



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

CENAE-R-PT

March 11, 2011

MEMORANDUM FOR THE RECORD

SUBJECT: *Field Indicators for Identifying Hydric Soils in New England (Version 3)*. New England Interstate Water Pollution Control Commission (NEIWPPCC), April 2004

1. This guide is an update of the previous version released in 1998. It clarifies and refines the 1998 version based on extensive field testing. This guide is currently the best available reference of its kind in New England and is specifically developed for New England soils.
2. This version of this guide is widely used by state and Federal agency staff and the consulting community. It is a standard reference for regulatory programs throughout much of New England.
3. This field guide provides an important resource to use in problem and disturbed situations where Chapter 5 "Difficult Wetland Situations in the Northcentral and Northeast Region" of the current *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region* is applicable. When properly used, this field guide provides results that help make determinations in these areas.
4. The Environmental Resource Section staff of the Policy Analysis and Technical Support Branch in the Regulatory Division use this field guide and continue to encourage its use by Corps staff and other wetland practitioners for Chapter 5 circumstances.

A handwritten signature in black ink, reading "Ruth M. Ladd", is positioned above the printed name.

RUTH M. LADD
Chief, Policy Analysis and
Technical Support Branch



Field Indicators for Identifying

Hydric Soils

in New England

Version 3
April 2004

***Field
Indicators
for Identifying
Hydric Soils
in New England***

***Version 3
April 2004***

Acknowledgements

This manual reflects the collective effort and vision of the New England Hydric Soils Technical Committee. The Committee consists of soil scientists, wetland scientists, and regulatory authorities. Its members represent the private sector, universities, organizations, societies, and state, local, and federal governments. We want to express our appreciation to these individuals and to all others who participated in the development and review of this manual.

Special thanks go to the staff of the New England Interstate Water Pollution Control Commission (NEIWPCC) for producing and distributing this manual, and to EPA-New England for funding the production and distribution.

Although this revised publication of *Field Indicators for Identifying Hydric Soils in New England* reflects current science and is representative of hydric soil morphologies in the region, the Technical Committee recognizes that this manual will undergo continuous field review and testing which will likely require future revisions.

Comments on this manual should be sent to:

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For information and updates to this document, visit www.neiwpcc.org/hydricsoils.htm. Also available at this website are downloadable PDFs of this document and its supplement, as well as a form for ordering hard copies.

The New England Hydric Soils Technical Committee (NEHSTC) consists of the following members:

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This manual should be cited as follows:

New England Hydric Soils Technical Committee. 2004. 3rd ed., *Field Indicators for Identifying Hydric Soils in New England*. New England Interstate Water Pollution Control Commission, Lowell, MA.

Table of Contents

Introduction	1
Regional Indicators For Hydric Soils	2
How To Use This Manual	3 – 6
Key to Hydric Soil Indicators	7 – 12
Diagrams of Soil Profiles of Field Indicators	13 – 58
Appendices	59 – 68
Appendix 1: Chart for Estimating Percent Redoximorphic Features	60
Appendix 2: Chart for Estimating 2 Percent Redoximorphic Features	61
Appendix 3: Chart for Estimating Size of Redoximorphic Features	62
Appendix 4: Table for Estimating Contrast of Redoximorphic Features	63
Appendix 5: Tabular Key for Contrast Determination using Munsell® Notation	64
Appendix 6: Chart for Determining Type of Soil Structure	65
Appendix 7: Table for Estimating Grade of Soil Structure	66
Appendix 8: Chart for Estimating Size of Granular Structure	67
Appendix 9: Chart for Estimating Size of Blocky Structure	68
Glossary	69 – 83
Notes	84 – 86

Introduction

In the mid-1980s, staff from the New England Division of the Army Corps of Engineers, with technical assistance provided by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (then the Soil Conservation Service), began developing New England-wide soil drainage class criteria to make field identification of hydric soils easier and more standardized. Several years of exhaustive field testing were conducted, involving a myriad of consulting firms, academic experts, professional societies, and federal, state, and local agencies.

Over the years, the soil drainage class criteria were revised many times as the knowledge base and experience grew. To gather data and obtain opinions, detailed questionnaires were circulated to soil scientists, wetland ecologists, and others in regulatory agencies, private consulting firms, and universities. Despite significant improvements, the criteria for the drainage classes were still confusing at times, and some of the region's soil scientists had reservations about using them.

In 1992, in response to efforts at the federal level to develop field indicators of hydric soils on a nationwide basis, a group of federal, state, private and academic experts in wetland and soil sciences (many of the same individuals from the earlier effort) convened to develop regional field indicators for identifying hydric soils in New England. Numerous drafts were produced, circulated for review, revised, and recirculated. The proposed field indicators were tested throughout New England by a variety of soil scientists and others in the wetlands profession. This manual is the culmination of those efforts.

Following the release of Version 1, the New England Hydric Soils Technical Committee and representatives from the National Technical Committee for Hydric Soils (NTCHS) had several joint meetings and field trips to develop consistency between the New England and National Indicators. As a result of that cooperative

effort, Version 2 of *Field Indicators for Identifying Hydric Soils in New England* included revisions in terminology to more nearly parallel the national indicators and additional clarification of indicators which increased both accuracy and consistency. Likewise, the NTCHS has made, and continues to make, revisions to the National Indicators that better reflect hydric ***soil morphologies*** indicative of the New England Region. Version 3 of the *Field Indicators for Identifying Hydric Soils in New England* continues this process.

The purpose of this field indicators guide is to make it easier for field personnel to identify and document hydric soils and to provide consistent and reliable evidence as to whether a certain soil meets the definition of a hydric soil. To correctly interpret and apply this guide, however, users must have practical experience and a working knowledge of soils. When properly applied, this field guide yields results that are consistent with the identification of hydric soils as per the *1987 Army Corps of Engineers Wetland Delineation Manual*.

While this field guide is the culmination of more than fifteen years of work, it is by no means a final product. Practical application, experience and continuing academic research provide sufficient reason to continue to periodically revise and update the field guide. Much of the supporting documentation for those revisions will come from you, the user.

Regional Indicators For Hydric Soils

A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the ***growing season*** to develop ***anaerobic conditions*** in the upper part (Federal Register, July 13, 1994). As a result of soil saturation and reducing conditions, hydric soils undergo chemical reactions and physical processes which differ from those found in upland soils. The field indicators of hydric soils contained within this guide are observable ***soil morphologies*** that have developed as a result of those chemical reactions and physical processes. Field indicators are also a historic record of cycles

Terms or phrases in ***bold italics*** are defined in the *Glossary of Terms*

of soil saturation and reduction that have been observed and documented by field soil scientists and validated through testing.

For many hydric soils, saturation and reduction in the ***upper part of the soil*** are seasonal and not continuous throughout the ***growing season***. When the soil morphologies observed at a site meet the criteria for one of the New England field indicators, this specifies a hydric soil. Users are cautioned that when working in areas where the hydrology has been altered, the presence or absence of hydric soil indicators may not reflect the current hydrologic conditions.

How To Use This Manual

This key is specifically designed to address the hydric soil conditions common to New England and may not be applicable to other regions of the United States. Soils identified as hydric soils using this key meet the definition of a hydric soil.

This key begins with soil conditions associated with the wettest soils—those with extended periods of saturation in the upper part and/or inundation. As the user progresses through this key, the soils have shorter periods of saturation in the upper part and the evidence of wetness may not be as clearly expressed in the ***soil morphology***. To avoid misinterpretation when evaluating these soils, other than histosols, this key requires the user to **identify a combination of soil morphologies observed within specified depths**.

