent materials contained low amounts of Fe/Mn initially. Soil formed in such materials may have low chroma colors that are not related to saturation and reduction. For such soils, features related to organic carbon depletions or accumulations should be used. These features are identified in this document, in part to handle soils whose parent materials may have had low amounts of Fe/Mn and where hydrogen sulfide gas is not detected.

CAUTIONS:

There are hydric soils that have soil conditions which are difficult to interpret or seem inconsistent with the landscape, vegetation, or hydrology such as disturbed areas, soils formed in low chroma, red, or low iron content parent material; soils with high pH or low organic matter content; Mollisols and Vertisols; and soils with relict redoximorphic features and areas that have disturbance such as cultivated soils, filled areas.

Morphological features of hydric soils indicate that saturation and anaerobic conditions have existed under either current or former hydrologic regimes. Features that do not reflect current hydrologic conditions of saturation and anaerobiosis are relict features. Artificially drained or protected (such as by levees) hydric soils are hydric if the soil in its undisturbed state would have met the criteria for hydric soils. These soils should also have at least one of the Hydric Soil Field Indicators. Occasionally it is difficult to ascertain whether morphological features being observed are the result of current or former hydrologic regimes unless other hydrologic features can be verified. When soil conditions are inconclusive, other hydrologic features are unobservable, or soil conditions seem inconsistent with the landscape, vegetation, or observable hydrology, it may be necessary to obtain the assistance of an experienced soil scientist and/or wetland scientist.

PROCEDURE:

To document a hydric soil first remove all loose leaf matter, needles, bark, and other easily identified plant parts to expose the surface. Depth of excavation and examination is usually 50 cm (20 inches {in.}), but may be greater if determination of an appropriate Indicator so requires. It is always recommended that soils be excavated and described as deep as necessary to understand the redoximorphic processes. For example, this may be less than 50 cm (20 in.) in soils with surface horizons of organic material or mucky sand. It will often be greater than 50 cm (20 in.) in Mollisols. In many sites it will be necessary to make some exploratory observations to a meter or more to determine the hydromorphic processes and soil morphological distinctions appropriate for the site. These observations should be made with the intent of documenting and understanding the variability in soil properties and hydrologic relationships.

Particular attention should be paid to changes in microtopography and parent materials over short distances. Small changes in elevation may result in sequences of hydric-nonhydric soils. In addition, the shape of the local landform surface 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. After sufficient exploratory observations have been made to understand the soil-hydrologic relationships at the site, subsequent excavations may then be shallower if interpretations of the Indicators identified are appropriate to the site.

Depths used in the Indicators are measured from the mineral surface. Unless otherwise specified, all colors refer to moist Munsell colors. For simplicity, 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 qua meeting an Indicator. For example: a soil ped with a chroma of between 2 and 3 should be listed as havi chroma of 2+. This soil does not have chroma of 2 and would not meet any indicator that requires a chroma of 2 (or less). Compare the soil characteristics in the soil to those recorded in the soil profile description for completeness. Using the completed soil description and comparing the soil features required by each Indicator, specify which Indicators have been matched with the conditions observed in the soil.

TO COMMENT ON THE INDICATORS:

Hydric soils are soils typically found in wetlands. As field data are collected to improve our understanding of hydric soil processes, the list of Indicators will be revised and updated to include indicators for all hydric soils.

If you know an area where the plant community and hydrologic data strongly suggest that an area is a wetland and there is no indicator that identifies that soil condition, please write to one of the persons listed below. To be most helpful, please provide suggestions for modifications you feel are needed and supporting documentation to:

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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 at the back o this document unless otherwise noted.

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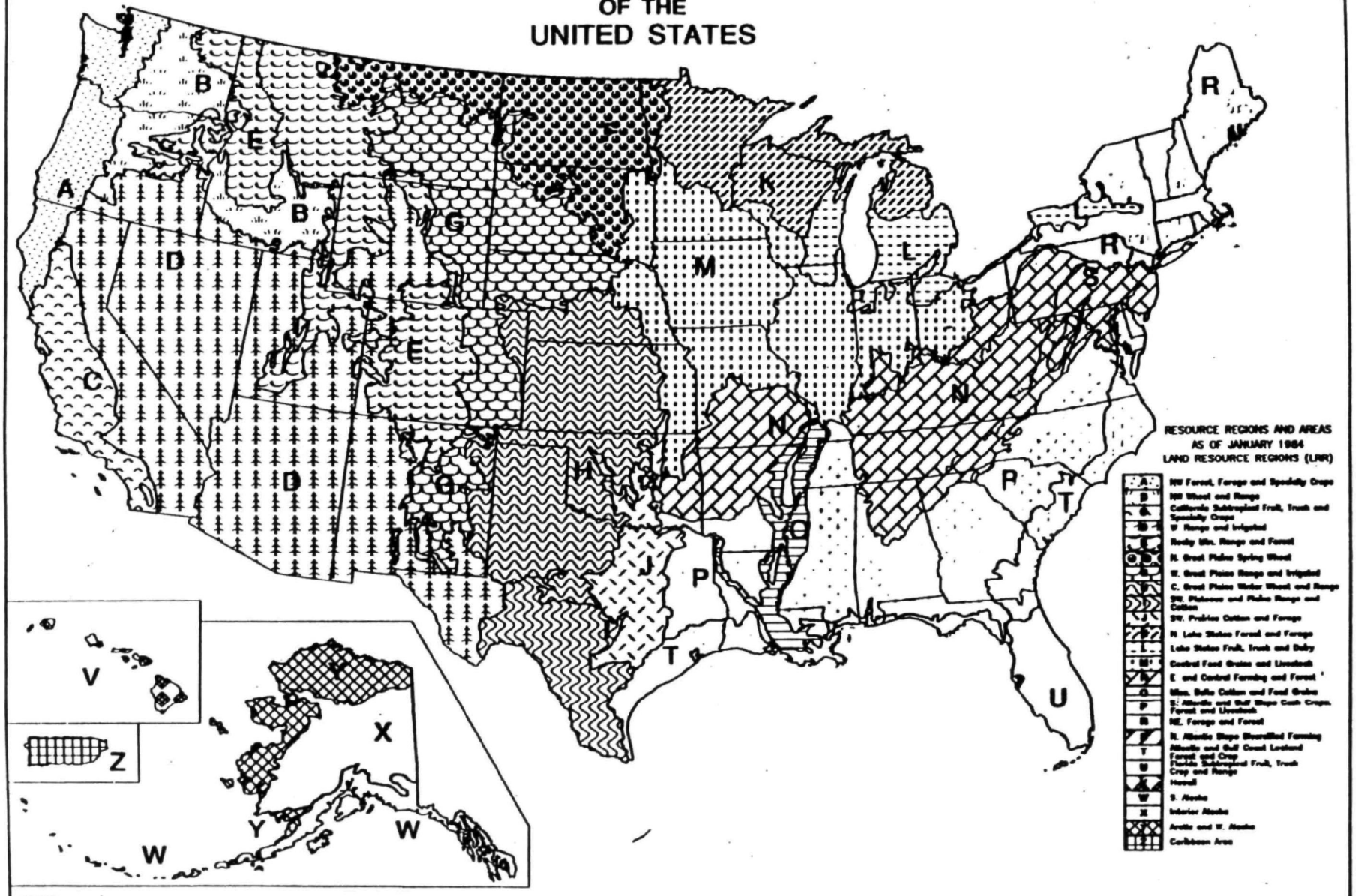
U.S. DEPARTMENT OF AGRICULTURE

