The Buzzards Bay National Estuary Program

Pocket Guide to Hydric Soils for Wetland Delineations in Massachusetts

Version 4.1

The Buzzards Bay National Estuary Program
June, 2019

This document is a compilation of material taken from Delineating Bordering Vegetated Wetlands under the Wetlands Protection Act, published by the Massachusetts Department of Environmental Protection, Division of Wetlands, and Waterways and the Field Indicators for Identifying Hydric Soils in New England, Version 4, April 2019.

Field Indicators for Identifying Hydric Soils in New England, Version 4, April 2019, has superseded Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0), Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineation Hydric Soils, Version 8.2, and Field Indicators for Identifying Hydric Soils in New England, Version 3 for use in wetland delineations in New England.

The Buzzards Bay National Estuary Program recommends the practitioner to download and read Field Indicators for Identifying Hydric Soils in New England, Version 4, April, 2019.

This document is meant to be a companion to "The Buzzards Bay National Estuary Program Pocket Guide to Delineating Wetlands," available at the Buzzards Bay National Estuary Program website, www.buzzardsbay.org.

This update includes the "Errata for Companion Guide to Field Indicators for Identifying Hydric Soils in New England: TA-6 to A-17" (November 2018) and the revisions reflected in Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineation Hydric Soils, Version 8.2 (2018)

Special thanks to Peter Fletcher for tips regarding the arrangement of the initial version of the booklet.

Version 4.1 is an update of the previous version to reflect changes to the Field Indicators for Identifying Hydric Soils in New England, Version 4, April 2019. This update was done by John Rockwell, M.S., who edited previous versions.

Previous versions of this document should be discarded.

Unless otherwise noted, photos are from the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0).

Cover photo: Soil samples from Carver. Wettest from right to left. These are disturbed, sandy spodosols (evergreen forest soils). Notice the redoximorphic features in all samples. Photo credit: John Rockwell.

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Preface

Introduction

Since 1995, the use of Hydric Soils has been an important part of the delineation process in wetland delineation pursuant to the M.G.L. Chapter 131, section 40, the Massachusetts Wetlands Protection Act.

Hydric Soils are considered a confirmation of wetland hydrology as called for in the regulatory definition of a bordering vegetated wetland, found in 310 CMR 10.55 (2)(c)., and should be part of every wetland delineation.

In disturbed sites, the presence of hydric soils is sufficient to determine that "there are indicators of saturated or inundated conditions sufficient to support a predominance of wetland indicator plants."

For areas that have been recently drained, DEP has determined that "hydric soils are often the best indicators for delineating recently drained wetlands."

Areas where vegetation has been altered or removed - such as golf courses, lawns, and agricultural fields - require the use of soils and other indicators of hydrology to delineate BVW boundaries. In some cases, such as where vegetation has been cut or removed (e.g. ongoing forestry activity), remnant vegetation should be considered, but other indicators of hydrology also should be used to establish the BVW boundary.

Areas where fill has been placed in wetlands require the analysis of soils directly beneath the fill. **[**See "Appendix 2. Guidelines for Identifying Human Altered Hydric Soils" in Field Indicators for Identifying Hydric Soils in New England, Version 4, April 2019. for a discussion of hydric soil determinations in these circumstances.]

The DEP Wetland Delineation Manual, Delineating Bordering Vegetated Wetlands under the Wetlands Protection Act, published by the Massachusetts Department of Environmental Protection, Division of Wetlands and Waterways, created a regulatory framework for assessing soils.

Page 29 of the DEP Manual lists "some hydric soil indicators." On pages 30 and 31 of the Manual, DEP lists six soil types that are hard to analyze. In addition, the first paragraph on page 30, DEP states, "In particularly difficult cases, consultation with the Natural Resources Conservation Service is recommended." NRCS uses the latest federal hydric soil list. In Massachusetts, a list of these soils can be found in the Field Indicators for Identifying Hydric

Soils in New England, Version 4, April 2019.

Delineations by their nature take place at the transition from hydric to non-hydric soils. So it should not be considered unusual for the delineator to encounter problem areas.

Organization of Booklet

Soils are listed first by descriptive name, then by the source, and finally the indicator (the DEP listed soils have no indicator numbers). Sources used in this booklet are:

DEP: Delineating Bordering Vegetated Wetlands under the Wetlands Protection Act,
and
HSNE: Field Indicators for Identifying Hydric Soils in New England, Version 4, April 2019..

Notes Regarding the Use of the ACOE Indicators from the Regional Supplement

Many of the ACOE hydric soil indicators were developed specifically for wetland delineation purposes. During the development of these indicators, soils in the interior of wetlands were not always examined; therefore, there are wetlands that lack any of the approved hydric soil indicators in the wettest interior portions.

Wetland delineators and other users of the these hydric soil indicators should concentrate their sampling efforts near the wetland edge and, if these soils are hydric, assume that soils in the wetter, interior portions of the wetland are also hydric, even if they lack an indicator.

ACOE hydric soil indicators are presented in three groups. Indicators for “All Soils” are used in any soil regardless of texture. Indicators for “Sandy Soils” are used in soil layers with USDA textures of loamy fine sand or coarser. Indicators for “Loamy and Clayey Soils” are used with soil layers of loamy very fine sand and finer.

Both sandy and loamy/clayey layers may be present in the same soil profile. Therefore, a soil that contains a loamy surface layer over sand is hydric if it meets all of the requirements of matrix color, amount and contrast of redox concentrations, depth, and thickness for a specific A (All Soils), F (Loamy and Clayey Soils), or S (Sandy Soils) indicator.

It is permissible to combine certain ACOE hydric soil indicators if all requirements of the individual indicators are met except thickness.

“All soils” refers to soils with any USDA soil texture. All mineral layers above any of the layers meeting the requirements of any A indicator(s), except for indicator A16, have a dominant chroma of 2 or less, or the thickness of the layer(s) with a dominant chroma of more than 2 is less than 6 in. In addition, nodules and concretions are not considered to be redox concentrations. Use the “A” indicators regardless of soil texture.

“Sandy soils” refers to soil materials with a USDA soil texture of loamy fine sand and coarser. Use the “S” indicators in soil layers consisting of sandy soil materials. It is permissible to combine indicators for soils that have both loamy and sandy textures in the upper part if it meets all the requirements of matrix color, amount and contrast of redox concentrations, depth, and thickness for any single indicator or combination of indicators. Refer to Appendix 6 for an example of combining indicators based on texture.

All mineral layers above any of the layers meeting an S indicator, except for indicator S6, must have a dominant chroma of 2 or less, or the layer(s) with a dominant chroma of more than 2 must be less than 6 in thick to meet any hydric soil indicator. Nodules and concretions are not considered to be redox concentrations unless otherwise noted.

“Loamy and clayey soils” refers to soil materials with USDA textures of loamy very fine sand and finer. Use the “F” indicators in soil layers consisting of loamy or clayey soil materials. All mineral layers above any of the layers meeting an F indicator, except for indicator F8 must have a dominant chroma of 2 or less, or the layer(s) with a dominant chroma of more than 2 must be less than 6 in thick to meet any hydric soil indicator. Nodules and concretions are not considered to be redox concentrations unless otherwise noted.

All mineral layers above any of the layers meeting an A, S, or F indicator must have a dominant chroma of 2 or less, or the layer(s) with a dominant chroma of more than 2 must be less than 6 in. thick, except for indicators S6, F8, F12, and F21 to meet any hydric soil indicator. Nodules and concretions are not considered to be redox concentrations unless otherwise noted.

Final Notes

Some of these soil morphologies should not be considered conclusive evidence of saturated or inundated conditions without an independent confirmation of hydrology. There soils are so noted in the BBNEP Notes.

A list of wetland hydrology indicators can be found in the Postscript on page 60.

For basic information on the use of soils in wetland delineation see "The Buzzards Bay National Estuary Program Pocket Guide to Delineating Wetlands."

Histosol (1) DEP

Histosols are soils with at least 16 inches of organic material measured from the soil surface.

Photo Credit: Jim Turenne

BBNEP note: This soil is not typically found at the BVW edge.

Histosol (2) ACOE A1

In most Histosols, 16 in. or more of the upper 32 in. is organic soil material. Histosols also include soils that have organic soil material of any thickness over rock or fragmental soil material that has interstices filled with organic soil material. Organic soil material has an organic carbon content (by weight) of 12 to 18 percent or more, depending on the clay content of the soil. The material includes muck (sapric soil material), mucky peat (hemic soil material), or peat (fibric soil material).

This Histosol consists of only a few inches of organic soil material over bedrock in a shallow glacial groove.

BBNEP Note: Indicator ACOE A1 differs from the DEP Histosol. To meet the ACOE A1 criteria, Histosols may be thinner, than the 16 inches called for in the DEP definition, over bedrock areas.

Histic Epipedon, DEP

These are soils with 8 to 16 inches of organic material measured from the soil surface.

Photo Credit: Field Indicators of Hydric Soils in the United States v. 6

ACOE A2 – Histic Epipedon, and ACOE A3 – Black Histic meet this DEP criteria.

BBNEP note: This soil is not typically found at the BVW edge

Sulfidic Material, DEP

A strong "rotten egg" smell generally is noticed immediately after the soil test hole is dug.

Photo credit: Slide from NRCS, Wetland Science Institute, Power Point Presentation "Field Indicators of Hydric Soils"

BBNEP note: This soil is associated with salt marshes and is not typically found at the BVW edge. The upper edge of salt marsh, as defined in 310 M 10.32(2), is the high tide line. ACOE A4 is included in this criteria.

Gleyed Matrix, DEP

Soils that are predominantly neutral gray, or occasionally greenish or bluish gray in color within 12 inches from the bottom of the O-horizon. (The Munsell Soil Color Charts have special pages for gleyed soils.) [Also applies to ACOE F2]

This soil has a gleyed matrix in the lowest layer, starting about 7 in. from the soil surface. The layer above the gleyed matrix has a depleted matrix. Photo Credit: Field Indicators of Hydric Soils in the United States v. 6

BBNEP note: This soil is not typically found at the BVW edge

Technical Description: A gleyed matrix that occupies 60 percent or more of a layer starting at a depth less than or equal to 6 in from the soil surface.

User Notes: Gley colors are not synonymous with gray colors. They are the colors on the gley color pages in the Munsell color book (X-Rite, 2009) that have hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB and value of 4 or more. For this indicator, the gleyed matrix only has to be present at a depth less than or equal to 6 in from 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. This indicator is most frequently found in tidal marshes and is not generally found at the boundaries between wetlands and non-wetlands.

Indicator S4 (Sandy Gleyed Matrix). The gleyed matrix begins at the surface of the soil.

BBNEP note: This soil is associated with salt marshes and is not typically found at the BVW edge. The upper edge of salt marsh, as defined in 310 M 10.32(2), is the high tide line.

The gleyed matrix only has to be present at a depth less than or equal to 12 in from 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. Soils that meet this indicator are typically inundated or saturated nearly all of the growing season in most years and are not usually found at the boundaries between wetlands and non-wetlands.

For hydric soil determinations, a gleyed matrix has the hues and chroma identified in this illustration with a value of 4 or more. [Due to inaccurate color reproduction, do not use this page to determine soil colors in the field.]