Because of the unique ***soil morphology*** associated with ***spodic horizons***, these are addressed separately in this key. In addition, some indicators are grouped by soil texture. To use this key properly, a user must start with Hydric Soil Indicator I and progress through the key systematically. If the soil conditions observed in the field match one of the hydric soil indicators, that soil is considered to be hydric.

This key was designed to be an easy-to-use field guide that would apply throughout the New England Region. With the myriad of soil conditions found in New England, it became evident early on that

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

one key could not address all hydric soil conditions without becoming very complex and difficult to use. Hence, this key addresses soil conditions most commonly associated with hydric soils in New England. It also recognizes that there are “problem soils” for which this key may not work properly. Indicator XIII has been greatly expanded to help the user understand some of the types of problem soils that may be encountered in New England. A separate supplement to this manual is planned, which will reference regional maps to be located on the NEIWPCC website showing the approximate extent of problem soil areas and a list of reliable field indicators for them.

When documenting hydric soils in the field, it is recommended that soil profiles be observed in test holes dug to a depth of two feet or more using a tile spade. The soil conditions observed in each test hole should then be described and documented using standards and terminology developed by the USDA. Depth measurements should always be made from the **soil surface**, but it is important to note that some indicators refer to the distance below the **top of the mineral soil material** or some other reference point as noted in the Indicators. Soil conditions and features that need to be observed and documented in order to use this key effectively include:

- **Soil horizons and layers** – list the horizon designation plus thickness and depth for each.
- **Soil texture** – note the textural class.
- **Soil color** – list the Munsell Notation for **matrix color** and other features as described under ‘**redoximorphic features**’ below.
- **Redoximorphic features:**
 - **Redoximorphic concentrations/depletions** - Describe each type and document their color, **abundance**, **size**, **contrast**, and **location** (e.g., **ped interiors**). Field identification of **redoximorphic features** is most reliable when their contrast is **distinct** or **prominent**, and their abundance is 2 percent or more. When features are **faint** and/or less than 2 percent, extra care and professional

judgment should be exercised as to whether or not they are an indication of a hydric soil.

- **Other redoximorphic features** – Depleted or gleyed matrix, nodules, pore linings, etc.
- **Soil structure** – describe type (shape), size, and grade.
- **Carbon-based features** – *histic epipedon*, *histosols*, thick mucky surface layers, and *stripped matrix*.
- **Other soil features may be required depending upon the situation** (e.g., depth of rooting, soil consistence).

This manual includes a series of diagrams which illustrate each hydric soil indicator. The scales on either side of the diagram show the reference point of measurement. Soil textures are depicted using contrasting patterns. Notes highlight important characteristics and morphologies. **Some features are difficult to show graphically and if there is a perceived difference in interpretation between the diagrams and narrative key, the narrative key takes precedence.**

 **User Notes** are shown on the page opposite the diagram and below the indicator that they refer to. Their purpose is to provide additional information which may help in identifying an indicator in the field, or to alert users to possible exceptions and/or situations where professional judgment may be needed. User Notes are identified by the symbol shown on the left.

 In addition to User Notes, soil features designated as **Field Testing Only** are *soil morphologies* which may be helpful when identifying field indicators, but users are cautioned that these features have not had the field testing needed to substantiate their reliability. People who have observed these soil features in the field should document their findings and forward them to the NEIWPCC Wetlands Group. Your active participation is greatly appreciated and will improve and strengthen this manual. Field Testing Only criteria are depicted by the symbol shown on the left. Standards for defining a functionally hydric soil are maintained by the National Technical Committee at the following website:

<http://soils.usda.gov/use/hydric/criteria.html>.

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

This manual also includes a **Glossary of Terms**. The terms included in the Glossary are in ***bold and italicized*** throughout the narrative text. Some definitions have been simplified to facilitate a field interpretation. Users who want complete definitions should refer to the references cited.

Please note that this manual does not address all hydric soil conditions found in New England, and professional judgment by a qualified individual is needed in unusual or problem soil areas.

Included with this version of the *Field Indicators* is a separate document entitled *Supplement to the Field Indicators of Hydric Soils in New England*. The supplement explains some of the nuances of assessing soils; it is intended as an aide for less experienced individuals. The supplement also includes guidance to assist in the evaluation of problem soils.

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KEY TO HYDRIC SOIL INDICATORS

Version 3 – April 2004

CAUTION: The field indicators in this book should not be considered all-inclusive. Although an attempt has been made to list the most relevant indicators, there are cases (see Problem Soils discussion on p. 54) where hydric soils exist that do not meet any of the currently listed indicators. Therefore, not meeting one of the indicators does not preclude a soil from being determined as hydric. In addition, there are rare occasions when a soil has one or more relevant field indicators but is not a hydric soil. Field indicators will continue to be revised as problem areas and exceptions to these keys become known or additional interpretation tools are developed. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, the assistance of an experienced soil or wetland scientist may be needed to determine whether the soil is hydric.

The following conditions and soil morphologies are recognized as field indicators of soils that have formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop *anaerobic conditions* in the upper part:

- I.   **Ponded or Flooded Soils.** Any soil that is *frequently ponded* or flooded for a *long* or *very long duration* during the *growing season*; or 14 – 15
- II.  **Tidal Soils.** Soils that are *flooded* daily by tides and/or have *sulfidic materials* within 12 inches of the *soil surface*; or 16 – 17
- III.  **Histosols.** Soils having *organic soil materials* at or near the *soil surface* that are greater than 16 inches thick (i.e., classify as *Histosols*)¹; or 18 – 19

1. Folists and soils with folistic epipedons are excluded from Hydric Soil Indicator III.



User Note/Field Testing Only: refer to page opposite the diagram depicting this indicator.

Terms or phrases in **bold italics** are defined in the *Glossary of Terms*

- IV.  **Histic Epipedons.** Soils having a layer of **organic soil materials** at or near the **soil surface** that is 8 to 16 inches thick (i.e., **histic epipedon**); and directly underlying the **O horizon** or, if present, the **A horizon** is a horizon with **redoximorphic features**;² or 20 – 21
- V.  **Mineral Histic.** Any mineral soil having a layer 4 to 8 inches thick of **slightly to well-decomposed organic soil material** and/or a **mucky A or Ap horizon**, and is **directly underlain** by a horizon with a **depleted or gleyed matrix**;² or 22 – 23
- VI.  **Depleted or Gleyed Matrix.** Within 10 inches of the top of the **mineral soil material** and directly underlying an **A or Ap horizon** (or, if they are not present, an **O horizon**), is a horizon with a **depleted or gleyed matrix** (for soils with **moderate to strong structure**, the **matrix color** is recorded for **ped interiors**); or 24 – 25
- VII. **Depleted Below Dark Surface.** Beginning within 20 inches of the top of the **mineral soil material** and directly underlying a **thick or very thick, dark A or Ap horizon** is a horizon with a **depleted or gleyed matrix** that is 4 inches or more thick (for soils with **moderate to strong structure**, the **matrix color** is recorded for **ped interiors**); or 26 – 27
- VIII. **Dark Mineral Soils.** Soils with a matrix chroma of 2 or less that extends to a depth of 20 inches below the **top of the mineral soil material**, and that have a **dark A or Ap horizon** (with or without an **O horizon**) that is directly underlain by a horizon with a matrix value of less than 4, and within 12 inches of the **top of the mineral soil material** or directly underlying an **A or Ap horizon**, whichever is shallower, 2 percent or more **redoximorphic features** that extend to either:

2. Soils with folistic epipedons are excluded from Hydric Soil Indicators IV and V.

 **User Note:** refer to page opposite the diagram depicting this indicator.

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

- A. a depth of 20 inches below the ***top of the mineral soil material***; or 28 – 29
- B. a ***depleted*** or ***gleyed matrix***, whichever is shallower; or 28 – 29
- IX. **Spodosols.** Mineral soils having a ***spodic horizon*** and one of the following morphologies:
- A.  within 6 inches of the ***top of the mineral soil material*** have an ***E horizon (eluvial horizon)*** with 2 percent or more ***redoximorphic features*** and/or have a ***stripped matrix*** that is ***directly underlain*** by a ***spodic horizon*** with either:
1. a ***Bh, Bhs, or Bs horizon*** with 2 percent or more ***redoximorphic features***; or 30 – 31
 2. a ***Bh*** and/or ***Bhs horizon*** that is ***directly underlain***, but within 20 inches of the ***top of the mineral soil material***, by a horizon with 2 percent or more ***redoximorphic features***; or 32 – 33
- B.  beginning within 10 inches of the ***top of the mineral soil material*** and directly underlying a ***dark A*** or ***Ap horizon*** and/or a ***shallow E horizon*** (or if neither is present, an ***O horizon***), there is a ***Bh*** and/or ***Bhs horizon***³ that is greater than 2 inches thick that is ***directly underlain***, but within 20 inches of the ***top of the mineral soil material***, by a horizon with 2 percent or more ***redoximorphic features***; or 34 – 35

3. This morphology can develop as a result of wetness, or in the cryic temperature regime, as a result of climate. See Section XIII for problem soil areas due to cold temperatures.



User Note: refer to page opposite the diagram depicting this indicator.

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

C.  beginning within 10 inches of the **top of the mineral soil material** and directly underlying a **dark A** or **Ap horizon**, is one of the following:

1. an **E horizon** with 2 percent or more **redoximorphic features** and/or a **stripped matrix directly underlain** by a **Bh, Bhs, or Bs horizon** with 2 percent or more **redoximorphic features**; or 36 – 37
2. a **Bh** and/or **Bhs horizon** that is **directly underlain**, but within 20 inches of **top of the mineral soil material**, by a horizon with 2 percent or more **redoximorphic features**; or 38 – 39
3. a **Bs horizon** with 2 percent or more **redoximorphic features**; or 40 – 41

X. Sandy With Redox. Soils that do not have a **spodic horizon** and:

A. have a layer 4 to 8 inches thick of **slightly to well-decomposed organic soil material** and/or a **mucky A** or **Ap horizon**; and are **directly underlain** by a horizon with a **loamy fine sand** or **coarser texture** with 2 percent or more **redoximorphic features**; or 42 – 43

B.  beginning within 10 inches of the **top of the mineral soil material** and directly underlying a **dark A** or **Ap horizon** (with or without an **O horizon**) is a horizon with a **loamy fine sand or coarser texture** with a **matrix color** due to wetness of chroma 3 or less, value 4 or more, with 2 percent or more **redoximorphic features**; or 44 – 45

C.  beginning within 15 inches of the **top of the mineral soil material** and directly underlying a **thick, very dark A** or **Ap horizon** there is a horizon with a **loamy fine sand or coarser texture** with a **matrix color** due to wetness of chroma 3 or less, value 4 or more, with 2 percent or more **redoximorphic features**; or 46 – 47

 **User Note:** refer to page opposite the diagram depicting this indicator.

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

- XI. Any Texture.** Soils that do not have a *spodic horizon* and
- A.** beginning within 10 inches of the *top of the mineral soil material* and directly underlying a *dark A* or *Ap horizon* (with or without an *O horizon*) is a horizon with 5 percent or more *redox depletions*, and within 20 inches of the *top of the mineral soil material* there is a horizon with a *depleted* or *gleyed matrix* (for soils with *moderate* to *strong structure*, the *matrix color* and percent *redox depletions* are recorded for *ped interiors*); or 48 – 49
 - B.** beginning within 15 inches of the *top of the mineral soil material* and directly underlying a *thick, very dark Ap horizon* is a horizon with 5 percent or more *redox depletions* and within 20 inches of the *top of the mineral soil material* there is a horizon with a *depleted* or *gleyed matrix* (for soils with *moderate* to *strong structure*, the *matrix color* and percent *redox depletions* are recorded for *ped interiors*); or. 50 – 51
- XII. Any Texture.** Soils that have a *very dark A* or *Ap horizon* less than 10 inches thick (with or without an *O horizon*) that are *directly underlain* by a horizon with a *matrix color* due to wetness of chroma 3 or less, with 10 percent or more *redoximorphic features*; and within 6 inches of the *top of the mineral soil material* have 2 percent or more *redoximorphic features*; and within 18 inches of the *top of the mineral soil material* have 2 percent or more *redox depletions*; or 52 – 53

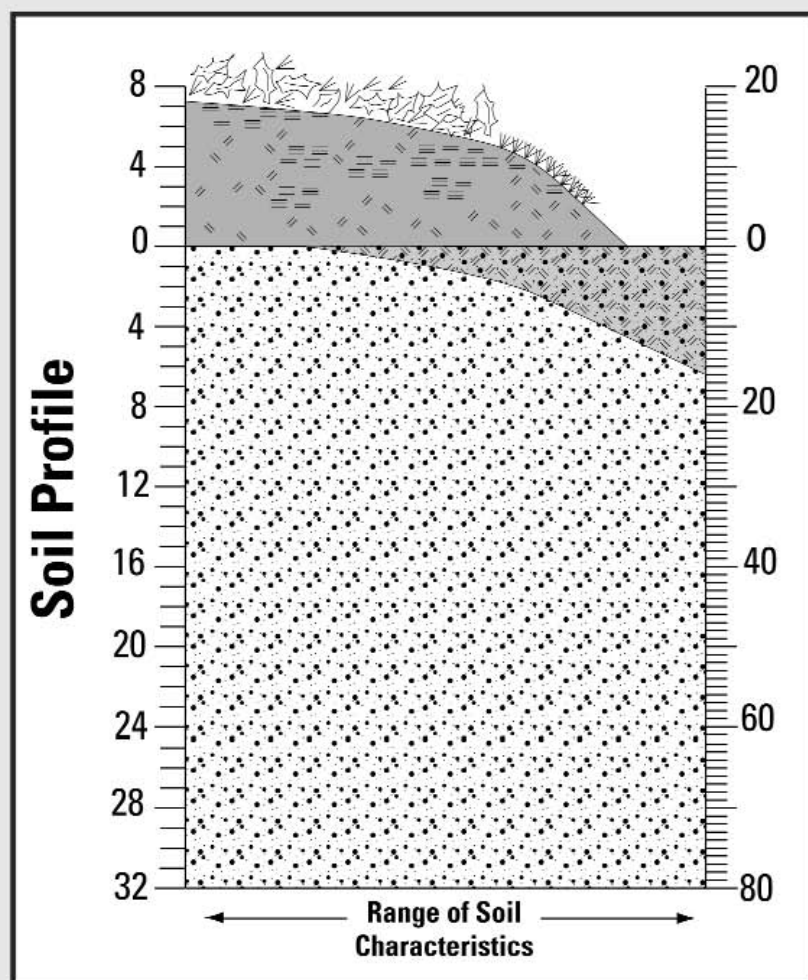
XIII. “Problem” Soil Areas. This category addresses a variety of conditions for which definitive indicators have yet to be developed. The term “problem area wetlands” was coined in the 1987 U.S. Army Corps of Engineers Wetland Delineation Manual and is used to describe environments where one or more of the wetland parameters are missing or difficult to interpret. The final evaluation of hydric status of these soils is left to professional judgment.54 – 58