NATURAL RESOURCES CONSERVATION SERVICE

LAND RESOURCE REGIONS OF THE UNITED STATES



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FIELD INDICATORS OF HYDRIC SOILS

The following list of Field Indicators of Hydric Soils are structured as follows:

1. Alpha Numeric Listing
2. Short Name
3. Applicable Land Resource Region(s) (LRRs)
4. Description of the Field Indicator
5. User Notes

For example, *A1* indicates the first indicator for all soils; *Histosol* is the short name; the indicator is for use in *all LRRs; Classifies as a Histosol, except Folists* is the indicator description; and user notes are added.

Unless otherwise indicated, all mineral layers above any of the hydric soil indicators have dominant chroma of 2 or less, or the layer(s) with dominant chroma of 3 or more are less than 15 cm (6 in.) thick. In addition, unless otherwise stated, nodules and concretions are not considered to be redox concentrations for the purposes of this document.

ALL SOILS

All soils refer to soils with any USDA soil texture. Use the following hydric soil indicators regardless of texture:

A1. Histosol. ***For use in all LRRs except P, T, and U.*** **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 an organic carbon content (by weight) of 12 to 18 percent, or more, dependent upon the clay content of the soil. These materials include muck (sapric soil material), mucky peat (hemic soil material), or peat (fibric soil material). Use of this indicator requires the presence of aquic conditions or artificial drainage.

A2. Histic Epipedon. ***For use in all LRRs except P, T, U, W, X, and Y.*** **Presence of a Histic epipedon.**

Histic Epipedon User Notes: Most histic epipedons are surface horizons 20 cm (8 in.) or more thick of organic soil material. Aquic conditions or artificial drainage are required. See Keys to Soil Taxonomy, page 3 (Soil Survey Staff, 1994). Slightly lower organic carbon contents are allowed in plowed soils (See Keys to Soil Taxonomy, page 4).

A3. Black Histic. ***For use in all LRRs except P, T, U, W, X, and Y.*** **Presence of a surface layer of peat, mucky peat, or muck 20 cm (8 in.) or more thick having hue 10YR or yellower and value 3 or less and chroma 1 or hue of N.**

Black Histic User Notes: Unlike Indicator A2 (above) use of this indicator does not require proof of aquic conditions or artificial drainage.

A4. Hydrogen Sulfide. ***For use in all LRRs.*** **Presence of hydrogen sulfide odor within 30 cm (12 in.) of the 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 presence or absence of a sulfidic odor is dependent upon current hydrology.

A5. Stratified Layers. ***For use in LRRs O, P, R, T, and U.*** **Presence of stratified layers in the upper 15 cm (6 in.). At least one layer has value 3 or less with chroma 1 or hue of N and/or it is muck, mucky peat, peat, or mucky modified mineral texture. The remaining layers have chroma 2 or less.**

Stratified Layers User Notes: The presence of 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. Use of this indicator may require assistance from a trained scientist with local experience. The minimum organic carbon content of at least one layer of this indicator is slightly less than required for 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. A hand lens is an excellent tool to aid this decision.

A6. Organic Bodies. ***For use in LRRs P, T, and U.*** **Presence of 2% or more organic bodies of muck or a mucky modified mineral texture, approximately 1 to 3 cm (0.5 to 0.75 in.) in diameter within the upper 15 cm (6 in.) of the mineral soil.**

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. Muck or mucky mineral as organic bodies within hemic (mucky peat) and/or fibric (peat) soil materials qualify as this indicator.

A7. 5 cm Mucky Mineral. ***For use in LRRs P, T, and U.*** **Presence of a mucky modified mineral surface layer 5 cm (2 in.) or more thick.**

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 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 glossary for definition of mucky modified mineral texture.

A8. Muck Presence. ***For use in LRRs U and V.*** **Presence of a surface layer of muck with value 3 or less and chroma 1 or hue of N.**

Muck Presence User Notes: 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. To determine if muck is present, first remove loose leaves, needles, bark, and other easily identified plant remains. 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. The presence of a leaf or root mat is not indicative of hydric soils or upland soils; it indicates that the vegetation present produces a large amount of biomass. 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 glossary for definition of muck.

A9. 1 cm Muck. ***For use in LRRs D, F, G, H, P, and T.*** **Presence of a surface layer of muck 1 cm (0.5 in.) or more thick with value 3 or less and chroma 1 or hue of N.**

1 cm Muck User Notes: 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. To determine if muck is present, first remove loose leaves, needles, bark, and other easily identified plant remains. 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. The presence of a leaf or root mat is not indicative of hydric soils or upland soils; it indicates that the vegetation present produces a large amount of biomass. 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 glossary for definition of muck.

A10. 2 cm Muck. ***For use in LRR M.*** **Presence of a surface layer of muck 2 cm (0.75 in.) or more thick with value 3 or less and chroma 1 or hue of N.**

2 cm Muck User Notes: 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. To determine if muck is present, first remove loose leaves, needles, bark, and other easily identified plant remains. 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. The presence of a leaf or root mat is not indicative of hydric soils or upland soils; it indicates that the vegetation present produces a large amount of biomass. 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 glossary for definition of muck.