Depleted Matrix (1), DEP

Soils with a matrix chroma of 0 or 1 and values of 4 or higher within 12 inches from the bottom of the 0-horizon

Oa, 7.5YR 2/0, muck.

A, 10YR 2/1, mucky silt loam

2Cg, 2.5Y 6/1, silt loam

Typical profile of a Birdsall mucky silt loam soil. Birdsall soils are very poorly drained soils formed in water-laid deposits of silt and very fine sand.

Photo Credit: Peter Fletcher

Depleted Matrix (2), DEP

Within 12 inches from the bottom of the 0-horizon, soils with a chroma of 2 or less and values of 4 or higher in the matrix, and mottles with a chroma of 3 or higher.

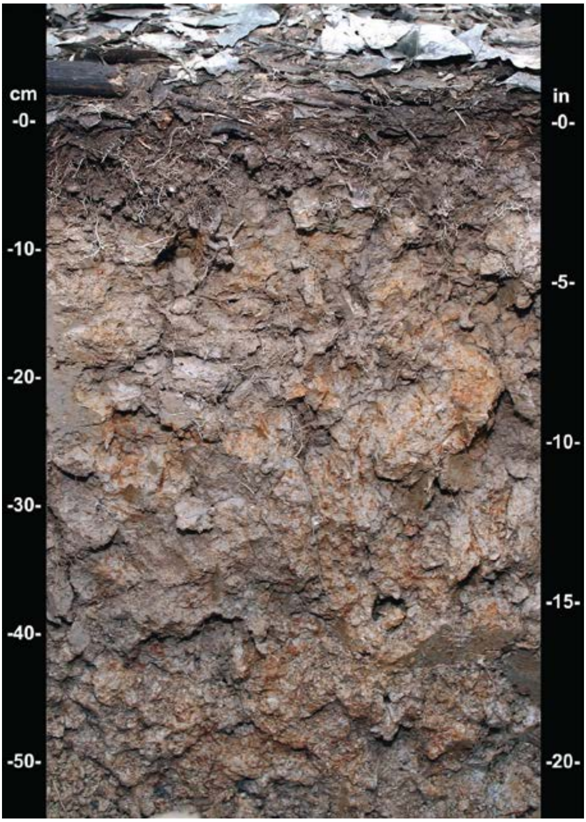
Photo from: NRCS, Wetland Science Institute, Power Point Presentation "Field Indicators of Hydric Soils."

Depleted Matrix (3) ACOE F3

Technical Description: 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. 2 inches, if the 2 inches starts at a depth ≤4 inches from the soil surface, or
b. 6 inches, starting at a depth ≤10 inches from the soil surface.

User Notes: A depleted matrix requires a value of 4 or more and chroma of 2 or less. Redox concentrations, including iron-manganese masses and/or pore linings, are required in soils with matrix colors of 4/1, 4/2, or 5/2. Concentrations are not required if the color is 5/1 or those with values of 6. A and E 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 weathering, parent material, or relict feature. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redoximorphic features to become visible. This is one of the most commonly observed hydric soil indicators at wetland boundaries.



Indicator F3 (Depleted Matrix). This soil has value of 4 or more and chroma of 2 or less and redox concentrations starting at a depth of 4 inches. Since the depleted matrix starts at a depth of ≤6 inches from the soil surface, the minimum thickness requirement is only 2 inches.

BBNEP Note: This depleted criteria differs from DEP Depleted Matrix as values/chromas of 6/2, 7/2, and 8/2 do not requires redox features.

(Photo from Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineation Hydric Soils, Version 8.2)

Illustration of values and chromas that require 2 percent or more distinct or prominent redox concentrations and those that do not, for hue 10YR, to meet the definition of a ACOE depleted matrix. Due to inaccurate color reproduction, do not use this page to determine soil colors in the field. Background image from the Munsell Soil Color Charts reprinted courtesy of Munsell Color Services Lab, a part of X-Rite, Inc. (Gretag/Macbeth 2000).

Depleted Below Dark Surface, ACOE A11

Technical Description: A layer with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less, starting at a depth $\leq$12 in. from the soil surface, and having a minimum thickness of either:

- 6 in. or
- 2 in. if the 2 in. consists of fragmental soil material.

Organic, loamy, or clayey layer(s) above the depleted or gleyed matrix must have value of 3 or less and chroma of 2 or less starting at a depth less than 6 in from the soil surface and extend to the depleted or gleyed matrix. Any sandy material above the depleted or gleyed matrix must have value of 3 or less and chroma of 1 or less starting at a depth less than or equal to 6 in from the soil surface and extend to the depleted or gleyed matrix. Viewed through a 10x or 15x hand lens, at least 70 percent of the visible sand particles must be masked with organic material. Observed without a hand lens, the sand particles appear to be close to 100 percent masked.

User Notes: This indicator often applies to soils with mollic, umbric, or dark colored ochric epipedons. For soils with dark colored epipedons more than 12 in thick, use ACOE indicator A12. A depleted matrix requires value of 4 or more and chroma of 2 or less.

n this soil, a depleted matrix starts immediately below the black surface layer at approximately 11 in. (28 cm).

Two percent or more distinct or prominent redox concentrations, including iron/manganese soft masses, pore linings, or both, are required in soils that have matrix values/chromas of 4/1, 4/2, and 5/2 (see figure below). [If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible.] A and E 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 masses or pore linings. In some places, the gleyed matrix may change color upon exposure to air (reduced matrix). This phenomenon is included in the concept of a gleyed matrix. This indicator is often found in soils subject to ponding. In New England, A11 is a common indicator.

Illustration of values and chromas that require 2 percent or more distinct or prominent redox concentrations and those that do not, for hue 10YR, to meet the definition of a depleted matrix. Due to inaccurate color reproduction, do not use this page to determine soil colors in the field.

BBNEP Note: This depleted criteria differs from DEP Depleted Matrix as values/chromas of 6/2, 7/2, and 8/2 do not requires redox features. For soils that have dark surface layers greater than 12 in. thick, use the A-Horizons that are Thick and Very Dark section of this booklet starting on page 36 of this booklet.

Depleted Matrix (4) Sandy Redox (ACOE S5)

Technical Description: A layer starting at a depth less than or equal to 6 in from the soil surface that is at least 4 in 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: Redox concentrations include iron and manganese masses and pore linings. At least 2% (common or many) redox concentrations are required. Included within the concept of redox concentrations are iron-manganese bodies occurring as soft masses with diffuse boundaries. If the soil is saturated, it may be necessary to let it dry to a moist condition for redoximorphic features to become visible. This is a very common indicator of hydric soils and is often used to identify the hydric/non-hydric soil boundary in sandy soils

Indicator S5 (Sandy Redox). This soil meets the requirements of indicator S5, having a matrix chroma of 2 or less and at least 2 percent redox concentrations starting at a depth of about 4 inches.

Redox Depletions (1), DEP

Within 12 inches from the bottom of the 0-horizon, soils with a matrix chroma of 3 and values of 4 or higher, with 10 percent or more low-chroma mottles, as well as indicators of saturation (i.e., mottles, oxidized rhizospheres, concretions, nodules) within 6 inches of the soil surface.

Photo from: “Redoximorphic Features” presentation developed by Michael Whited, NRCS - Wetland Science Inst. August, 2000.

Redox Depletions(2)
Depleted Dark Surface, ACOE F7

Technical Description: Redox depletions with a value of 5 or more and chroma of 2 or less in a layer that is at least 4 in thick, starting at a depth less than or equal to 8 in from the mineral soil surface, and has:

- matrix value of 3 or less and chroma of 1 or less and 10 percent or more redox depletions, or
- 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 the mixing of an E horizon into the surface layer as depletions. Knowledge of local conditions is required in areas where E 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. Depletions should have associated concentrations that occur as pore linings or masses within or surrounding the depletions.

Redox depletions (lighter colored areas) are scattered within the darker matrix. Scale is in centimeters.

Coast Prairie Redox (ACOE A16)

Applicable Subregions: not for use in the Cape Cod Subregion (MLRA 149B of LRR S).

Technical Description: A layer starting at a depth less than or equal to 6 in from the soil surface that is at least 4 in 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 soils occur mainly in depressions on the landscape. Concentrations occur mainly as iron-dominated pore linings. Common or many concentrations are required. Chroma 3 matrix colors are allowed because they may be the color of stripped sand grains or because few or common sand-sized reddish course fragments occur and may prevent obtaining chroma of 2 or less.

BBNEP Note: Look for a second confirmation of wetland hydrology, as listed on the DEP Form, when using this indicator. Additional indicators of hydrology are found in the Postscript to this booklet.

Sandy Soils, DEP

"Sandy soils" refers to soil materials with a USDA soil texture of loamy fine sand and coarser.

Soil colors often are not distinctive in most sandy soils. Instead, look for these indicators of hydric sandy soils:

a) high organic content in the surface layer (typically darker colors with values less than 3 and chroma of 2 or less) with mottles or other indicators of saturation directly below;

b) organic streaking (now referred to as stripping) directly below the A-horizon; or

c) matrix chroma of 3 (from the Munsell Soil Color Charts) in the top 12 inches of soil measured from the bottom of the 0-horizon, with distinct or prominent mottling.

Photo credit: Southeast Soil & Water Service, http://www.hydricsoils.com

Note: Indicators of hydric soils may be lacking altogether in the soil of newly formed sand bars and interdunal depressions. See also Three Chroma Sands, NE-S1, on page 24.

Sandy Soils: Sandy Mucky Mineral, ACOE S1

Technical Description: A layer of mucky modified sandy soil material 2 in. or more thick starting at a depth less than or equal to 6 in. from the soil surface (see figure below).

User Notes: Mucky" is a USDA texture modifier for mineral soils. These soil materials have significant organic carbon, but not enough to meet the requirement of organic soil materials. The organic carbon content by weight is at least 5% and ranges up to 14% for sandy soils. The percentage requirement is dependent upon the clay content of the soil. Users should consult the Field Indicators for Identifying Hydric Soils in New England, Version 4, April 2019 glossary and Appendix D for the definition of mucky modified mineral texture.

In New England, this indicator is not common but may be found in localized areas. User should consult Appendix D for field tests for determining the kinds of organic soil materials.

The mucky modified sandy layer is approximately 3 in. thick. Scale in inches on the right side of ruler.

Sandy Soils: Stripped Matrix, ACOE S6

Technical Description: A layer starting at a depth less than or equal to 6 in from 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 faintly contrasting pattern of two or more colors with diffuse boundaries. The stripped zones are 10 percent or more of the volume and are rounded.

User Notes: This indicator includes the indicator previously named polychromatic matrix as well as the term organic streaking. Common or many areas of stripped (unmasked) soil materials are required. The stripped areas are typically 0.5 to 1 in in size, but may be larger or smaller. Commonly, the stripped areas have a value of 5 or more and chroma of 2 or less, with unstripped areas having a chroma of 3 or 4. The matrix color does not necessarily have to have a chroma of 3 or 4. The translocation of oxides and/or organic matter is the likely process resulting in a splotchy pattern of masked and unmasked soil areas. This may be a difficult pattern to recognize in the typical vertical exposure of the soil and may be more evident when a horizontal slice is observed.