In Version 2 of this manual, the need was recognized to “*identify general locations of these unique soils and to develop reliable field indicators for identifying hydric soils within them.*” This need is also recognized by the U.S. Army Corps of Engineers (Wakeley, 2002). Information from the USDA-STATSGO maps available for the New England region provide a reasonable picture of where many of the problem soils may be encountered. Regional soil maps identify the general location of problem soil areas at a scale of 1:250,000. They are available at the NEIWPCC website: www.neiwpcc.org/hydricsoils.htm

In 2002 the New England Hydric Soils Technical Committee (NEHSTC) established sub-committees to begin research and development of keys for identifying hydric soils in the problem soil areas. Soil scientists with specific experience and expertise in respective problem areas lead the sub-committees. The sub-committees are investigating: 1) Disturbed soils 2) Folists and Soils with Folistic Epipedons 3) Soils formed in Dark Parent Material and 4) Soils formed in Red Parent Material. All subcommittees have been assigned three principal tasks: summarizing the principal difficulties in making hydric soil determinations in these areas, developing appropriate research and monitoring of “bench mark” sites, and producing a key that will be useable in the professional wetland science community. A detailed description of these areas is found in the section on Problem Soil Areas starting on page 54 of this manual.

Diagrams of Soil Profiles of Field Indicators

*Version 3
April 2004*



- I. **PONDED OR FLOODED SOILS.** Any soil that is *frequently ponded or flooded* for a long or very long duration during the growing season; or

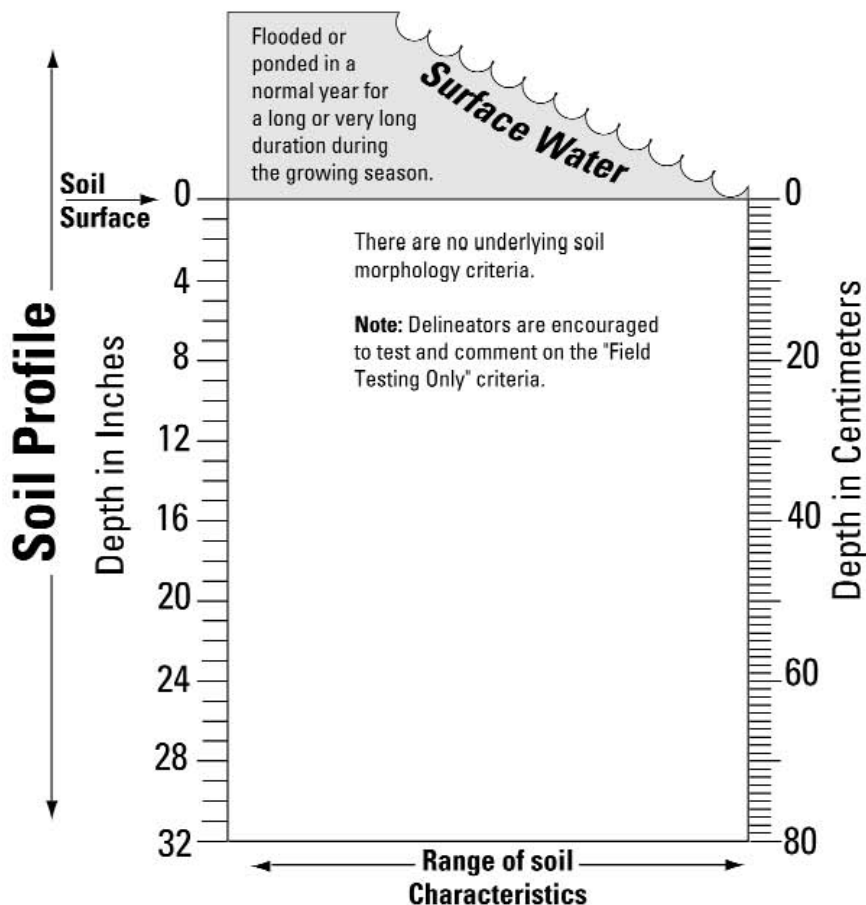
 **USER NOTE:** Landscape position is a critical element when assessing an area for its susceptibility to, and frequency of, flooding or ponding. Landforms that are prone to flooding or ponding include, but are not limited to: floodplains, meander scars, backswamps, oxbows and closed depressions..

 **FIELD TESTING ONLY:** After verification of landscape position, *soil morphologies* that indicate *long* and *very long durations* of flooding or ponding may include, but are not limited to:

1. 5% or more *redoximorphic features* within the upper 6 inches of the *soil surface*; or
2. Stratified layers starting within the upper 6 inches of the soil surface with one or more of the layers being either *very dark, organic soil material* and/or *mucky mineral material*; and within 12 inches of the soil surface there is a layer with a *depleted or gleyed matrix*.

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

I. Ponded or Flooded Soils



Key for Soil Textures

 Slightly to partially decomposed organic matter

 Well decomposed organic matter

 Mucky mineral soil

 Loamy fine sand or coarser soil textures

 Any mineral soil texture

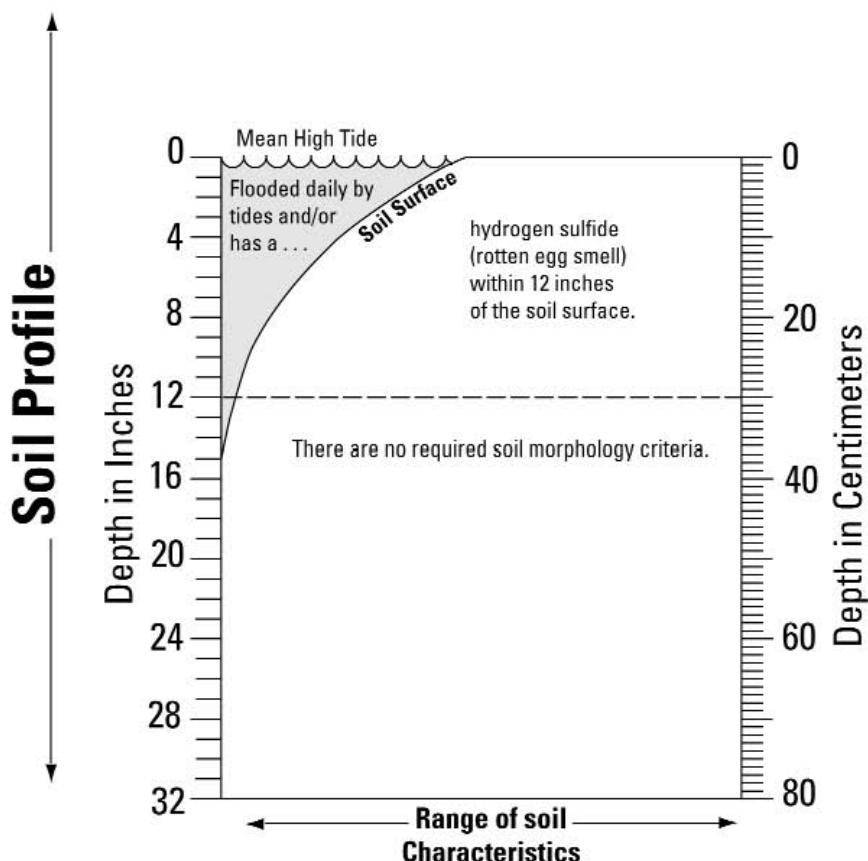
II. TIDAL SOILS. Soils that are *flooded* daily by tides and/or have *sulfidic materials* within 12 inches of the *soil surface*; or



USER NOTE: The presence of hydrogen sulfide gas (rotten egg smell) indicates the presence of *sulfidic materials*. Be aware that there may be other strong odors present in hydric soils.