SANDY SOILS

Sandy soils refer to those soils with a USDA texture of loamy fine sand and coarser. Use the following sandy hydric soil indicators if all layers are sandy to a depth of 25 cm (10 in.):

S1. Sandy Mucky Mineral. ***For use in all LRRs except P, T, U, W, X, and Y.*** **Presence of a mucky modified mineral surface layer 5 cm (2 in.) or more thick.**

Sandy Mucky Mineral User Notes: "Mucky" is a USDA texture modifier for mineral soils. The organic carbon content is at least 5 and ranges as high as 14 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. In sandy soils a quick field test for mucky is: place one unbroken ped of soil between thumb and fingers; rub twice only, if you can neither see or feel sand grains it is likely mucky. See glossary for definition of mucky modified mineral texture.

S2. 3 cm Mucky Peat or Peat. ***For use in LRRs G and H.*** **Presence of a surface layer of mucky peat or peat 3 cm (1 in.) or more thick with value 4 or less and chroma 3 or less.**

3 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. Then, examine for undecomposed to partly decomposed organic soil material. The presence of a leaf or root mat is not indicative of hydric soils or upland soils; it indicates that the vegetation present produces a large amount of biomass. See glossary for definition of mucky peat and peat.

S3. 5 cm Mucky Peat or Peat. ***For use in LRRs F and M.*** **Presence of a surface layer of mucky peat or peat 5 cm (2 in.) or more thick with value 3 or less and chroma of 2 or less.**

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. Then, examine for undecomposed to partly decomposed organic soil material. The presence of a leaf or root mat is not indicative of hydric soils or upland soils; it indicates that the vegetation present produces a large amount of biomass. See glossary for definition of mucky peat and peat.

S4. Sandy Gleyed Matrix. ***For use in all LRRs except W, X, and Y.*** **Presence of a gleyed matrix 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 page (Kollmorgen Instruments Corporation, 1994). They have hue 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5BP; or hue is neutral (N) with value 4 or more. The gleyed matrix only has to be present within 15 cm of the surface. Soils with gleyed matrices are saturated for significant duration; this is why no thickness of the layer is required. See glossary for definition of gleyed matrix.

S5. Sandy Redox . ***For use in all LRRs except V, W, X, and Y.*** **Presence of a layer with an upper boundary 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.**

Sandy Redox User Notes: Distinct and prominent are defined in National Soil Survey Handbook (Soil Survey Staff, 1993a). Redox concentrations include iron and manganese masses (reddish mottles) and pore linings (Vepraskas, 1992). 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 of 3 or less and a chroma of 3 or less; most commonly they are black. Iron/manganese masses should not be confused with the larger and redder iron nodules (Soil Survey Staff, 1993a) associated with plinthitic soils or relic concretions. Common to many redox concentrations (Soil Survey Staff, 1993b) are required.

S6. Stripped Matrix. ***For use in all LRRs except V, W, X, and Y.*** **Presence of a layer within 15 cm (6 in.) of the surface in which iron/manganese oxides and organic matter have been stripped from the matrix exposing the primary base color of soil materials. The translocated oxides and organic matter forms a diffuse splotchy pattern of two or more colors. The stripped zones are 10% or more of the volume, rounded, and 1 to 3 cm (0.5 to 1 in.) in diameter.**

Stripped Matrix User Notes: This indicator includes the indicator previously named "polychromatic matrix" (Florida Soil Survey Staff, 1992) as well as the undefined term "streaking". Common to many (Soil Survey Staff, 1993b) areas of stripped (uncoated) soil materials 1 to 3 cm (0.5 to 1 in.) in size is a requirement. Commonly the splotches of color have value 5 or more and chroma 1 and/or 2 (stripped) and chroma 3 and/or 4 (unstripped). The matrix may lack the 3 and/or 4 chroma material. The mobilization and translocation of the oxides and/or organic matter is the important process and should result in splotchy coated and uncoated soil areas.

S7. Dark Surface. ***For use in LRRs N, P, R, S, T, U, and V.*** **Presence of surface layer 10 cm (4 in.) or more thick with matrix value 3 or less and chroma 1 or less. At least 70% of the visible soil particles must be covered, to represent the matrix color, this is determined on individual soil particles covered 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.**

Dark Surface User Notes: The organic carbon content of this indicator is slightly less than required for "mucky". At least seventy percent of the soil material is covered, coated, or similarly masked with organic matter. An undisturbed sample must be observed. A hand lens is an excellent tool to help aid this decision. Many wet soils have a ratio of about 50 percent soil particles, which are covered or coated with organic matter, and about 50 percent uncoated or uncovered soil particles, giving the soil a salt and pepper appearance. This 50/50 ratio is not a hydric indicator.

S8. Alaska Gleyed. ***For use in LRRs W, X, and Y.*** **Dominant hue of 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5BP; or hue is neutral (N) with value 4 or more in the matrix within 30 cm (12 in.) of the mineral surface, and underlain by hue of 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 page (Kollmorgen Instruments Corporation, 1994). They have hue 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5BP; or hue is neutral (N) with value 4 or more. Color comparison to underlying material must be based on material of the same type or lithology.

S9. Sandy Gray Surface. ***For use in LRRs R and S.*** **Presence of a surface layer with value 3 or less and chroma 1 or less immediately underlain by a 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, which ever is less. At least 70% of the visible soil particles in the surface layer must be covered to represent the matrix color, this is determined on individual soil particles covered, coated, or masked with organic material.**

Thin Dark Surface User Notes: This indicator describes soils with a very dark gray or black surface less than 10 cm (4 in.) thick, where organic matter has been evenly incorporated into the underlying eluvial (E) horizon. The chroma of 1 or less is critical because it limits application of this indicator to only those soils which are depleted of iron. This indicator commonly occurs in hydric Spodosols; however, the identification of a spodic horizon is not required.