In New England, proper application of this indicator requires a determination that the features observed in the horizon with the stripped matrix (typically an E horizon) are indicative of wetness. Very commonly, immediately underlying the horizon with the stripped matrix is a thick dark spodic horizon which may be cemented. Users should be aware that this indicator may lead to false positive interpretations that a soil is hydric. Careful analysis of the topography, evidence of wetness, presence of hydrophytic vegetation, and morphological adaptations should be considered when applying this indicator.

Indicator S6 (Stripped Matrix). This indicator requires diffuse splotchy patterns with rounded areas stripped of organic matter or iron, as exemplified in this photo.

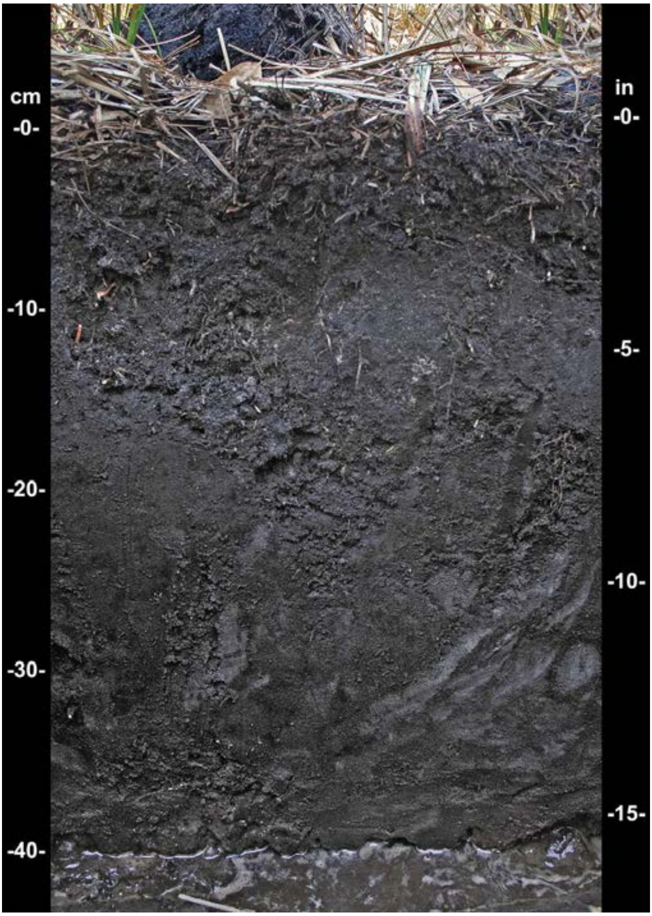
(Photo from Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineation Hydric Soils, Version 8.2)

Sandy Soils: Dark Surface, ACOE S7

Technical Description: A layer 4 in thick starting at a depth less than or equal to 6 in from the soil surface with a matrix value of 3 or less and chroma of 1 or less. When viewed with a 10x or 15x hand lens, at least 70 percent of the visible soil particles must be masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked. The matrix color of the layer immediately below the dark layer must have the same colors as those described above or any color that has a chroma of 2 or less.

User Notes: An undisturbed sample must be observed. Many wet soils have a ratio of about 50 percent soil particles that are masked with organic matter and about 50 percent unmasked soil particles, giving the soils a salt-and-pepper appearance. Where the coverage is less than 70 percent, the Dark Surface indicator does not occur.

If the dark layer is greater than 4 in thick, then the indicator is met, because any dark soil material in excess of 4 in meets the requirement that the layer immediately below the dark layer must have the same colors as those described above. If the dark layer is exactly 4 in thick, then the material immediately below must have a matrix chroma of 2 or less. Horizons meeting the dark surface criteria are rich in soil organic carbon.



Indicator S7 (Dark Surface). This soil has value of 3 or less and chroma of 1 or less from the surface to a depth of 10 cm. Directly below 10 cm, it is the same color, meeting the requirement of having chroma of 2 or less.

(Photo from Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineation Hydric Soils, Version 8.2)

Sandy Soils: Thin Dark Surface, ACOE S9

Technical Description: A layer 2 in. or more thick starting within the upper 6 in of the soil, with a value of 3 or less and chroma of 1 or less. When viewed with a 10- or 15-power hand lens, at least 70 percent of the visible soil particles in this layer must be masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked. This layer is underlain by a layer(s) with a value of 4 or less and chroma of 1 or less to a depth of 12 in. (30 cm) 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 2 in. thick and is underlain by a layer in which organic matter has been carried downward by flowing water (see figure below). 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. See Appendix C for field criteria to identify a spodic horizon.

Example of Indicator S9 (Thin Dark Surface). Scale in inches on right.

Three Chroma Sands, NE-S1

Technical Description: A layer 4 in or more thick with value 3 or less and chroma 1 or less that is directly underlain by a layer that begins at a depth less than or equal to 12 in from the soil surface that has a matrix value 4 or more, chroma 3 or less with 2% or more redox features that are distinct or prominent**.**

User Notes: This indicator is of limited extent in New England and should only be considered if there is strong evidence of wetland hydrology and a plant community dominated by wetland plants (hydrophytic vegetation). This indicator may lead to false positive interpretations that a soil is hydric when it is not. Careful analysis of the topography, evidence of wetness, presence of hydrophytic vegetation and morphological adaptations should be considered when applying this indicator.

BBNEP Note: Look for a second confirmation of wetland hydrology, as listed on the DEP Form, when using this indicator. Additional indicators of hydrology are found in the Postscript to this booklet.

Sandy Soils: 5 cm Mucky Peat or Peat, ACOE S3

Technical Description: A layer of mucky peat or peat 5 cm (2 in) or more thick with a value of 3 or less and chroma of 2 or less, starting at a depth less than or equal to 15 cm (6 in) from the soil surface, and underlain by sandy soil material.

User Notes: In New England, this indicator is of limited application because of the possibility of false positive interpretations and should only be considered if there is strong evidence of wetland hydrology and a hydrophytic vegetation.

Mucky peat (hemic soil material) and peat (fibric soil material) have a minimum organic carbon content of 12 to 18 percent, depending on the clay content of the materials. Users should consult Appendix 1 of Field Indicators for Identifying Hydric Soils in New England, Version 4, April 2019 for a complete criteria. Fibric soil materials show minimal evidence of decomposition and are defined as having >40% rubbed fiber contents. Hemic soil materials show an intermediate stage of decomposition and are defined as having between 17 and 40% rubbed fiber content (Soil Survey Staff, 2014). Users should consult Appendix D for the field test for determining the kind of organic soil materials and Stolt and Bakken (2012) for discussion on organic soil materials.

BBNEP Note: Look for a second confirmation of wetland hydrology, as listed on the DEP Form, when using this indicator. Additional indicators of hydrology are found in the Postscript to this booklet.

Soils with Evidence of Spodic Development
Evergreen Forest Soils, DEP

Sandy soils on Cape Cod and other areas may possess gray colored E-horizons just beneath the surface. These colors are not necessarily the result of saturation or inundation, but form as a result of the leaching of organic material and aluminum and iron oxides by organic acids. These soils are called **spodosols** and the gray layer that forms below the surface is known as the E-horizon. Organic material and aluminum and iron oxides are deposited in a layer below the E-horizon called the spodic horizon.

Hydric indicators in spodosols include a combination of two or more of the following features, with one occurring within the upper 12 inches of the soil surface and others documented below the soil surface:

a) a thick, black, sandy surface layer;

b) organic streaking (now referred to as stripping) in the E-horizon;

c) mottles within the E-horizon;

d) oxidized rhizospheres within the A or E-horizon;

e) iron concretions/nodules within the E-horizon or spodic horizon;

f) a partially or wholly cemented spodic horizon usually within 18 inches of the surface measured from the bottom of the 0-horizon; and mottling within the spodic horizon.

Non-hydric spodosols can be recognized by brightly colored soil material below the E-horizon and without mottles or other indicators of saturation.

Attendees of the MACC/BBNEP 2009 Advanced session check colors for a partially cemented spodic horizon. Photo Credit: John Rockwell.

BBNEP Note: These soils can be found throughout the Buzzards Bay watershed. They can be found in loams, but more often occurring in sandy soils. See Appendix C for information on spodosol field identification and the excerpt of Appenix 5. Identifying Spodic Hydric Soils from Field Indicators for Identifying Hydric Soils in New England, 4th ed.

These soils are quite varied but were all found within 100 feet of each other at Washburn Park in Marion, Massachusetts. The three on the right are samples from a disturbed site. The left sample is a wet spodosol. Photo Credit: John Rockwell.

Soils with Evidence of Spodic Development
Sandy Soils: Stripped Matrix, ACOE S6

Technical Description: A layer starting within 6 in. 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 faintly contrasting pattern of two or more colors with diffuse boundaries. The stripped zones are 10 percent or more of the volume and are rounded.

User Notes: This indicator includes the indicator previously named "polychromatic matrix" as well as the term "streaking." Common or many areas of stripped (unmasked) soil materials are required. The stripped areas are typically 0.5 to 1 inch in size but may be larger or smaller. Commonly, the stripped areas have value of 5 or more and chroma of 2 or less, and the unstripped areas have chroma of 3 and/or 4. The matrix (predominant color) may not have the material with chroma of 3 and/or 4. The mobilization and translocation of oxides and/or organic matter is the important process and should result in a splotchy pattern of masked and unmasked soil areas. This may be a difficult pattern to recognize and is more evident when a horizontal slice is observed.

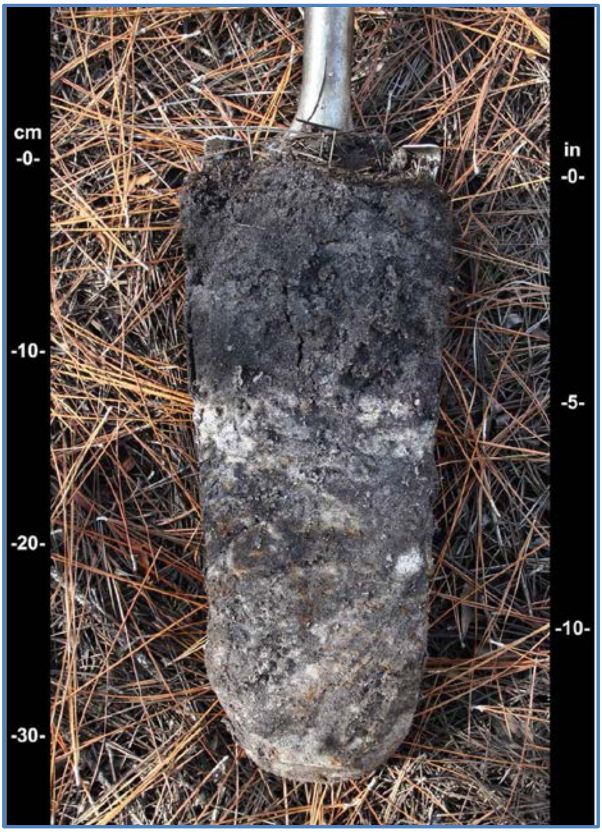
Indicator S6 (Stripped Matrix). This indicator requires diffuse splotchy patterns with rounded areas stripped of organic matter or iron, as exemplified in this photo.
(Photo from Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineation Hydric Soils, Version 8.2)

[Proper application of this indicator requires a determination that the features observed in the horizon with the stripped matrix (typically an E horizon) are indicative of wetness. Very commonly, immediately underlying the horizon with the stripped matrix is a thick dark spodic horizon which may be cemented. Users should be aware that this indicator may lead to false positive interpretations that a soil is hydric. Careful analysis of the topography, evidence of wetness, presence of hydrophytic vegetation, and morphological adaptations should be considered when applying this indicator]

Soils with Evidence of Spodic Development
Polyvalue Below Surface, ACOE S8

Technical Description: A layer with value of 3 or less and chroma of 1 or less starting at a depth ≤ 6 inches from the soil surface. When viewed with a 10x or 15x hand lens, at least 70 percent of the visible soil particles must be masked with organic material. When viewed without a hand lens, the particles appear to be nearly 100 percent masked. Immediately below this layer, 5 percent or more of the soil volume has value of 3 or less and chroma of 1 or less, and the remainder 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 4 inches thick and is underlain by a layer in which organic matter has been differentially distributed within the soils by water movement (see fig. below). The translocation of organic matter result in splotchy coated and uncoated soil areas, as described in the Sandy Redox (S5) and Stripped Matrix (S6) 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.