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

II. Tidal Soils



Key for Soil Textures

 Slightly to partially decomposed organic matter	 Mucky mineral soil	 Any mineral soil texture
 Well decomposed organic matter	 Loamy fine sand or coarser soil textures	

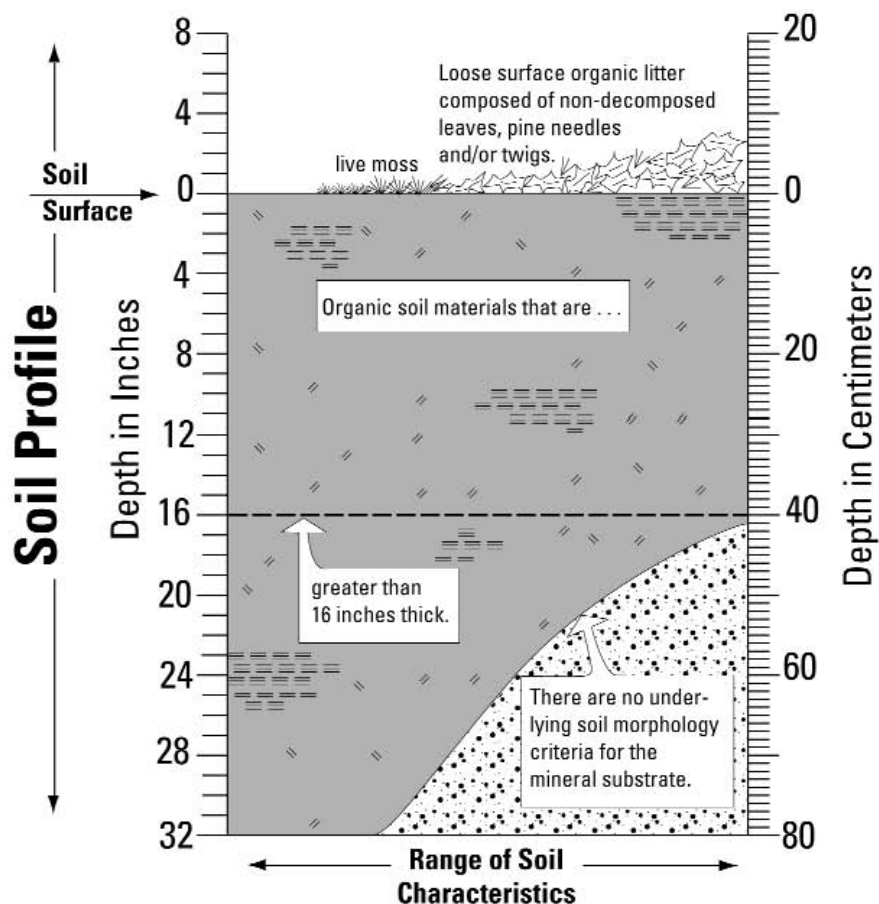
III. HISTOSOLS. Soils having *organic soil materials* at or near the *soil surface* that are greater than 16 inches thick (i.e., classify as *Histosols*);¹ or

 **USER NOTE:** Within *frigid* and *cryic soil temperature* regimes and typically associated with areas having climatic conditions that favor the accumulation of organic material (e.g. maritime influence or high elevation), there are organic soils (i.e., *Folists*) that are never saturated with water except for a few days following heavy rains. Soils having these conditions are not hydric.

-
1. *Folists* and soils with folistic epipedons are excluded from Hydric Soil Indicator III.

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

III. Histosols



Key for Soil Textures

Slightly to partially decomposed organic matter
 Well decomposed organic matter

Mucky mineral soil
 Loamy fine sand or coarser soil textures

Any mineral soil texture

IV. HISTIC EPIPEDONS. Soils having a layer of *organic soil materials* at or near the *soil surface* that is 8 to 16 inches thick (i.e., *histic epipedon*); and directly underlying the *O horizon* or, if present, the *A horizon*, is a horizon with *redoximorphic features*;² or

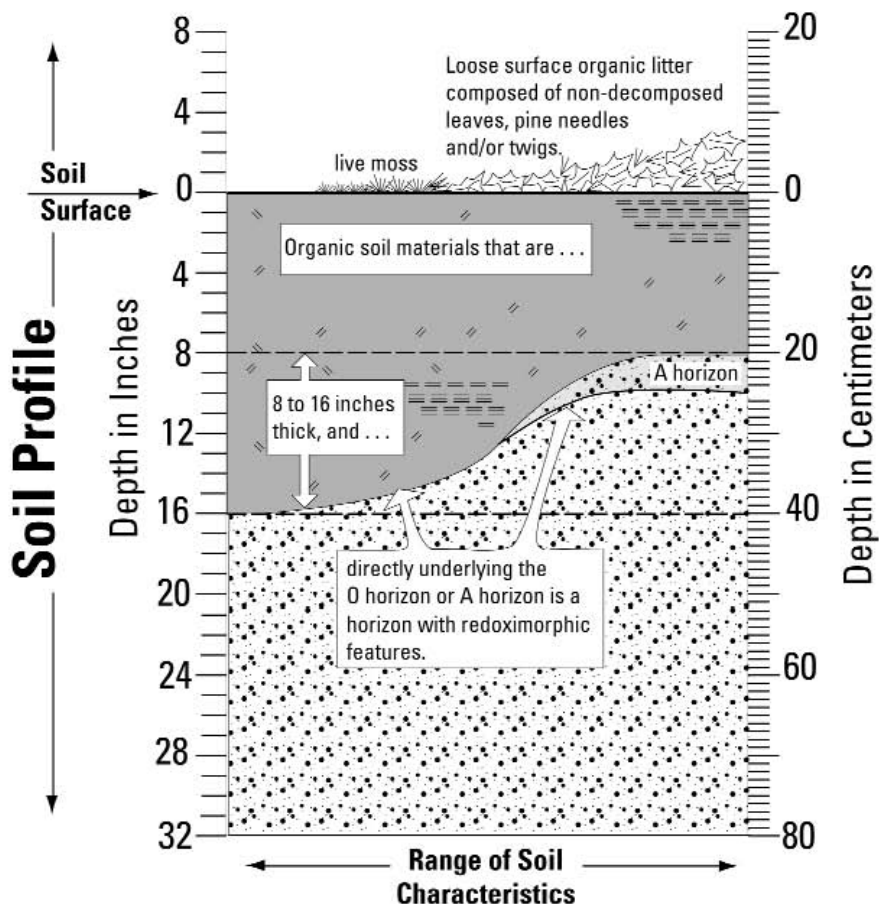


USER NOTE: Excludes soils with *folistic epipedons*. In order to distinguish between a folistic and histic epipedon, look at the underlying mineral soil morphology. A histic epipedon develops due to *anaerobic conditions* related to wetness whereas a *folistic epipedon* develops due to reduced microbial activity related to cool temperatures.