S10. Polyvalue Organic Concentrations. ***For use in LRRs R and S.*** **Presence of a surface layer with value 3 or less and chroma 1 or less, underlain by a layer where translocated organic matter unevenly covers the soil material forming a diffuse splotchy pattern. At least 70% of the visible soil particles the surface layer must be covered to represent the matrix color, this is determined on individual soil particles covered, coated, or masked with organic material.. The organic coating occupies 5% or more of the soil volume with value 3 or less and chroma 1 or less, and the remainder of the soil volume has chroma 1 or less.**

Polyvalue Organic Concentrations User Notes: This indicator describes soils with a very dark gray or black surface layer less than 10 cm (4 in.) thick where organic matter has been preferentially carried downward by flowing water into the eluvial (E) horizon. It may also cover the anaerobic decay of roots previously growing in the E horizon. The preferential flow creates a splotchy pattern that is sometimes referred to as "streaking". The indicator keys on vertical striations as well as a coarse diffuse pattern similar to redox concentrations in sands except the whole color sequence is in shades of black and gray without any brown. The chroma of 1 or less is critical because it limits application of this indicator to only those soils which are depleted of iron. Because the chroma is at the lower limit, 1 or less, the splotchy pattern refers only to changes in value. The uneven distribution of organic matter may also be referred to as polyvalue.

LOAMY AND CLAYEY SOILS

Loamy and clayey soils refer to those soils with USDA textures of loamy very fine sand and finer. Use the following loamy and clayey hydric soil indicators if any layer is loamy or clayey within the upper 25 cm (10 in.) of the soil:

F1. Loamy Mucky Mineral. ***For use in all LRRs except P, T, U, V, W, X, and Y.*** **Presence of a mucky modified mineral surface layer 10 cm (4 in.) or more thick.**

Loamy Mucky Mineral User Notes: "Mucky" is a USDA texture modifier for mineral soils (Soil Survey Staff, 1951, 1993a, and 1993b). The organic carbon is at least 8 percent but can range up to 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 7 percent organic carbon but not more than about 14 percent organic carbon. See glossary for definition of mucky modified mineral texture.

F2. Loamy Gleyed Matrix. ***For use in all LRRs except W, X, and Y.*** **Presence of a gleyed matrix which occupies 60% or more of a layer within 30 cm (12 in.) of the 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 (Kollmorgen Instruments Corporation, 1994). They have hue 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5BP; or hue is neutral (N) 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 significant duration, this is why no thickness of the layer is required. See glossary for definition of gleyed matrix.

F3. Depleted Matrix. ***For use in all LRRs except W, X, and Y.*** **Presence of a layer at least 15 cm (6 in.) thick with 60% or more depleted matrix starting within 25 cm (10 in.) of the surface.**

Depleted Matrix User Notes: Redox concentrations include iron and manganese masses (reddish mottles) and/or pore linings. The low chroma matrix must be due to wetness and not a relict or parent material feature. See glossary for definition of depleted matrix.

F4. Depleted Below Dark Surface. ***For use in all LRRs except P, T, U, W, X, and Y.*** **Presence of a layer at least 15 cm (6 in.) thick with 60% or more depleted matrix 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. This indicator is most often associated with soils in depressional landscape positions. For soils with dark colored epipedons greater than 30 cm (12 in.) thick use Indicator F5.

F5. Thick Dark Surface. ***For use in all LRRs except P, T, U, W, X, and Y.*** **Presence of a layer at least 15 cm (6 in.) thick with 60% or more depleted or 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 (in.) and value 3 or less and chroma 1 or hue of N 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 of 3 or less, chroma 1 or hue of N. Below the dark colored epipedon is a depleted matrix or gleyed matrix. This indicator is most often associated with overthickened soils in concave landscape positions.

F6. Redox Dark Surface. ***For use in all LRRs except P, T, U, W, X, and Y.*** **Presence of 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 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. soils which are wet due to a subsurface water table, the layer immediately below the dark epipedon should have a depleted or gleyed matrix. Soils which are wet due to ponding or shallow perched water tables may not always have a depleted/gleyed matrix below the dark surface. It is recommended to evaluate the hydrologic source and to examine and describe the layer below the dark colored epipedon when applying this indicator.

F7. Depleted Dark Surface. ***For use in all LRRs except P, T, U, W, X, and Y.*** **Presence of redox depletions, with value 5 or more and chroma 2 or less or hue of N, 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 hue of N 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 a subsurface water table, the layer immediately below the dark surface should have a depleted or gleyed matrix.

F8. Redox Depressions. ***For use in all LRRs except P, R, T, U, 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 within the upper 15 cm (6 in.).**

Redox Depressions User Notes: Most often soils pond water because of two reasons: they occur in landscape positions that collect water and/or they have a restrictive layer(s) that prevent water from moving downward through the soil. For these landscape positions there is no restriction on matrix value and chroma.

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 within the upper 15 cm (6 in.).**

Vernal Pools User Notes: Most often soils pond water because of two reasons: they occur in landscape positions that collect water and/or they have a restrictive layer(s) that prevent water from moving downward through the soil.

F10. Marl. ***For use in LRR U.*** **A surface texture of marl.**

Marl User Notes: Marl is a limnic material deposited in water by precipitation of algae as defined in Soil Taxonomy (Soil Survey Staff. 1975 and 1994). Marl is not carbonatic substrate material associated with limestone bedrock.

F11. Depleted Ochric. ***For use in LRR O.*** **Presence of 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.).**

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 P and T.*** **On floodplains, a layer 10 cm (4 in.) or more thick with a 40% or more depleted matrix 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 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: Iron/ manganese masses most commonly are near the soil surface and within the upper 15 cm (6 in.) of the soil. They 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. The low chroma must be due to wetness and not a relict or parent material feature. Iron/manganese masses should not be confused with the larger and redder iron nodules (Soil Survey Staff, 1993a) associated with plinthitic soils or with concretions that have abrupt boundaries in the region. This indicator occurs on floodplains of rivers such as the Apalachicola, Congaree, Mobile, and Savannah Rivers.

F13. Umbric Surface. ***For use in LRRs P and T.*** **On concave positions of interstream divides; and in depressions, a surface layer 15 cm (6 in.) or more thick with value of 3 or less and chroma of 1 or hue of N immediately underlain by a layer 10 cm (4 in.) or more thick with chroma of 2 or less.**

Umbric Surface User Notes: Thickness requirements are slightly less that those required by an umbric epipedon. Other requirements are the same. Umbric surfaces on higher landscape positions, such as Umbrepts, are excluded.

F14. Hawaii Gleyed. ***For use in LRR V.*** **Presence of a layer within 30 cm (12 in.) of the surface that has dominate hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB.**

Hawaii Gleyed User Notes: Gley colors are not synonymous with gray colors. Gley colors are those colors that are found on the gley page (Kollmorgen Instruments Corporation, 1994). They have hue 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB; or hue is neutral (N) with value 4 or more.