(Photo from Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineation Hydric Soils, Version 8.2)

Soils with Evidence of Spodic Development
Sandy Soils: Thin Dark Surface, ACOE S9

Technical Description: A layer 2 in or more thick, starting at a depth less than or equal to 6 in from the soil surface, with a value of 3 or less and chroma of 1 or less. When viewed with a 10x or 15x hand lens, at least 70 percent of the visible soil particles in this layer must be masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked. This layer is underlain by a layer(s) with a value of 4 or less and chroma of 1 or less to a depth of 12 in 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 2 in thick and is underlain by a layer with strong evidence of eluviation of organic matter (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, but a spodic horizon is not required. Users should be aware that this indicator may lead to false positive interpretations that a soil is hydric. Careful analysis of the topography, evidence of wetness, presence of hydrophytic vegetation and morphological adaptations should be considered when applying this indicator. This indicator commonly occurs in hydric Spodosols, but a spodic horizon is not required. (See Appendix C for field criteria to identify a spodic horizon.)

Indicator S9 (Thin Dark Surface). A dark surface horizon about 5cm thick overlies a thin layer with value of 4 or less and chroma of 1 or less. Directly below the second layer is a spodic horizon, starting at a depth of about 7 cm.

(Photo from Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineation Hydric Soils, Version 8.2)

BBNEP Note: Look for a second confirmation of wetland hydrology, as listed on the DEP Form, when using this indicator. Additional indicators of hydrology are found in the Postscript to this booklet.

Soils with Evidence of Spodic Development
Mesic Spodic, ACOE 17 (formerly TA6)

Applicable Subregions: For testing in MLRAs 144A and 145 of LRR R and MLRA 149B of LRR S

Technical Description: A layer greater than or equal to 2 inches thick, that starts at a depth ≤6 inches from the mineral soil surface, that has value of 3 or less and chroma of 2 or less and is underlain by either:

a. One or more layers of spodic materials that have a combined thickness ≥3 inches, that start at a depth ≤12 inches from the mineral soil surface, and that have a value and chroma of 3 or less; or
b. One or more layers that have a combined thickness ≥2 inches, that start at a depth ≤12 inches from the mineral soil surface, that have a value of 4 or more and chroma of 2 or less, and that are directly underlain by one or more layers that have a combined thickness ≥3 inches, that are spodic materials, that have a value and chroma of 3 or less.

User Notes: This indicator is used to identify wet soils that have spodic materials or that meet the definition of Spodosols. The layer or layers described above that has value of 4 or more and chroma of 2 or less is typically described as E or Eg horizons. The layer or layers that are 3 in or more, that have value and chroma 3 or less, and meet the definition of a spodic materials (i.e. have an illuvial accumulation of amorphous materials consisting of organic carbon and aluminum with or without Fe) are typically described as Bh, Bhs, or Bhsm horizons. These Bh, Bhs, or Bhsm horizons typically have several color patterns and/or cementation.

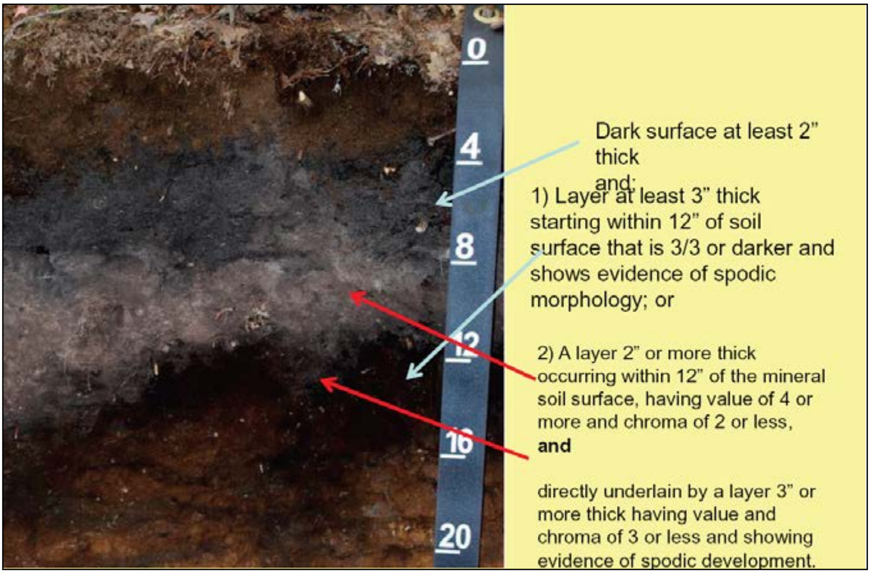


Photo credit: Mark Stolt

BBNEP Note: Users should consult Appendix C for identifying spodic hydric soils.

Soils with Evidence of Spodic Development
Frigid Spodic, NE-A1

Applicable Subregions: For testing in MLRAs 143 and 144B

Technical Description: A layer starting at a depth less than or equal to 6 in from the soil surface that has value of 4 or more and chroma of 2 or less in which iron, manganese and other oxides have been stripped from the soil matrix and the primary base color of the soil material has been exposed, and there are 2 percent or more redox concentrations occurring as soft masses or pore linings. The stripped areas and translocated oxides and/or organic matter form a faintly contrasting pattern of two or more colors with diffuse boundaries. The layer immediately below the stripped layer must have value 3 or less and chroma 2 or less due to the accumulation of illuvial organic carbon, aluminum, or iron (and other oxides), and be at least 3 in thick.

User Notes: This indicator is used to identify hydric soils in frigid or cryic soil temperature regimes that have spodic materials. The color of the eluvial layer should represent the base color of the primary particles and be described as an Eg horizon suggesting saturation and reduction occurring within the layer. The layer(s) with evidence of illuvial organic carbon, aluminum, or iron are typically described as Bh, Bhs, or Bhsm horizons.

Caution should be exercised when using this indicator because very similar morphologies can be observed as a result of podzolization in non-hydric soils. Careful attention should be paid to landscape setting and other parameters outside the profile. A professional Soil Scientist with experience in the Land Resource Region should be consulted. Refer to Appendix C for more discussion on the difficulties in identifying hydric spodic soils.

BBNEP Note: Look for a second confirmation of wetland hydrology, as listed on the DEP Form, when using this indicator. Additional indicators of hydrology are found in the the Postscript to this booklet.

Floodplain Soils

These soils usually are characterized by distinctly layered soil material. The layers form when new sediment is deposited during flood events. As a result of this pattern of deposition, hydric soil indicators may never form, or may be buried even though saturated or inundated conditions are present long enough to create wetland hydrology.

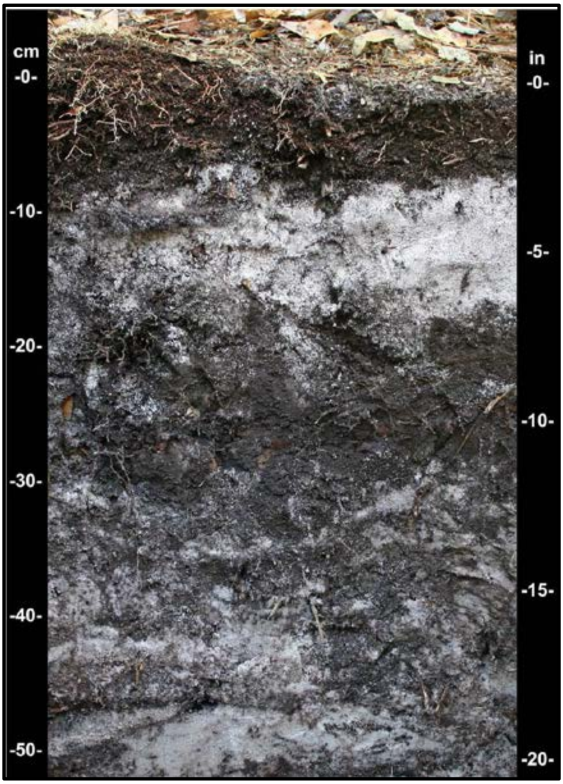
Stratified layers in loamy material. (Photo from Field Indicators of Hydric Soils)

BBNEP Note: DEP has not provided any morphological criteria for this difficult soil. See the following ACOE Indicators.

Floodplain Soils
Stratified Layers, ACOE A5

Technical Description: Several stratified layers starting at a depth less than or equal to 6 in from the soil surface. At least one of the layers has a value of 3 or less with a chroma of 1 or less or it is muck, mucky peat, peat, or mucky modified mineral texture. The remaining layers have chroma of 2 or less. Any sandy material that constitutes the layer with a value of 3 or less and a chroma of 1 or less, when viewed with a 10x or 15x hand lens, must have at least 70 percent of the visible soil particles masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked.

User Notes: Use of this indicator may require assistance from a trained soil scientist with local experience. A stratified layer is depositional and not pedogenic. Keep in mind that one layer has to have a value 3 or less and, chroma 1 or less, or composed of organic soil material (e.g. muck/sapric material), or have a mucky modified texture class (e.g. mucky sandy loam). An undisturbed sample must be observed. Individual strata are dominantly less than 2.5 cm (1 in) thick. A hand lens is an excellent tool to aid in the identification of this indicator. Many alluvial soils have stratified layers at greater depths; these soils do not meet the requirements of this indicator. Many alluvial soils have stratified layers at the required depths but do not have chroma of 2 or less; these do not meet the requirements of this indicator. The stratified layers may have any soil texture. Stratified layers generally occur on floodplains and other areas where wet soils are subject to rapid and repeated burial with thin deposits of sediment.



Stratified layers in sandy material. (Photo from Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineation Hydric Soils, Version 8.2)

Floodplain Soils
Iron-Manganese Masses, ACOE F12

Technical Description: On floodplains, a layer 4 in 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 and manganese masses with diffuse boundaries. The layer starts at a depth less than or equal to 8 inches from 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 are generally 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 weathering or parent material feature. Iron-manganese masses should not be confused with the larger and redder iron nodules or concretions that have sharp boundaries.

Iron-manganese masses (black spots) in a 40 percent depleted matrix. Scale is in inches.

BBNEP Note: Look for a second confirmation of wetland hydrology, as listed on the DEP Form, when using this indicator. Additional indicators of hydrology are found in the Regional Supplement.