2. Soils with *folistic epipedons* are excluded from Hydric Soil Indicator IV.

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

IV. Histic Epipedons



Key for Soil Textures

 Slightly to partially decomposed organic matter	 Mucky mineral soil	 Any mineral soil texture
 Well decomposed organic matter	 Loamy fine sand or coarser soil textures	

- V. MINERAL HISTIC.** Any mineral soil having a layer 4 to 8 inches thick of *slightly to well-decomposed organic soil material* and/or a *mucky A or Ap horizon*,³ and is *directly underlain* by a horizon with a *depleted or gleyed matrix*; or

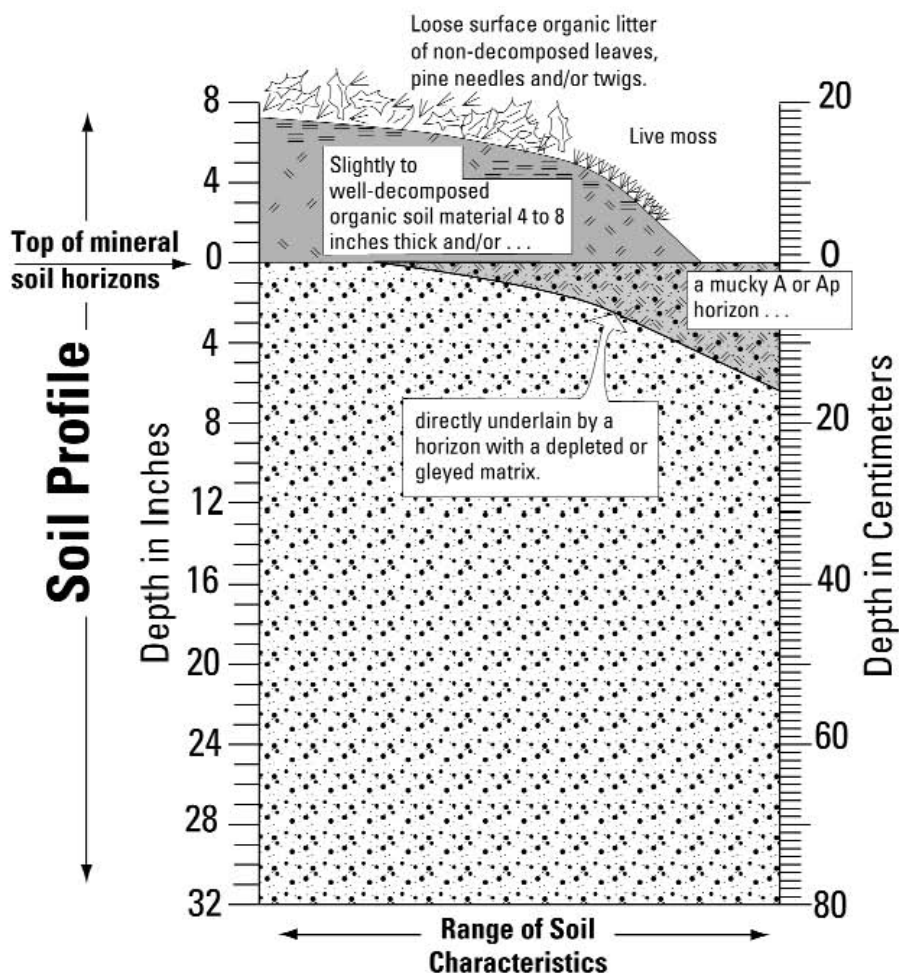


USER NOTE: An *E horizon* usually has low chroma colors as a result of an eluvial process and only qualifies as a *depleted or gleyed matrix* if it has 2 percent or more *redoximorphic concentrations*. For soils with *E horizons*, refer to Indicators IX.A, IX.B, and IX.C.

-
3. Soils with *folistic epipedons* are excluded from Hydric Soil Indicator V.

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

V. Mineral Histic



Key for Soil Textures

	Slightly to partially decomposed organic matter		Mucky mineral soil		Any mineral soil texture
	Well decomposed organic matter		Loamy fine sand or coarser soil textures		

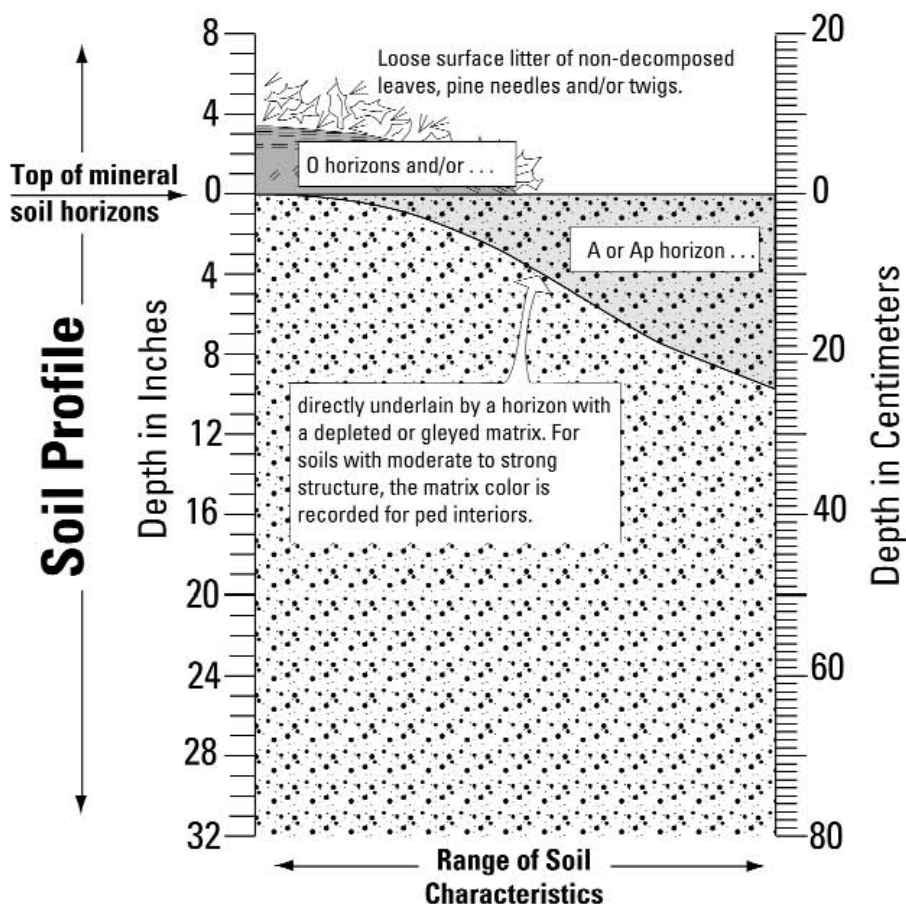
VI. DEPLETED OR GLEYED MATRIX. Within 10 inches of the *top of the mineral soil material* and directly underlying an *A* or *Ap* horizon (or, if they are not present, an *O* horizon), is a horizon with a *depleted* or *gleyed matrix* (for soils with *moderate to strong structure*, the *matrix color* is recorded for *ped interiors*); or



USER NOTE: An *E* horizon usually has low chroma colors as a result of an eluvial process and only qualifies as a *depleted* or *gleyed matrix* if it has 2 percent or more *redoximorphic concentrations*. For soils with *E* horizons, refer to Indicators IX.A, IX.B, and IX.C.