F15. Alaska Redox Gleyed. ***For use in LRRs W, X, and Y.*** **Presence of a layer that has dominant matrix hue of 5Y with chroma 3 or less, or hues of 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, 5PB, or N with 10% or more redox concentrations as pore linings with value and chroma of 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 is required. Gleyed colors have hue of 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG 5B, 10B 5PB, or N with 10% or more redox concentrations. Pore linings must have value and chroma of 4 or more.

F16. Alaska Depleted Macropores. ***For use in LRRs W, X, and Y.*** **Presence of a layer that has dominant hue of 2.5 Y or redder and chroma 2 or less with 10% redox depletions with hue of 5Y 5GY, 5G, 5BG, 5B, or N with value 4 or more and chroma 1 or less that occur along non-living root channels. The layer occurs within 30 cm (12 in.) of the surface.**

Alaska Depleted Macropores User Notes: Presence of 10 percent redox depletions with low chroma in a low chroma matrix is required.

F17. Alaska Gleyed Pores. ***For use in LRRs W, X, and Y.*** **Presence of 10% hue of 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, 5PB, or N with value 4 or more in the matrix or along non-living root channels within 30 cm (12 in.) of the surface. The matrix has dominant chroma of 2 or less.**

Alaska Gleyed Pores User Notes: Presence of 10 percent gleyed root channels or within the matrix in a low chroma matrix are required.

F18. High Plains Depressions. ***For use in MLRA's 72 and 73 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 that has chroma of 1 or hue of N and:**

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

b. redox concentrations as nodules or concretions with distinct or prominent halos.

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 10 cm (4 in.) layer must be a chroma of 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 halos usually are reddish brown, strong brown, or yellowish brown. The nodules/concretions can be removed from the soil and the 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. Please note that some of the indicators below have been approved for use in certai Major Land Resource Regions (MLRA's) of a certain LRRs. They are listed as Test Indicators due to their limited use extent and because of the urgent need for testing in other areas.

ALL SOILS

TA1. Natric Horizon. *For testing in LRR D.* Presence of a natric horizon within 30 cm (12 in.) of the surface with value 5 or more and chroma 2 or less at least 15 cm (6 in.) thick.

TA2. Playa Rim Stratified Layers. *For testing in LRR D.*. Presence of stratified layers in the upper 15 cm (6 in.). 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 playas of the western United States. Unlike the national Stratified Layer Indicator (A5), 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 vegetated rims adjacent to the non-vegetated playas. A dominant vegetative species is Allenrolfea occidentalis.

TA3. Stratified Layers. *For testing in LRRs F, K, L, M, N, S, and V.* Presence of stratified layers in the upper 15 cm (6 in.). At least one layer has value 3 or less with chroma 1 or hue of N and/or it is muck, mucky peat, peat, or mucky modified mineral texture. The remaining layers have chroma 2 or less.

Stratified Layers User Notes: The presence of stratified mineral and/or organic 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. Use of this indicator may require assistance from a trained soil scientist with local experience. The percent organic carbon in one or more layers is at least 1 percent. The minimum organic carbon content of at least one layer of this indicator is slightly less than required for 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. A hand lens is an excellent tool to aid this decision.

SANDY SOILS

TS1. Iron Staining. *For testing in LRRs W, X, Y.* Presence of continuous zone, 3 cm (1.2 in.)or more thick, of iron staining with value 4 or more and chroma 6 or more within 15 cm (6 in.) of the mineral surface. The zone is immediately below a horizon in which iron/manganese oxides have been removed from the matrix exposing the primary base color of the silt and sand grains.

TS2. ? cm Muck. *For testing in LRRs K, L.* Presence of a surface layer of Muck ? cm thick with value 3 or less and chroma 1 or hue of N.

TS3. Thick Sandy Dark Surface. *For testing in LRR F.* Presence of a layer at least 15 cm (6 in.) thick with 60% or more depleted or 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; 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.

TS4. Dark Surface 2. *For testing in LRR G.* Presence of a surface layer 10 cm (4 in.) or more thick with matrix value 2 or less and chroma 1 or hue of N. At least 70% of the soil materials are covered, coated, or masked with organic matter. The matrix color of the layer immediately below the dark surface must have value 4 or more and chroma 2 or less.

TS5. Thin Dark Surface. *For testing in LRRs K and L.* Presence of a surface layer with value 3 or less and chroma 1 or hue of N immediately underlain by a layer(s) with value 4 or less and chroma 1 or hue of N to a depth of 30 cm (12 in.) or to the spodic horizon, whichever is less. At least 70% of the visible soil particles in the surface layer must be covered to represent the matrix color, this is determined on individual soil particles covered, coated, or masked with organic material.

LOAMY AND CLAYEY SOILS

TF1. ? cm Muck. *For testing in LRRs K, L.* Presence of a surface layer of muck ? cm thick with value of 3 or less and chroma 1 or hue of N.

TF2. ? cm Mucky Peat or Peat. *For testing in LRRs F, G, H, and M* Presence of a surface layer of mucky peat or peat ? cm thick with value 4 or less and chroma 3 or less.

TF3. Red Parent Material. *For testing in LRR's G, H, K, L, R, S.* Presence of a layer at least 10 cm (4 in.) thick with a matrix hue 7.5YR or redder with chroma 3 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 surface.

TF4. Alaska Concretions. *For testing in W, X, Y.* Within 30 cm (12 in.) of the mineral surface, presence of redox concentrations as nodules or concretions greater than 2 mm in diameter that occupy more than approximately 2 percent of the soil volume in a layer 10 cm (4 in.) or more thick with a matrix chroma of 2 or less.

TF5. 2.5Y/5Y Below Dark Surface. *For testing in LRRs F and M.* Presence of 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 surface. The layer(s) above the 2.5Y/5Y layer have value of 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 are indicative of wetness.

TF6. 2.5Y/5Y Below Thick Dark Surface. *For testing in LRRs F and M.* Presence of 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 below 30 cm (12 in.) of the 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 hue of N to a depth of 30 cm (12 in.) and value 3 or less and chroma 1 or hue of N in the remaining of the epipedon.