Floodplain Soils
Piedmont Floodplain Soils, ACOE F19

Technical Description: On floodplains, a mineral layer at least 6 in thick starting at a depth less than or equal to 10 in from 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 on flood plains and does not apply to stream terraces associated with a historic stream levels or representative of an abandoned flood plain. While these soils are found on flood plains, flooding may be rare and groundwater is often the source of hydrology. In New England, this indicator is of limited extent and should only be considered if there is strong evidence of wetland hydrology and hydrophytic vegetation.

. Photo by M. Rabenhorst. Scale in 4-in. increments.

BBNEP Note: Look for a second confirmation of wetland hydrology, as listed on the DEP Form, when using this indicator. Addition indicators of hydrology are found in the Regional Supplement.

A-horizons that are Thick and Very Dark. DEP

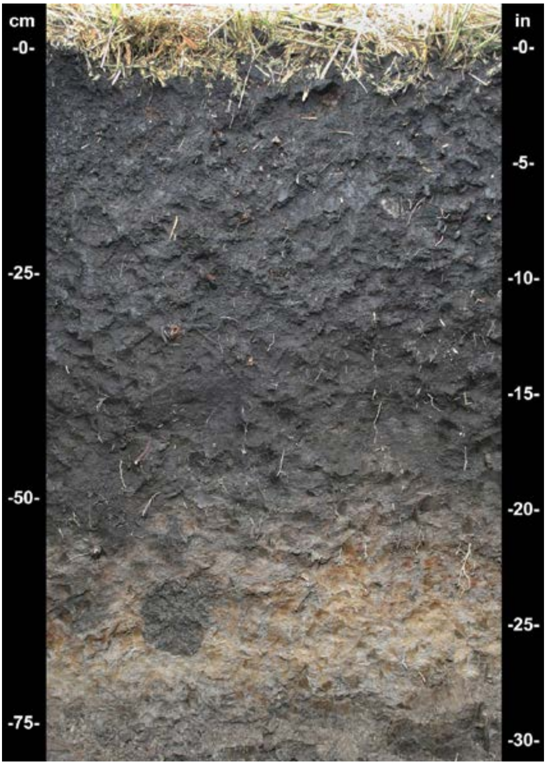
A-horizons greater than or equal to 12 inches thick with values less than 3 and chroma of 2 or less are difficult to analyze because indicators of saturation are difficult to see. Therefore, look directly below the A-horizon for a matrix chroma of 1 or less and values of 4 or higher. If the matrix color directly below the thick and dark A-horizon is chroma 2 and value 4 or higher, other indicators of saturation need to be present in the soil directly below the A-horizon. In uncommon situations, it may be necessary to dig deeper to evaluate colors below the A-horizon.

Photo credit: NRCS

A-horizons that are Thick and Very Dark
Thick Dark Surface, ACOE A12

Technical Description: A layer at least 6 in. thick with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less starting below 12 in. of the surface. The layer(s) above the depleted or gleyed matrix and starting at a depth < 6 in. from the soil surface must have value of 2.5 or less and chroma of 1 or less to a depth of at least 12 in. and value of 3 or less and chroma of 1 or less in any remaining layers above the depleted or gleyed matrix. In any sandy material above the depleted or gleyed matrix, at least 70 percent of the visible soil particles must be masked with organic material, viewed through a 10x or 15x hand lens. Observed without a hand lens, the particles appear to be close to 100 percent masked.

User Notes: This indicator applies to soils that have a black layer 12 in. or more thick and have value of 3 or less and chroma of 1 or less in any remaining layers directly above a depleted or gleyed matrix. This indicator is often associated with over-thickened soils in concave landscape positions. A depleted matrix requires value of 4 or more and chroma of 2 or less. Redox concentrations, including iron-manganese masses and/or pore linings, are required in soils with matrix colors of 4/1, 4/2, or 5/2. A and E 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 masses or pore linings.



Indicator A12 (Thick Dark Surface). Deep observation is needed to determine whether a soil meets the requirements of this indicator. In this soil, depth to the depleted matrix is about 20 in.

In New England, this indicator is often applicable to soils that have been modified by agriculture, or areas that have thickening of the A horizon and/or Ap horizon, and some soils formed in dark parent materials.

A-horizons that are Thick and Very Dark
Redox Dark Surface, F6

Technical Description: A layer that is at least 4 inches thick, starting at a depth ≤ 8 inches from the mineral soil surface, 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 with a high content of organic matter and a dark surface layer are commonly small and difficult to see. The organic matter masks some or all of the concentrations that may be present. Careful examination is required to see what are commonly brownish concentrations in the darkened materials. If the soil is saturated at the time of sampling, it may be necessary to let it dry at least to a moist condition for redoximorphic features to become visible. Soils that are wet because of ponding or that have shallow perched water, may have any color below the dark surface. This morphology has been observed in soils that have been compacted by tillage and other means. It is recommended that delineators evaluate the hydrologic source, and examine and describe the layer below the dark colored surface layer. A hand lens may be helpful for observing and describing small concentrations. Care should be taken to examine the interior of soil peds for concentrations. Dry colors, if used, must also have matrix chromas of 1 or 2, and the concentrations must be distinct or prominent. In soils that are wet because of subsurface saturation, there is a high likelihood that the layer immediately below the dark epipedon will have a depleted or gleyed matrix.

In New England, soils formed in dark parent materials, and certain calcareous parent materials, may also lack an underlying depleted/gleyed matrix. Users should consult page 39 for locations where these parent materials may be present. Field measurement of soil pH, observations of the kind of coarse fragments, and reference to the applicable NRCS soil surveys may be used to support the identification of calcareous parent material. Redox features can be small and difficult to see within a dark soil layer.

A-horizons that are Thick and Very Dark
Depleted Dark Surface, ACOE F7

Technical Description: Redox depletions with a value of 5 or more and chroma of 2 or less in a layer that is at least 4 in. thick starting at a depth ≤ 8 inches from the mineral soil surface, and has:

a) Matrix value of 3 or less and chroma of 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.

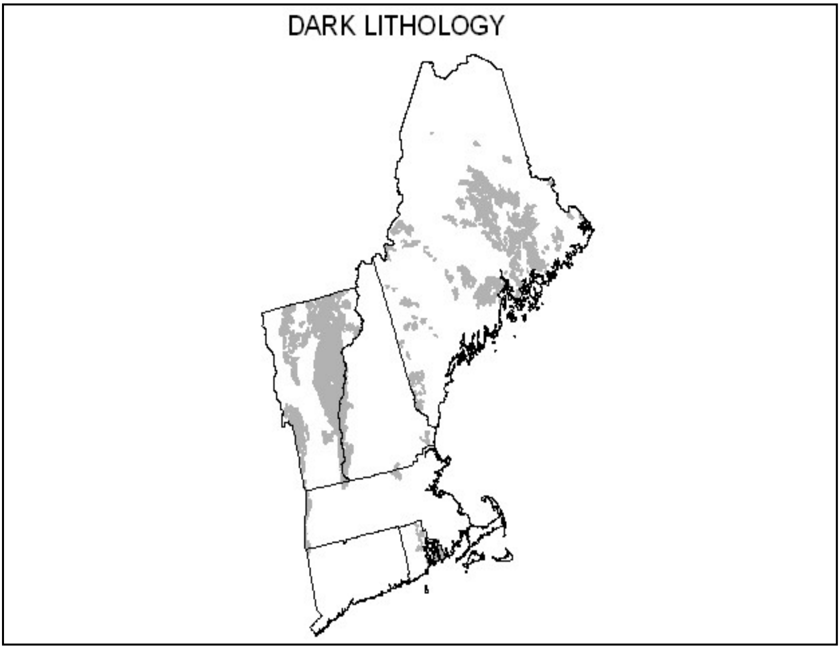
User Notes: Care should be taken not to mistake mixing of an E horizon into the surface layer as depletions. Knowledge of local conditions is required in areas where E horizons may be present. In soils that are wet because of subsurface saturation, the layer directly below the dark surface layer should have a depleted or gleyed matrix. Depletions should have associated concentrations that occur as pore linings or masses within or surrounding the depletions.

Redox depletions (lighter colored areas) are scattered within the darker matrix. Scale is in centimeters.

Soil from Highly Colored Parent Material

Some soils derived from highly colored parent material have strong red, brown, or black colors. As a result, the gray colors indicative of hydric soils may not be obvious. Red soils generally are confined to certain areas within the Connecticut River Valley. Brown soils derived from Brimfield schists generally are found in and around the town of Brimfield. Black soils generally are confined to southeastern Massachusetts (principally Bristol County).

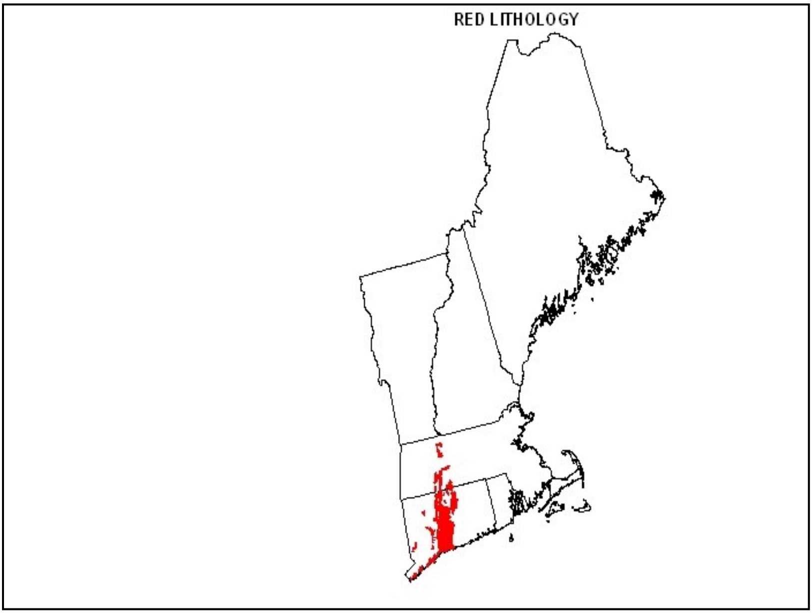
Dark Parent Material



From the Regional Supplement: Soils formed in dark parent materials refer specifically to glacial parent materials derived from dark phyllite, slate, shale, and/or schist. These soils are found in the Narragansett and Boston basins of Rhode Island and Massachusetts (associated with Paleozoic age sedimentary and meta-sedimentary rocks high in carbon) and across the northern New England hills and mountains in Vermont, New Hampshire, and Maine (associated primarily with phyllite found in belts of Ordovician, Silurian, and Devonian igneous and metamorphic rock across New England). Because the region has been subject to continental glaciation, there are varying degrees of geographic fidelity between dark parent materials and the bedrock they originate from. These dark parent materials often have low value (3 or less) matrix colors below the surface and as a result fail to meet depleted matrix criteria. Specifically, these dark colors often preclude meeting criteria for the otherwise common A11, A12, and F3 indicators. Indicator F6 is commonly used in dark parent materials. The F6 indicator does not solve the hydric soil identification problem in all areas.

BBNEP Note: DEP has not provided any morphological criteria for this difficult soil.

Soil from Highly Colored Parent Material
Red Parent Materials



These maps were prepared by Al Averill and Darlene Monds of the NRCS Massachusetts office.