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

VI. Depleted or Gleyed Matrix



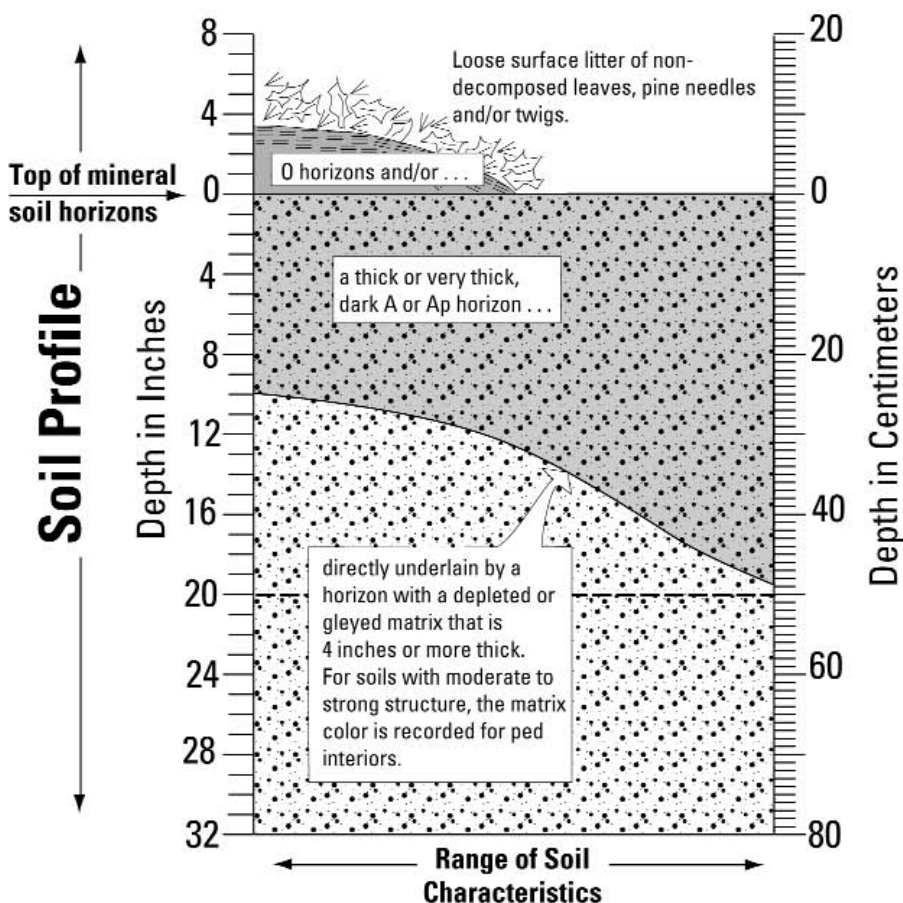
Key for Soil Textures

	Slightly to partially decomposed organic matter		Mucky mineral soil		Any mineral soil texture
	Well decomposed organic matter		Loamy fine sand or coarser soil textures		

VII. DEPLETED BELOW DARK SURFACE. Beginning within 20 inches of the *top of the mineral soil material* and directly underlying a *thick* or *very thick, dark A* or *Ap horizon* is a horizon with a *depleted* or *gleyed matrix* that is 4 inches or more thick (for soils with *moderate to strong structure*, the *matrix color* is recorded for *ped interiors*); or

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

VII. Depleted Below Dark Surface



Key for Soil Textures

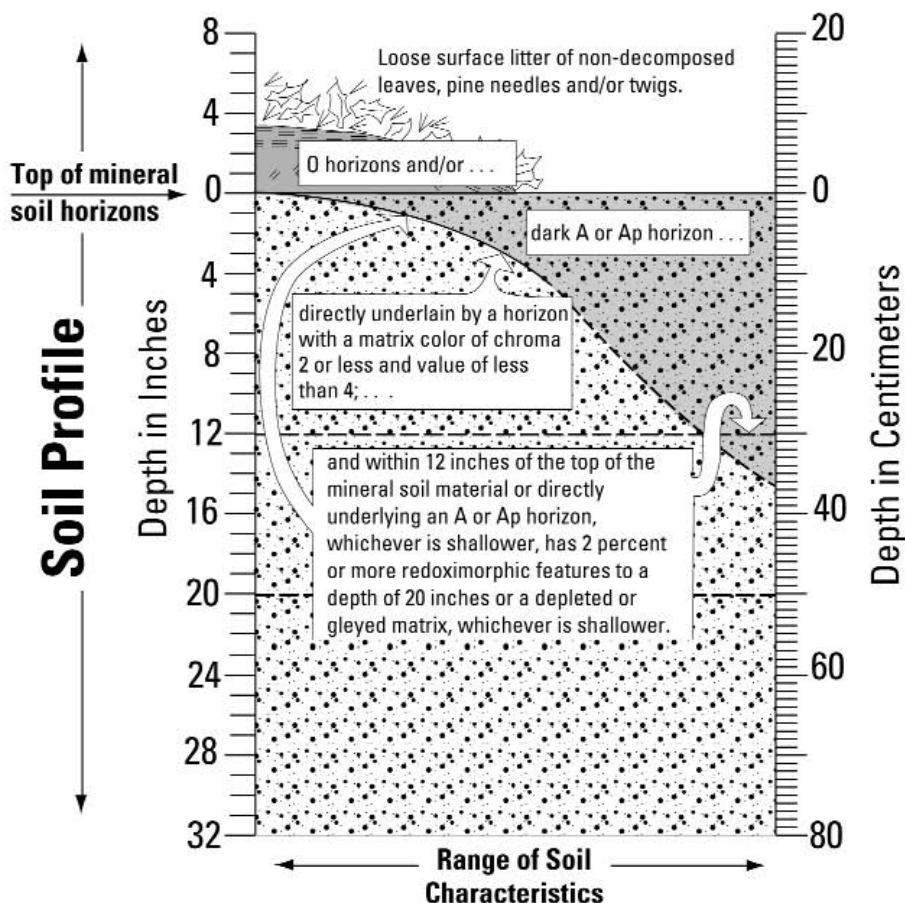
	Slightly to partially decomposed organic matter		Mucky mineral soil		Any mineral soil texture
	Well decomposed organic matter		Loamy fine sand or coarser soil textures		

VIII. DARK MINERAL SOILS. Soils with a matrix chroma of 2 or less that extends to a depth of 20 inches below the *top of the mineral soil material*, and that have a *dark A or Ap horizon* (with or without an *O horizon*) that is directly underlain by a horizon with a matrix value of less than 4, and within 12 inches of the *top of the mineral soil material* or directly underlying an *A or Ap horizon*, whichever is shallower, 2 percent or more *redoximorphic features* that extend to:

- A. a depth of 20 inches below the *top of the mineral soil material*; or
- B. a *depleted or gleyed matrix*, whichever is shallower; or

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

VIII. A. and B. Dark Mineral Soils



Key for Soil Textures

 Slightly to partially decomposed organic matter

 Well decomposed organic matter

 Mucky mineral soil

 Loamy fine sand or coarser soil textures

 Any mineral soil texture

IX. SPodosols. Mineral soils having a *spodic horizon* and one of the following morphologies:

A. within 6 inches of the *top of the mineral soil material* have an *E horizon (eluvial horizon)* with 2 percent or more *redoximorphic features* and/or have a *stripped matrix*, that is *directly underlain* by a *spodic horizon* with either:

1. a *Bh, Bhs, or Bs horizon* with 2 percent or more *redoximorphic features*; or