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 surface. It is overlain by a layer(s) with value 3 or less and chroma 1 or hue of N. 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 of 1.

Calcic Dark Surface User Notes: This indicator is the Soil Taxonomy criteria that separates Aeric Calciaquolls from Typic Calciaquolls, with an additional criteria of black or very dark gray surface layers. In the Midwest, the hydric/nonhydric boundary has generally been accepted as the "line" between Aeric and Typic Calciaquolls. Further documentation is needed to determine if all Typic Calciaquolls are hydric.

TF8. Thick Dark Surface 2/1. *For testing in all LRRs except LRRs O, P, T, AND U.* Presence of a layer at least 15 cm (6 in.) thick with 60% or more depleted or gleyed matrix starting below 30 cm (12 in.) of the surface. The layer(s) above the depleted or gleyed matrix have hue 10YR or yellower, value 2.5 or less and chroma 1 to a depth of 30 cm (12 in.) and value 3 or less and chroma 1 or hue of N 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 of 3 or less, chroma 1. Below the mollic (umbric) epipedon is a depleted matrix or gleyed matrix. This indicator is most often associated with overthickened 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 what landscape positions this indicator "fails". It may be necessary to limit the use of this indicator to concave landscapes.

TF9. Redoxed Spring Seeps. *For testing in LRR D.* Presence of a layer with value 2 or less and chroma 2 or more 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 mineral soil.

Redoxed 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, values 1 and 2 and chroma 2 and 3 are 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 occurs in seeps and flow-through areas adjacent to springs and up-slope end of drainageways as well as depressional seeps surrounded by uplands. A dominant vegetative species is Phragmities australis.

TF10. Depleted Below Dark Surface. *For testing in LRRs W, X, and Y.* Presence of a layer at least 15 cm (6 in.) thick with 60% or more depleted matrix 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 also applies to soils with umbric epipedons. This indicator is most often associated with soils in slightly concave to concave landscape positions. For soils with dark colored epipedons greater than 30 cm (12 in.) thick use Indicator F5.

TF11. Thick Dark Surface. *For testing in LRRs W, X, and Y.* Presence of a layer at least 15 cm (6 in.) thick with 60% or more depleted or 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 hue of N in the remainder of the epipedon.

Thick Dark Surface User Notes: The soil has a black surface layer 30 cm (12 in.) or more thick. The dark colored subsoil has value of 3 or less, chroma 1 or hue of N. Below the dark surface epipedon is a depleted matrix or gleyed matrix. This indicator is most often associated with overthickened soils in concave landscape positions.

F12. Redox Dark Surface. *For testing in LRRs W, X, and Y.* Presence of 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 hue of N 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 hue of N 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 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. In soils which are wet due to a subsurface water table, the layer immediately below the dark colored epipedon should have a depleted or gleyed matrix. Soils which are wet due to ponding or shallow perched water tables may not have a depleted/gleyed matrix below the dark colored surface. It is always best to consider the hydrologic source and to examine and describe the layer below the dark colored epipedon when applying this indicator.

TF13. Depleted Dark Surface. *For testing in LRRs W, X, and Y.* Presence of redox depletions, with value 5 or more and chroma 2 or hue of N, 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 hue of N 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.

TF14. Redox Depressions. *For testing in LRRs R, 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 within the upper 15 cm (6 in.).

Redox Depressions User Notes: Most often soils pond water because of two reasons: they occur in a landscape positions that collect water and they have a restrictive layer(s) that prevent water from moving downward through the soil. For these landscape positions there is no restriction on matrix value and chroma.

TF15. High Plains Depressions. *For use in MLRA's 72 and 73 of LRR H. For testing in other MLRA's 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 that has chroma of 1 or less and:

a. 1% or more distinct or prominent redox concentrations as soft to hard iron/manganese masses, c
b. Distinct or prominent redox concentrations as nodules or concretions with distinct or prominent halos.

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 on soils such as the Ness and Pleasant series. The matrix color of the 10 cm (4 in.) layer must be a chroma of 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 halos usually are reddish brown, strong brown, or yellowish brown. The nodules/concretions can be removed from the soil and the 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.

TF16. Delta Ochric. *For testing in LRR O.* Presence of 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 surface.

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

GLOSSARY

A Horizon - A mineral horizon that formed at the surface or below an O horizon where organic material is accumulating.

Accreting Areas - Landscape position accumulating soil material through deposition from higher elevations or upstream positions as opposed to loss of soil material through erosion.

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

Aquic Conditions - Are conditions in the soil represented by one or more of the following: saturation (endosaturation, episaturation, anthric saturation), degree of reduction, and redoximorphic features.

Calcic Horizon - An illuvial horizon in which secondary calcium carbonates, or other carbonates have accumulated to a significant extent.

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

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

Coated Sand Grains - Sand grains coated, covered, or masked with organic matter, silicate clay, iron, aluminum, or some combination of these.

COE- US Army Corps of Engineers

Concave Landscapes - A landscape whose surface curves downward (depressional landform).

***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% 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% or more distinct or prominent redox concentrations as soft masses and/or pore linings.

Diffuse - Changes in color occur over more than 2 mm.

***Distinct** - Readily seen but contrast only moderately with the color to which they are compared. Distinct mottles commonly have the same hue as the color to which they are compared but differ by 2 to 3 units of chroma or 3 to 4 units of value; or differ to which they are compared by 2.5 units (one card) of hue but by no more than 1 unit of chroma or 2 units of value.

E Horizon - A mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, organic matter, or some combination of these, leaving a concentration of sand and silt particles.

EPA - US Environmental Protection Agency.

Epipedon - A soil horizon that has developed at the soil surface.

Fe/Mn Concretions - Firm to extremely firm irregularly shaped bodies with diffuse boundaries and composed mainly of iron and/or manganese compounds. When broken in half concretions have concentric layers.

Fe/Mn Nodules - Firm to extremely firm irregularly shaped bodies with diffuse boundaries and composed mainly of iron and/or manganese compounds. When broken in half nodules have a uniform internal fabric.

Fibric - See peat.

FWS - United States Department of Interior Fish and Wildlife Service.

Glauconite - A greenish micaceous mineral.

***Gleyed Matrix** - Soils with a gleyed matrix have the following combinations of hue, value, and chroma and the soils are not glauconitic:

1. 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5BP 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.

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.

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 overlying rock or fragmental materials that have interstices filled with organic soil materials.