From the Regional Supplement: Soils formed in red parent materials are found in the Connecticut Valley, which is a Triassic-Jurassic-aged rift valley spanning Connecticut and Massachusetts. The sedimentary rocks found in this valley are red in color, and the soils formed in parent materials derived primarily from this rock has been measured to have a low propensity for color change. Hydric soils formed in this parent material often do not meet indicator criteria associated with depleted matrixes. ACOE indicators F21, and NE-F1 were developed specifically for hydric soils formed in problematic red parent materials. Other indicators are typically not used in hydric soils formed in red parent materials near wetland boundaries.

BBNEP Note: DEP has not provided any morphological criteria for this difficult soil. For Red Parent Materials see ACOE indicator F21 and New England Indicator NE-F1. These difficult soils are not found in the Buzzards Bay watershed

Soil from Highly Colored Parent Material
Glaciated Northeast Red Parent Material, NE-F1

Technical Description: A layer derived from red parent materials that is at least 6 in thick, starting at a depth less than or equal to 10 in from the soil surface with a hue of 7.5YR or redder, with a matrix that has a value and chroma greater than or equal to 2 and less than or equal to 4. The layer must contain 5 percent or more distinct or prominent depletions and/or redox concentrations occurring as soft masses or pore linings.

User Notes: This indicator in intended for use in areas of glaciated soils with parent material derived from red Triassic-Jurassic sedimentary rock, typically in the Connecticut River Valley. This indicator is applicable in soils having Color Change Propensity Index (CCPI) values below 30 (Rabenhorst and Parikh, 2000). This index is required because it cannot be assumed that all soil layers overlying red-colored bedrock or red surficial deposits are derived solely from this one source. Where these soils have developed in glacial till: 1) the morphology is often associated with footslopes and lower concave landscape positions; 2) there is, typically, a perched water table; and 3) the most apparent redoximorphic features are typically found near the upland soil/hydric soil boundary, as masses of manganese or iron-manganese that are black or dark reddish brown with diffuse boundaries. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redoximorphic features to become visible. Small black concretions and nodules of manganese should not be considered as redoximorphic features when applying this indicator. Several observations should be made within lateral proximity of the initial observation before making a final determination. Observation of redoximorphic features in the layer directly below a surface layer meeting this indicator, is advised as a confirmation of saturation.

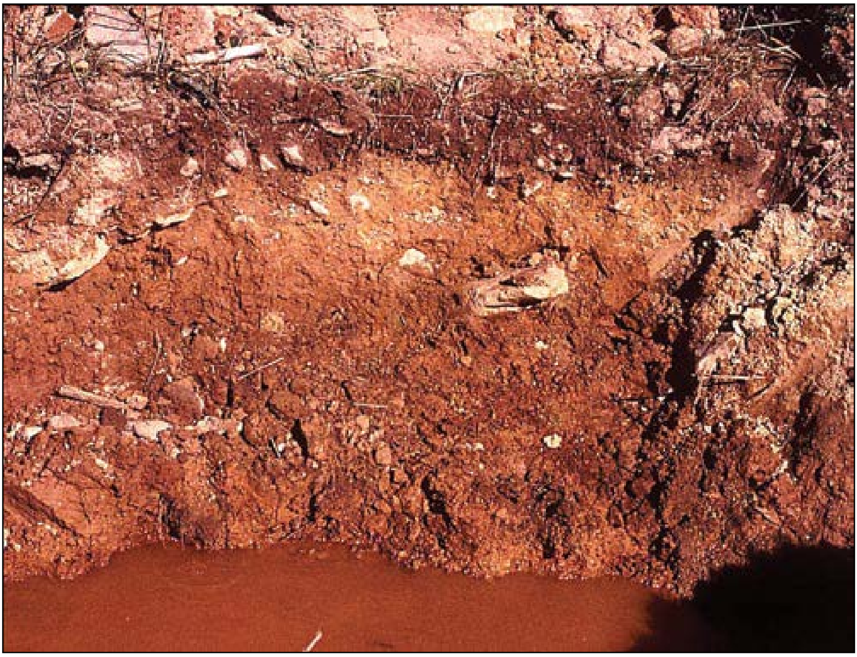
BBNEP Note: Look for a second confirmation of wetland hydrology, as listed on the DEP Form, when using this indicator. Additional indicators of hydrology are found in the Postscript to this booklet. Questions about hydric soil morphologies in red parent materials should be directed to Donald Parizek, Soil Scientist at the Connecticut NRCS office in Tolland.

Soil from Highly Colored Parent Material
Red Parent Materials, ACOE F21

Technical Description: A layer, derived from red parent materials (see glossary), is at least 4 in thick, starting at a depth less than or equal to 10 in from the soil surface with a hue of 7.5YR or redder. The matrix has a value and chroma greater than 2 and less than or equal to 4. The layer must contain 10 percent or more depletions and/or distinct or prominent redox concentrations occurring as soft masses or pore linings. Redox depletions should differ in color by having:

a) A minimum difference of one value higher and one chroma lower than the matrix, or

b) Value of 4 or more and chroma of 2 or less.



Indicator F21 (Red Parent Material). This indicator should be used only in areas of red parent material that is resistant to reduction. Not all red soils formed in red parent material.

User Notes: This indicator is intended for use in soils formed in transported red parent material such as glacial till. Soils potentially derived from red parent materials should be evaluated to determine the Color Change Propensity Index (CPPI) and be shown to have CCPI values below 30 (Rabenhorst and Parikh, 2000). In landscapes where mixing or stratification of parent materials occur, it cannot be assumed that sediment overlying red parent material is derived solely from that parent material. The total percentage of all concentrations and depletions must add up to at least 10 percent to meet the threshold for this indicator. This indicator is typically found at the boundary between hydric and non-hydric soils.

BBNEP Note: Questions about hydric soil morphologies in red parent materials should be directed to Donald Parizek, Soil Scientist at the Connecticut NRCS office in Tolland.

Other, more common indicators may be found in the interior of the wetland. It may be helpful to involve a soil scientist familiar with these soils to determine if they qualify for this indicator. Users should also consider applying NE-F1 if there is strong evidence of wetland hydrology and hydrophytic vegetation.

ACOE Indicator F3 (Depleted Matrix) in red parent material. If a soil that formed in red parent material stays wet and anaerobic long enough, it may develop the indicator F3.

BBNEP Note: Questions about hydric soil morphologies in red parent materials should be directed to Donald Parizek, Soil Scientist at the Connecticut NRCS office in Tolland.

Technical Description: 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 2 inches or more thick and starts at a depth ≤4 inches from the soil surface.

User Notes: This indicator occurs in soils of depressions such as vernal pools and kettle holes. This indicator is not meant to be applied to micro-depressions (approximately 1 m in diameter) on convex or plane landscapes. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redoximorphic features to become visible. This is a common, but often overlooked, indicator for identifying the wetland/ non-wetland boundary in landscape depressions.

This is a common but often overlooked indicator found at the wetland/non-wetland boundary on depressional sites.

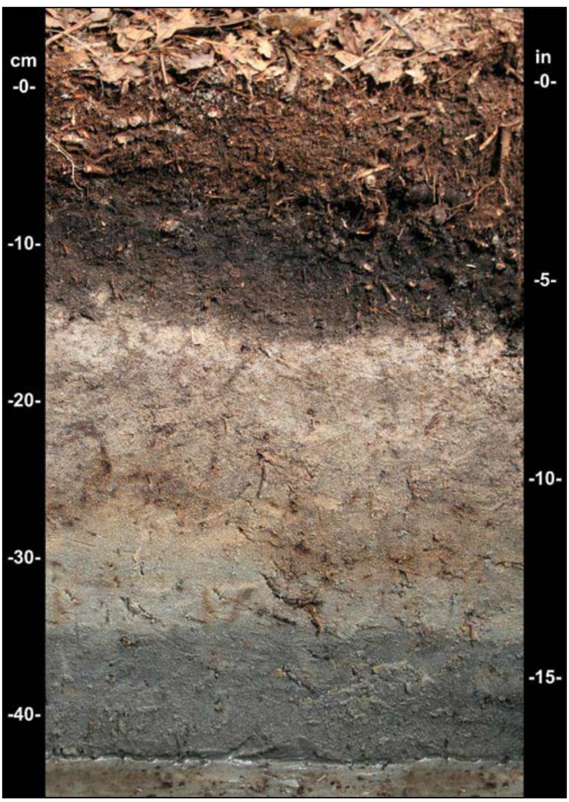
In this example, the layer of redox concentrations begins at the soil surface and is slightly more than 2 in. thick.

2 cm Muck, ACOE A10

Technical Description: A layer of muck 0.75 in. or more thick with a value of 3 or less and chroma of 1 or less, starting at a depth less than or equal to 6 in. of the soil surface.

Applicable Subregions: Cape Cod (MLRA 149B of LRR S).

User Notes: The muck layer is typically at the ground surface, but it may occur at any depth less than or equal to 15 cm (6 in) from the ground surface. Muck is sapric soil material with a minimum content of organic carbon that ranges from 12 to18 percent, depending on the content of clay (see Appendix 1). Sapric materials (muck) are virtually so decomposed that little of the plant fibers are observable. By definition, these materials have <17% rubbed fiber contents (Soil Survey Staff, 2014). Generally, muck is black and has a greasy in feel; sand grains should not be evident. Users should consult Appendix D for the field test for determining the kind of organic soil materials.



This soil has more than 2 cm of muck, starting at 8 cm on the left measuring tape. Photo credit: Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineating Hydric Soils, Version 7.0, 2010

BBNEP Note: Look for a second confirmation of wetland hydrology, as listed on the DEP Form, when using this indicator. Additional indicators of hydrology are found in the Postscript to this booklet.

Dark Muck or Mucky Peat,NE-A2

Technical Description: A layer of muck or mucky peat >2 in and <8 in thick that starts less than or equal to 15 cm 6 in from the soil surface; has a value of 3 or less, and chroma of 2 or less; and is underlain by mineral soil material with a chroma of 2 or less.

User Notes: Unlike indicator A2, this indicator does not require proof of aquic conditions or artificial drainage. This indicator does not include folistic epipedons. Muck (sapric soil material) or mucky peat (hemic soil material) have a minimum organic carbon content of 12 to 18 percent by weight, depending on the clay content of the materials. Users should consult Appendix 1 of Field Indicators for Identifying Hydric Soils in New England, Version 4, April 2019 for a complete criteria. Hemic soil materials (Oe horizons) show an intermediate stage of decomposition and are defined as having between 17 and 40% rubbed fiber content. Sapric (Oa horizons) soil materials have nearly complete decomposition of plant materials and are defined as having <17% rubbed fiber content (Soil Survey Staff, 2014).

In New England, these soils are relatively abundant and are often found in wetlands that are ponded or saturated to the ground surface nearly all of the growing season in most years. Users should consult Appendix D for field tests for determining kinds of organic soil materials.

BBNEP Note: Look for a second confirmation of wetland hydrology, as listed on the DEP Form, when using this indicator. Additional indicators of hydrology are found in the Postscript to this booklet.

Very Shallow Dark Surface, ACOE F22

Technical Description: In depressions and flood plains subject to frequent ponding and/or flooding, one of the following must be observed:

a) If bedrock occurs between 6 in and 10 in of the soil surface, a layer at least 6 in thick starting at a depth less than or equal to 4 in from the soil surface with a value of 2.5 or less and chroma of 1 or less, and the remaining soil to bedrock must have the same colors as above or any other color that has a chroma of 2 or less.
b) If bedrock occurs at a depth less than or equal to 6 in from the soil surface, more than half of the soil thickness must have a value of 2.5 or less and chroma of 1 or less, and the remaining soil to bedrock must have the same colors as above or any other color that has a chroma of 2 or less.