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.

Hydric Soil - 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 of H_2O gas similar to rotten eggs.

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

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. Lithologic discontinuities are designated in soil profile descriptions by use of an Arabic number preceding the master soil horizon designation (ex. 2C). Soil survey manuscripts published prior to about 1980 use a roman numeral preceding the master horizon designation to indicate lithologic discontinuities (ex. IIC).

LRR - Land Resource Region. LRRs are geographic areas characterized by a particular pattern of soils, climat water resources, and land use. Each LRR has a different letter of the alphabet (A-Z).

Marl - An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under fresh water lacustrine conditions.

Masked - A covering or coating of individual silt and sand grains by organic matter.

Matrix - The dominant soil volume which is continuous in appearance and envelops microsites. 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.

Mollic Epipedon - A mineral surface horizon that is relatively thick, dark colored, humus rich, and has high base saturation of more than 50 percent.

Mollisols - Mineral soils that have a mollic epipedon and base saturation > 50 percent.

***Muck** - A sapric organic soil material with virtually all of the organic material is decomposed not allowing 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 is lower chroma and value than 5/1, 6/2, and 7/3.

Mucky Modified Texture - A USDA soil texture modifier i.e. mucky sand. Mucky modified mineral soils with 0% clay has between 5 and 12 percent organic carbon. Mucky modified mineral soils with 60 percent clay has between 11 and 18 percent organic carbon. Soils with an intermediate amount of clay have an intermediate amount of organic carbon.

Mucky Peat - A hemic organic material with intermediate decomposition between fibric and sapric organic material. Bulk density is normally between 0.1 and 0.2. Mucky peat does not have fiber content (after rubbing) or sodium pyrophosphate solution extract color requirements for either fibric or sapric soil material.

Nodules - See Fe/Mn nodules.

NRCS - Natural Resources Conservation Service formerly Soil Conservation Service.

NTCHS - National Technical Committee for Hydric Soils.

Organic Matter - Material derived from plant remains and other biologic materials.

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 - Reddish brown, iron-enriched bodies that are low in organic matter and are coherent enough to be separated readily from the surrounding soil.

Ponding - Standing water in a closed depression which is removed only by percolation, evaporation, or transpiration.

Pore Linings - Zones of accumulation that may be either coatings on a pore surface or impregnations of the matrix adjacent to the pore.

Prominent - Contrast strongly with the color to which they are compared. Prominent mottles are commonly the most obvious color feature of the section described. Prominent mottles commonly differ from the color to which they are compared by 5 units (two pages) of hue if chroma and value are the same; at least 4 units of value and/or chroma if the hue is the same; or at least 1 unit of chroma or 2 units of value if hue differs by 2.5 units (one card).

Redox Concentrations - Bodies of apparent accumulation of Fe/Mn oxides. Redox concentrations include sof masses, pore linings, nodules, and concretions. For the purposes of the Indicators nodules and concretio are excluded from the concept of redox concentrations unless otherwise specified by specific indicators.

Redox Depletions - Bodies of low chroma (<2) having values of 4 or more where Fe-Mn oxides alone have been apparently removed or where both Fe-Mn oxides and clay have been apparently removed.

Redoximorphic Features - Features formed by the processes of reduction, translocation, and oxidation of Fe and Mn oxides. Formerly called mottles and low chroma colors.

Reduced Matrix - Soil matrices that have low chroma and high value in situ, but whose color changes in hue or chroma when exposed to air.

***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 transformatio of ferric iron (Fe^{+++}) to ferrous iron (Fe^{++}) occurs.

Relict Features - Soil morphological features that do not reflect the current hydrologic conditions of saturation and anaerobiosis.

***Sapric** - See muck.

Saturation - When the soil water pressure is zero or positive. That is when most all the soil pores are filled with water.

Soft Masses - Referring to redox concentrations, soft bodies, frequently within the matrix, whose shape is variable.

SCS - Soil Conservation Service now Natural Resources Conservation Service.

Soil Texture - Is the weight proportion of the separates of mineral soil 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.

Umbric Epipedon - A thick, black mineral surface horizon with base saturation of less than 50 percent.

USDA - United States Department of Agriculture.

Vertisols - A mineral soil with 30 percent or more clay in the soil surface. These soils expand and shrink depending on moisture content.

Wetland - An area that has hydrophytic vegetation, hydric soils, and wetland hydrology.

* 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.

LIST OF FIELD INDICATORS
BY
LAND RESOURCE REGION (LRR)

LRR	Field Indicators
A	A1, A2, A3, A4, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF8.
B	A1, A2, A3, A4, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF8.
C	A1, A2, A3, A4, S1, S4, S5, S6,, F1, F2, F3, F4, F5, F6, F7, F8, F9, TF8.
D	A1, A2, A3, A4, A9, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F9, TA1, TA2, TF8, TF9.
E	A1, A2, A3, A4, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF8.
F	A1, A2, A3, A4, A9, S1, S3, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TA3, TS3, TF2, TF5, TF6, TF7, TF8, TF9.
G	A1, A2, A3, A4, A9, S1, S2, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TS4, TF2, TF3, TF7, TF8.
H	A1, A2, A3, A4, A9, S1, S2, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8., F18, TF2, TF3, TF5, TF8.
I	A1, A2, A3, A4, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF8.
J	A1, A2, A3, A4, S1, S4, S5, S6, S10, F1, F2, F3, F4, F5, F6, F7, F8, TF8.
K	A1, A2, A3, A4, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TA3, TS2, TS5, TF1, TF3, TF8.
L	A1, A2, A3, A4, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TA3, TS2, TS5, TF1, TF3, TF8.
M	A1, A2, A3, A4, A5, A10, S1, S3, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TA3, TF2, TF5 TF6, TF7, TF8.
N	A1, A2, A3, A4, A5, S1, S4, S5, S6, S7, F1, F2, F3, F4, F5, F6, F7, F8, TA3, TF8.
O	A1, A2, A3, A4, A5, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F11, TF16.

LRR	Field Indicators
P	A4, A5, A6, A7, A9, S4, S5, S6, S7, F2, F3, F12, F13,
R	A1, A2, A3, A4, A5, S1, S4, S5, S6, S7, S9, S10, F1, F2, F3, F4, F5, F6, F7, TF3, TF8, TF14.
S	A1, A2, A3, A4, A5, S1, S4, S5, S6, S7, S9, S10, F1, F2, F3, F4, F5, F6, F7, F8, TA3, TF3, TF8.
T	A4, A5, A6, A7, A9, S4, S5, S6, S7, F2, F3, F12, F13.
U	A4, A5, A6, A7, A8, S4, S5, S6, S7, F2, F3, F5, F10.
V	A1, A2, A3, A4, A8, S1, S4, S7, F2, F3, F4, F5, F6, F7, F8, F15, TA3, TF8.
W	A1, A4, S8, F14, F16, F17, TS1, TF4, TF8, TF10, TF11, TF12, TF13, TF14.
X	A1, A4, S8, F14, F16, F17, TS1, TF4, TF8, TF10, TF11, TF12, TF13, TF14.
Y	A1, A4, S8, F14, F16, F17, TS1, TF4, TF8, TF10, TF11, TF12, TF13, TF14.
Z	A1, A2, A3, A4, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF8.

CORRELATION OF 1987 MANUAL AND DRAFT 1995 HYDRIC SOIL INDICATORS

1987 Manual	June 1995 Indicators
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)
	F15 (Alaska Redox Gleyed)
	F14 (Hawaii Gleyed)
	F17 (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 (Alaska Depleted Macro-pores)
	F18, TF15 (High Plains Depressions)
	TA1 (Natric Horizon)
	TF9 (Redox Spring Seeps)
g. Soil appearing on the hydric soils list	----------
h. Iron and Manganese concretions	F12 (Iron/Manganese Masses)
	TF4 (Alaska Concretions)
Not listed in the 1987 Manual	A5, TA3 (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, TF10 (Depleted Below Dark Surface)
	F5, TF11 (Thick Dark Surface)
	F6, TF12 (Redox Dark Surface)
	F7, TF13 (Depleted Dark Surface)
	F10 (Marl)
	F13 (Umbric Surface)
	TF5 (2.5Y/5Y Below Dark Surface)
	TF6 (2.5Y/5Y Below Thick Dark Surface)
	TF7 (Calcic Dark Surface)
	TA2 (Playa Rim Stratified Layers)
	TF1 (? cm Muck)
	TF2 (? cm Mucky Peat or Peat)
	TF3 (Red Parent Material)
	TF11 (Thick Dark Surface)

1987 Manual	June 1995 Indicators
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)
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)
	TF5 (2.5Y/5Y Below Dark Surface)
	TF6 (2.5Y/5Y Below Thick Dark Surface)
	TF7 (Calcic Dark Surface)
	TS2 (? cm Muck)
	TS3 (Thick Sandy Dark Surface)
	TS4 (Dark Surface 2)
h. Streaking of subsurface horizons by organic matter	S6 (Stripped Matrix)
	S10 (Polyvalue Organic Concentrations)
i. Organic pan	S9, TS5 (Thin Dark Surface)
j. Soils appearing on the hydric soils list	---
Not listed in the 1987 Manual	A5, TA3 (Stratified Layers)
	S4 (Sandy Gleyed Matrix)
	S8 (Alaska Gleyed)
	TA1 (Natric Horizon)
	TA2 (Playa Rim Stratified Layers)
	TS1 (Iron Staining)

1987 Manual	June 1995 Indicators
PROBLEM SOILS	
Recently deposited sandy materials	A5, TA3 (Stratified Layers) S6 (Stripped Matrix) S10 (Polyvalue Organic Concentrations) TA2 (Playa Rim Stratified Layers)
Soils with thick dark A horizons	F4, TF10 (Depleted Below Dark Surface) F5, TF11 (Thick Dark Surface) F6, TF12 (Redox Dark Surface) F7, TF13 (Depleted Dark Surface) F13 (Umbric Surface) F18, TF15 (High Plains Depressions) TF5 (2.5Y/5Y Below Dark Surface) TF6 (2.5Y/5Y Below Thick Dark Surface) TF7 (Calcic Dark Surface) TS3 (Thick Sandy Dark Surface) TF8 (Thick Dark Surface 2/1)
Soils with red parent material	F8, TF14 (Redox Depressions) F9 (Vernal Pools) TS1 (Iron Staining) TF3 (Red Parent Material) TF9 (Redox Spring Seeps)

LIST OF FIELD INDICATORS

ALL SOILS

A1 Histosols
A2 Histic Epipedon
A3 Black Histic
A4 Hydrogen Sulfide
A5, TA3 Stratified Layers
A6 Organic Bodies
A7 5 cm Mucky Mineral
A8 Muck Presence
A9 1 cm Muck
A10 2 cm Muck
TA1 Natric Horizon
TA2 Playa Rim Stratified Layers

SANDY SOILS

S1 Sandy Mucky Mineral
S2 3 cm Mucky Peat or Peat
S3 5 cm Mucky Peat or Peat
S4 Sandy Gleyed Matrix
S5 Sandy Redox
S6 Stripped Matrix
S7 Dark Surface
S8 Alaska Gleyed
S9, TS5 Thin Dark Surface
S10 Polyvalue Organic Concentrations
TS1 Iron Staining
TS2 ? cm Muck
TS3 Thick Sandy Dark Surface
TS4 Dark Surface 2

LOAMY AND CLAYEY SOILS

F1 Loamy Mucky Mineral
F2 Loamy Gleyed Matrix
F3 Depleted Matrix
F4, TF10 Depleted Below Dark Surface
F5, TF11 Thick Dark Surface
F6, TF12 Redox Dark Surface
F7, TF13 Depleted Dark Surface
F8, TF14 Redox Depressions
F9 Vernal Pools
F10 Marl
F11 Depleted Ochric
F12 Iron/Manganese Masses
F13 Umbric Surface
F14 Hawaii Gleyed
F15 Alaska Redox Gleyed
F16 Alaska Depleted Macropores
F17 Alaska Gleyed Pores
F18 TF15 High Plains Depressions
TF1 ? cm Muck
TF2 ? cm Mucky Peat or Peat
TF3 Red Parent Material
TF4 Alaska Concretions
TF5 2.5Y/5Y Below Dark Surface
TF6 2.5Y/5Y Below Thick Dark Surface
TF7 Calcic Dark Surface
TF8 Thick Dark Surface 2/1
TF9 Redoxed Spring Seeps
TF16 Delta Ochric