User Notes: In New England, this indicator is of limited extent and should only be considered if there is strong evidence of wetland hydrology and hydrophytic vegetation.

BBNEP Note: Look for a second confirmation of wetland hydrology, as listed on the DEP Form, when using this indicator. Additional indicators of hydrology are found in the Postscript to this booklet.

5. Areas where the Hydrology has been Recently Altered.

In areas where the hydrology has been recently altered, hydric soil indicators may not accurately reflect the current hydrology of the site. Areas that have been recently flooded - or where the water table has risen due to flooding or some other change in hydrologic conditions - may not exhibit hydric soil characteristics. These areas may not have been saturated long enough to develop hydric characteristics. Conversely, areas that have been effectively drained and wetland hydrology is no longer present may still possess hydric soil indicators. Where there is evidence that the hydrology has been substantially altered at a site, careful evaluation of vegetation, soils, and other indicators of hydrology should be made before making a final delineation. Altered areas are particularly difficult to evaluate and require special attention.

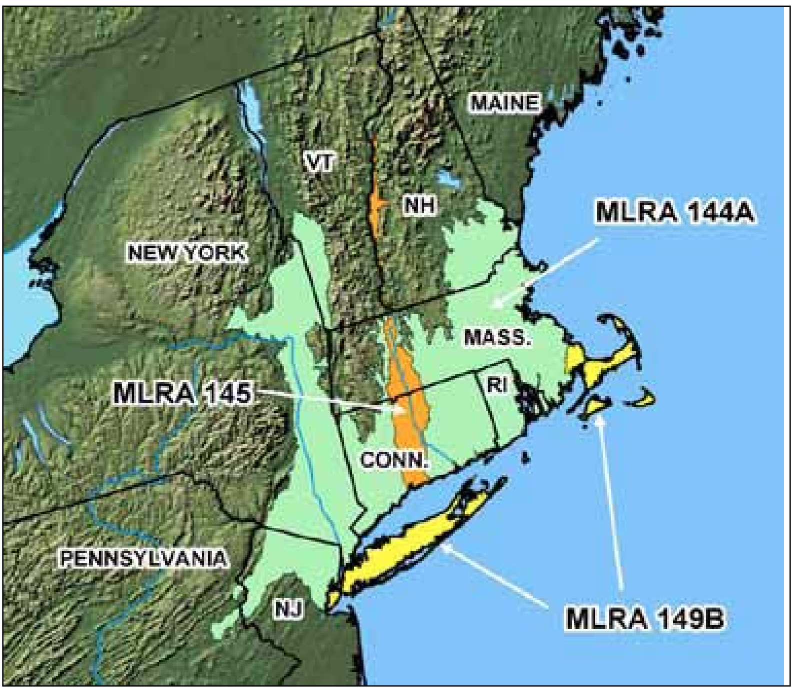
Practitioners are directed to Appendix 2. Guidelines for Identifying Human Altered Hydric Soils of Field Indicators for Identifying Hydric Soils in New England, Version 4, April 2019 for more information regarding the delineation of wetlands on altered sites. Altered sites must be delineated using soils for submissions pursuant to the Wetlands Protection Act, M.G.L Ch. 131, s. 40.

Photo credit: Muncie Sanitary District

BBNEP Note: Use Google Earth to determine the timing of the alteration. The area may be subject to enforcement action depending on the date of the alteration activity.

Appendix A Major Land Resource Areas (MLRA) and Land Resource Regions (LLR) for ACOE Indicators

Massachusetts is predominately in LLR R. Region and subregion boundaries are depicted in the figure below as sharp lines. However, climatic conditions and the physical and biological characteristics of landscapes do not change abruptly at the boundaries. In reality, regions and subregions often grade into one another in broad transition zones that may be tens or hundreds of miles wide. The lists of wetland indicators presented in the Regional Supplement for the Northcental and Northeast region, as depicted in this guide, may differ between adjoining regions or subregions. In transitional areas, the investigator must use experience and good judgment to select the supplement and indicators that are appropriate to the site based on its physical and biological characteristics. Wetland boundaries are not likely to differ between subregions in transitional areas, but one subregion criteria may provide more detailed treatment of certain problem situations encountered on the site. If in doubt about which criteria to use in a transitional area, apply all available indicator criteria and compare the results.



Location of MLRAs 144A and 145 in LRR R and MLRA 149B in LRR S.

BBNEP Note: Users in the Buzzards Bay watershed are in the transition zone of MLRA 144A and MLRA 149B. Use indicators for both regions in this area.

Appendix B: Thickness Criteria for ACOE Indicators

It is permissible to combine certain hydric soil indicators if all requirements of the individual indicators are met except thickness (see Hydric Soil Technical Note 4, (https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2_053979). The most restrictive requirements for thickness of layers in any indicators used must be met. Not all indicators are possible candidates for combination. For example, ACOE indicator F2 (Loamy Gleyed Matrix) has no thickness requirement, so a site would either meet the requirements of this indicator or it would not. Table B1 lists the indicators that are the most likely candidates for combining in the region.

Table B1: Minimum thickness requirements for commonly combined indicators in the Northcentral and Northeast Region

ACOE Indicator	Thickness Requirement
S5 – Sandy Redox	4 in. thick starting within 6 in. of the soil surface
S7 – Dark Surface	4 in. thick starting within 6 in. of the soil surface
F1 – Loamy Mucky Mineral	4 in. thick starting within 6 in. of the soil surface
F3 – Depleted Matrix	6 in. thick starting within 10 in. of the soil surface
F6 – Redox Dark Surface	4 in. thick entirely within the upper 12 in.
F7 – Depleted Dark Surface	4 in. thick entirely within the upper 12 in.

Table B2 presents an example of a soil in which a combination of layers meets the requirements for indicators F6 (Redox Dark Surface) and F3 (Depleted Matrix). The second layer meets the morphological characteristics of F6 and the third layer meets the morphological characteristics of F3, but neither meets the thickness requirement for its respective indicator. However, the combined thickness of the second and third layers meets the more restrictive conditions of thickness for F3 (i.e., 6 in. starting within 10 in. of the soil surface). Therefore, the soil is considered to be hydric based on the combination of indicators.

Table B2. Example of a soil that is hydric based on a combination of ACOE indicators F6 and F3.

Depth (inches)	Matrix Color	Redox Concentrations			Texture
		Color	Abundance	Contrast	
0 – 3	10YR 2/1	--	--	--	Loamy/clayey
3 – 6	10YR 3/1	7.5YR 5/6	3 percent	Prominent	Loamy/clayey
6 – 10	10YR 5/2	7.5YR 5/6	5 percent	Prominent	Loamy/clayey
10 – 14	2.5Y 4/2	--	--	--	Loamy/clayey

Appendix B: Thickness Criteria for ACOE Indicators.

Another common situation in which it is appropriate to combine the characteristics of hydric soil indicators is when stratified textures of sandy (i.e., loamy fine sand and coarser) and loamy (i.e., loamy very fine sand and finer) material occur in the upper 12 in. of the soil. For example, the soil shown in Table B3 is hydric based on a combination of indicators F6 (Redox Dark Surface) and S5 (Sandy Redox). This soil meets the morphological characteristics of F6 in the first layer and S5 in the second layer, but neither layer by itself meets the thickness requirement for its respective indicator. However, the combined thickness of the two layers (6 in.) meets the more restrictive thickness requirement of either indicator (4 in.).

Table B3. Example of a soil that is hydric based on a combination of ACOE indicators F6 and S5.

Depth (inches)	Matrix Color	Redox Concentrations			Texture
		Color	Abundance	Contrast	
0 – 3	10YR 3/1	10YR 5/6	3 percent	Prominent	Loamy/clayey
3 – 6	10YR 4/1	10YR 5/6	3 percent	Prominent	Sandy
6 – 16	10YR 4/1	--	--	--	Loamy/clayey

Appendix C: Spodic Material Field Criteria

When an Ap is present look for the following colors directly below the Ap (If an E-horizon is present look for these directly below the E):

a. . a hue of 5YR or redder (i.e. 2.5YR, etc); or

b. a hue of 7.5YR, color value 5 or less and chroma 4 or less (a hue of 7.5YR with value 5 and chroma 6 does not qualify without additional chemical properties); or

c. a hue of 10YR or neutral and color value and chroma 2 or less; or

d. a color of 10YR 3/1.

Bs – value and chroma are more than 3
Bhs - both the value and chroma are 3 or less

Photo credit: John Rockwell. This is an example of a spodosol altered by agricultural activity. This activity has obliterated the E horizon and the top of the Bhs horizon. This soil meets the criteria for DEP Particularly Difficult Soils Indicator A16.

BBNEP Note: The identification of spodosols can be difficult. If the site has been subject to some kind of agricultural activity, the E-horizon and spodic horizon may have been mixed with the A horizon to form an Ap horizon, sometimes known as a plow layer. Look below the Ap to see if the soil has a reddish tinge.

Identifying Spodic Hydric Soils (excerpt from Field Indicators for Identifying Hydric Soils in New England, Version 4)

Spodic morphologies are defined here as soils with well-developed Bs, Bhs, or Bhsm (spodic) horizons. These soils typically have strongly expressed E horizons above the spodic horizons. The eluvial E horizons, however, may be erased by plowing and are not always present. Spodic morphologies develop through the classic process referred to as podzolization. In this process, organic matter chelates aluminum (Al) and/or iron (Fe) and moves these constituents lower in the soil where they accumulate to form spodic horizons. As such, the E horizon represents the zone stripped of organic matter, Al, and/or Fe. While the spodic horizon is where these constituents accumulate.

Most soils with spodic morphology have formed in parent materials with weatherable minerals that release both Fe and Al. In such cases the Al and/or Fe is chelated during podzolization and accumulates in the spodic horizons which is indicated by the "s" suffix designation. The Bs horizon designation is used when the colors are not dominated by organic matter, and thus, values or chromas are greater than 3 (e.g. 7.5YR 4/3, 7.5YR 3/4). Most spodic horizons in wetland areas, however, are dominated by organic matter, have colors 3/3 or darker with redder hues (e.g. 7.5YR), and are designated as Bhs. Some soils may form in only siliceous minerals, such as quartz, and the spodic horizons have accumulations of organic matter without Fe or Al. These spodic horizons are designated as Bh. In New England, almost all spodic horizons with dark colors should be designated as Bhs. If the spodic horizon is cemented the "m" suffix is applied (e.g. Bhsm). Cemented spodics are often referred to as "ortsteins".

There are a number of complications associated with identifying hydric soils with spodic morphologies. Since spodic morphologies are best expressed in sandy materials, the national hydric soil indicators developed for spodic hydric soils are all sandy indicators (e.g. S1, S6, S7, S8, S9). In New England, however, soils with spodic morphologies commonly occur in wetland settings in both sandy and coarse-loamy outwash, ice-contact, and till landscapes. With decreasing temperatures (e.g. moving north or higher in elevation) upland soils in New England may also develop well expressed spodic morphologies. The coarse-textured soil materials that spodic horizons typically form in generally have small amounts of Fe, and that Fe is easily reduced in the saturated wetland environment and lost from the system during leaching. Thus, in many cases there is little or no Fe in the system to form the redoximorphic features (concentrations or depletions of Fe or Mn) we often use to identify hydric soils. Because podzolization does not always result in uniform colors throughout a spodic horizon, zones of redder colors may be a function of differential podzolization and not redox processes resulting in Fe concentrations. Thus, considering that many of the hydric soils with spodic morphologies lack redoximorphic features; that differential podzolization may result in misidentification of Fe concentrations; that upland soils in northern New England can have well developed spodic horizons; and that the national indicators for identifying hydric soils with spodic morphologies only apply to sandy soils; identifying spodic hydric soils in New England can be problematic.

Guidance:

For very wet spodic hydric soils A2 and A3 can be applied when a histic epipedon is identified. Using other A or the F indicators can be problematic since most or all require the presence of redoximorphic features. As discussed above, the process of podzolization occurs in all soils with spodic morphologies, while redoximorphic features may not form due to the lack of Fe and Mn in the soil horizons. As such, color patterns perceived to be redox depletions or concentration may be a function of differential podzolization and not reduction and leaching. Thus, care should be taken when attempting to distinguish between redoximorphic features and those features with similar morphologies resulting from podzolization in the spodic or overlying E horizons.

In the case of sandy spodic hydric soils, indicators S1, S7, and S9 can be effectively applied if these morphologies are present. Consistently applying S6 can be difficult because of the vague nature in which S6 is defined, and that similar morphologies have been observed in non-hydric soils, especially in northern New England. Considering these issues, care should be taken when applying S6. Typically, hydric soils that meet S-6 have E horizons that are thicker and have a lower value (darker) than adjacent upland soils with these morphologies (thin and nearly white). Also, the Bhs horizons of hydric Spodosols are typically thicker than adjacent upland Spodosols and may be cemented (ortstein). Thus, like the use of all the indicators, position on the landscape, morphologies of the upland soils, evidence of wetland hydrology, and the dominant vegetation should be considered when applying S6.

For sandy and coarse loamy soils, A16 appears to be an effective indicator for soils with spodic morphologies in southern New England without redoximorphic features (see section on indicators for problem hydric soils). In northern New England, the preponderance of soils with spodic morphologies in non-hydric soils requires extra caution. The NE-A1 indicator was developed to identify hydric soils in frigid or cryic soil temperature regimes that have spodic materials in northern New England. Caution should be taken when using this indicator because very similar morphologies can result from podzolization without saturation and reduction in non-hydric soils. Careful attention should be paid to landscape setting and other parameters outside the profile. A professional soil scientist with experience in the Land Resource Region should be consulted when applying this indicator.

Appendix D: Mucky Mineral Field Identification for ACOE Indicators - Determining the texture of soil materials high in organic carbon.

Material high in organic carbon could fall into three categories: organic, mucky mineral, or mineral. In lieu of laboratory data, the following estimation method can be used for soil material that is wet or nearly saturated with water. This method may be inconclusive with loamy or clayey textured mineral soils. Gently rub the wet soil material between forefinger and thumb. If upon the first or second rub the material feels gritty, it is mineral soil material. If after the second rub the material feels greasy, it is either mucky mineral or organic soil material. Gently rub the material two or three more times. If after these additional rubs it feels gritty or plastic, it is mucky mineral soil material; if it still feels greasy, it is organic soil material.

Photo credit: http://www.ohiowineandmore.com/

USE OF THIS CHART: Depending on the site, determining the organic matter content of a soil can be difficult often with significant differences between experienced professionals. No field test alone is reliable enough to conclude with a high degree of confidence that a particular sample has a specified percentage of organic carbon/organic matter. The confidence level increases as additional tests are applied and results compared.

Compiled by Peter C. Fletcher Draft December 8, 2011

FIELD TEST	ORGANIC SOIL MATERIAL (OSM)	MUCKY MINERAL SOIL (MMS)	MINERAL SOIL MATERIAL (MSM)
1. **Soil Color Moist:** Organic matter is a strong coloring agent in the soil and as little as 3 to 5% can turn a mineral soil black. Dark and very dark colors confirm the presence of organic matter in soil. Soil color alone is not a definitive test for OSM or MMS.	Fibric and hemic material, typically have colors with values of 4 or less and chromas of 3 or less. Sapric material has very dark soil colors with values and chromas of 2 or less. Organic soils formed in tidal marshes often have higher values and chromas.	Has a very dark soil color most often with values and chromas of 2 or less.	Has a broad spectrum of soil colors including black. Soils that have colors with values of 3 or higher and chromas of 2 or more are most often MSM.
2. **Air-Dry Soil Color:** For this test smear a very moist soil sample onto a sheet of white paper and let dry.	The dry soil retains nearly all of its dark color.	The dry soil retains some of its dark color, typically with values of 4 or less and chromas of 2 or less.	The dry soil turns a light color with values of 4 or higher and any chroma, or values and chromas of 3 or higher.
3. **Rubbed Fiber Content:** The percentage of visible fibers observed with a hand lens after rubbing in one's palm approximately 10 times. Live roots do not count as soil organic matter and should be removed before conducting this test.	Fibric material has a rubbed fiber content of 40% or more by volume. Hemic material has rubbed fiber content of 17 to 40%. For Sapric material it is less than 17%. *Reliable test for fibric and hemic material when used in combination with Test 6.*	Typically lacks fibers or has low fiber content.	Most often lacks fibers or has a very low fiber content.
4. **Soil Strength:** For this test, remove a clod (undisturbed piece) of soil, about the size of a lemon, from the side of the pit. The sample should be very moist but not saturated. If dripping wet, wrap the sample in a paper towel to remove excess water. When conducting this test, the soil sample should be squeezed but not repeatedly worked within one's hand.	When squeezed firmly, soil material oozes out freely from between one's fingers. *Reliable test for sapric material when used in combination with Tests 1 and 5.* 	When squeezed firmly, soil material has a slight to moderate tendency to ooze between one's fingers. *Reliable test when used in combination with Tests 1, 2, and 5.*	When squeezed firmly, soil material forms a solid mass and no soil material oozes from between one's fingers. *Reliable test when used in combination with Tests 2, 5 and/or 6.*
5. **Gritty Feel:** For this test rub a saturated sample in one's palm using moderate thumb pressure. This test is unreliable if the mineral fraction of the soil is predominantly very fine sand, silt and/or clay size particles.	After 5 rubs retains its greasy, slippery feel with no grittiness.	Initially has a creamy, smooth feel that after 3 to 5 rubs has an underlying gritty feel. *Reliable test when the mineral soil is a sand, loamy sand, sandy loam or loam.*	Has a gritty feel after 1 or 2 rubs. This test only works well when there are sand size particles present. *Reliable test when the mineral soil is a sand, loamy sand, sandy loam or loam.*
6. **Air-dry Weight:** For this test form a moist sample of soil into a mass about the size of a lime and let dry for 1-2 days.	Soil sample becomes significantly lighter in weight and retains most of its original color. If sapric, the mass often shrinks in size.	May lose a noticeable amount of its original weight and retains some of its dark color. When held up to the light, one can often see a shiny reflection off the mineral soil particles.	Retains a significant amount of its original weight and turns considerably lighter in color.
7. **Squeezed Liquid:** For this test, place a saturated sample of soil about the size of a lemon in one's palm and squeeze using firm pressure. The extruded liquid and particulates are then examined. If there is a difference in results (fibric, hemic, or sapric) between this method and the rubbed fiber content, the rubbed fiber content is used. This method was originally developed by L.von Post and is described in more detail in ASTM Standard D 5715-00		The liquid extruded from fibric material is typically clear to brown with no organic solids. The liquid extruded from hemic material is dark and often turbid with as much as 1/3 of the sample squeezed out. For sapric material the liquid is very turbid or it is thick and pasty with most of the sample squeezed out. The test is not used for mineral soils or mucky mineral soils.	

Appendix E: Redox Features- Faint vs. Distinct

Compare the matrix color to the redox feature color. The contrast is distinct if: (Note: Regardless of the magnitude of hue difference, where both colors have value ≤3 and chroma ≤2, the contrast is faint.)

Threshold for Distinct		
Δ Hue	Δ Value	Δ Chroma
0	≤2	>1 to <4
0	>2 to <4	<4
1	≤1	>1 to <3
1	>1 to <3	<3
2	0	>0 to <2
2	>0 to <2	<2

Conversely, faint is evident only on close examination. The contrast is faint if:

Upper Threshold for Faint		
Δ Hue	Δ Value	Δ Chroma
0	≤2	≤1
1	≤1	≤1
2	0	0
Hue	Value	Chroma
Any	≤3	≤2

Any feature above the upper threshold for faint features would be considered either distinct or prominent. If an indicator requires distinct or prominent features then those features at or below the faint threshold do not count.

Appendix F– Observing and Recording Hue, Value and Chroma

All colors noted in this Booklet refer to moist Munsell® colors (Gretag/Macbeth 2000). Do not attempt to determine colors while wearing sunglasses or tinted lenses. Colors must be determined under natural light and not under artificial light.

Chroma

Soil colors specified in the ACOE indicators do not have decimal points (except for indicator A12); however, intermediate colors do occur between Munsell chips. Soil color should not be rounded to qualify as meeting an indicator. For example, a soil matrix with a chroma between 2 and 3 should be recorded 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 of 2 or less.

Hue and Value

Hue and value should be rounded to the nearest color chip when using the indicators. For example, if the color is in between value of 3 and 4 it should be rounded and not excluded from meeting either Depleted Matrix, ACOE F3 or Redox Dark Surface, ACOE F6 because it is in between values. If the value is closer to a 3 then F6 or some other dark surface indicator should be considered and if it is closer to 4 then F3 or some other depleted matrix indicator should be considered.

Timing - not too wet, and not too dry

Always examine soil matrix colors in the field immediately after sampling. Ferrous iron, if present, can oxidize rapidly and create colors of higher chroma or redder hue. In soils that are saturated at the time of sampling, redox concentrations may be absent or difficult to see, particularly in darkcolored soils. It may be necessary to let the soil dry to a moist state (5 to30 minutes or more) for the iron or manganese to oxidize and redox features to become visible.

Postscipt: ACOE Indicators of Hydrology

Primary Indicators (minimum of one required)

Surface Water
High Water Table
Saturation
Hydrogen Sulfide Odor
Water Marks
Presence of Reduced Iron
Recent Iron Reduction in Tilled Soils
Thin Muck Surface
Sparsely Vegetated Concave Surface
Water-Stained Leaves
Aquatic Fauna
Oxidized Rhizospheres on Living Roots
Sediment Deposits
Drift Deposits
Algal Mat or Crust
Iron Deposits
Inundation Visible on Aerial Imagery

Secondary Indicators (minimum of two required)

Surface Soil Cracks
Moss Trim Lines
Crayfish Burrows
Stunted or Stressed Plants
Shallow Aquitard
FAC-Neutral Test
Drainage Patterns
Dry-Season Water Table
Saturation Visible on Aerial Imagery
Geomorphic Position
Microtopographic Relief

BBNEP Note: For details on these hydrology indicators, see the DEP Delineation Manual and the ACOE Regional Supplement.

Notes

Notes

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