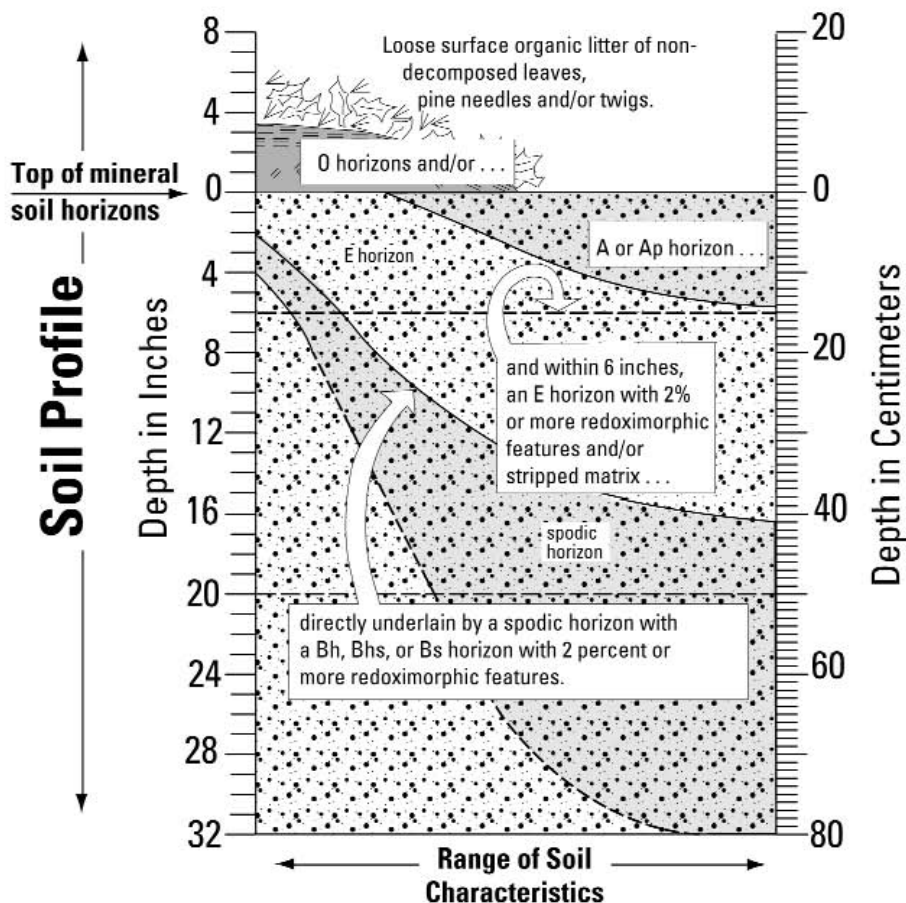
USER NOTE: Soils with an *E horizon* that have dark brown to reddish brown colors in the horizon directly underlying it are considered to have evidence of spodic development. The *E horizon* is often discontinuous across the landscape because of natural disturbances. Some soils will have a *dark A or Ap horizon* overlying a dark brown to reddish brown *spodic horizon*. Not all soils that show evidence of spodic development will classify taxonomically as having a *spodic horizon*. These soils are considered problem soils. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, the assistance of an experienced soil or wetland scientist may be needed to determine whether the soil is hydric.



USER NOTE: Check Appendix 1 Chart for Estimating Percent Redoximorphic Features.

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

IX. A. 1. Spodosols



Key for Soil Textures

	Slightly to partially decomposed organic matter		Mucky mineral soil		Any mineral soil texture
	Well decomposed organic matter		Loamy fine sand or coarser soil textures		

IX. SPodosols. Mineral soils having a *spodic horizon* and one of the following morphologies:

- A. within 6 inches of the *top of the mineral soil material* have an *E horizon (eluvial horizon)* with 2 percent or more *redoximorphic features* and/or have a *stripped matrix*, that is *directly underlain* by a *spodic horizon* with either:
2. a *Bh* and/or *Bhs horizon* that is *directly underlain*, but within 20 inches of the *top of the mineral soil material*, by a horizon with 2 percent or more *redoximorphic features*; or



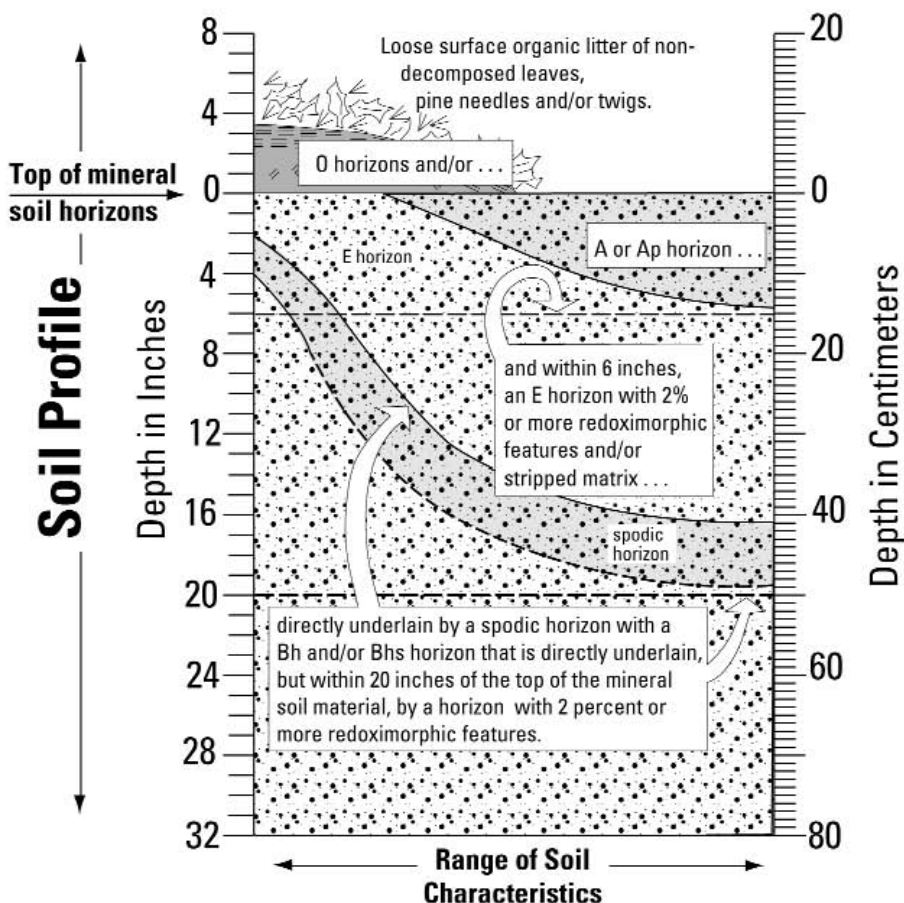
USER NOTE: Soils with an *E horizon* that have dark brown to reddish brown colors in the horizon directly underlying it are considered to have evidence of spodic development. The *E horizon* is often discontinuous across the landscape because of natural disturbances. Some soils will have a *dark A* or *Ap horizon* overlying a dark brown to reddish brown *spodic horizon*. Not all soils that show evidence of spodic development will classify taxonomically as having a *spodic horizon*. These soils are considered problem soils. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, the assistance of an experienced soil or wetland scientist may be needed to determine whether the soil is hydric.



USER NOTE: Check Appendix 1 Chart for Estimating Percent Redoximorphic Features.

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

IX. A. 2. Spodosols



Key for Soil Textures

Slightly to partially decomposed organic matter
 Well decomposed organic matter

Mucky mineral soil
 Loamy fine sand or coarser soil textures

Any mineral soil texture

IX. SPodosols. Mineral soils having a *spodic horizon* and one of the following morphologies:

- B.** beginning within 10 inches of the *top of the mineral soil material* and directly underlying a *dark A* or *Ap horizon* and/or a *shallow E horizon* (or if neither is present, an *O horizon*), there is a *Bh* and/or *Bhs horizon*⁴ that is greater than 2 inches thick that is *directly underlain*, but within 20 inches of the *top of the mineral soil material*, by a horizon with 2 percent or more *redoximorphic features*; or

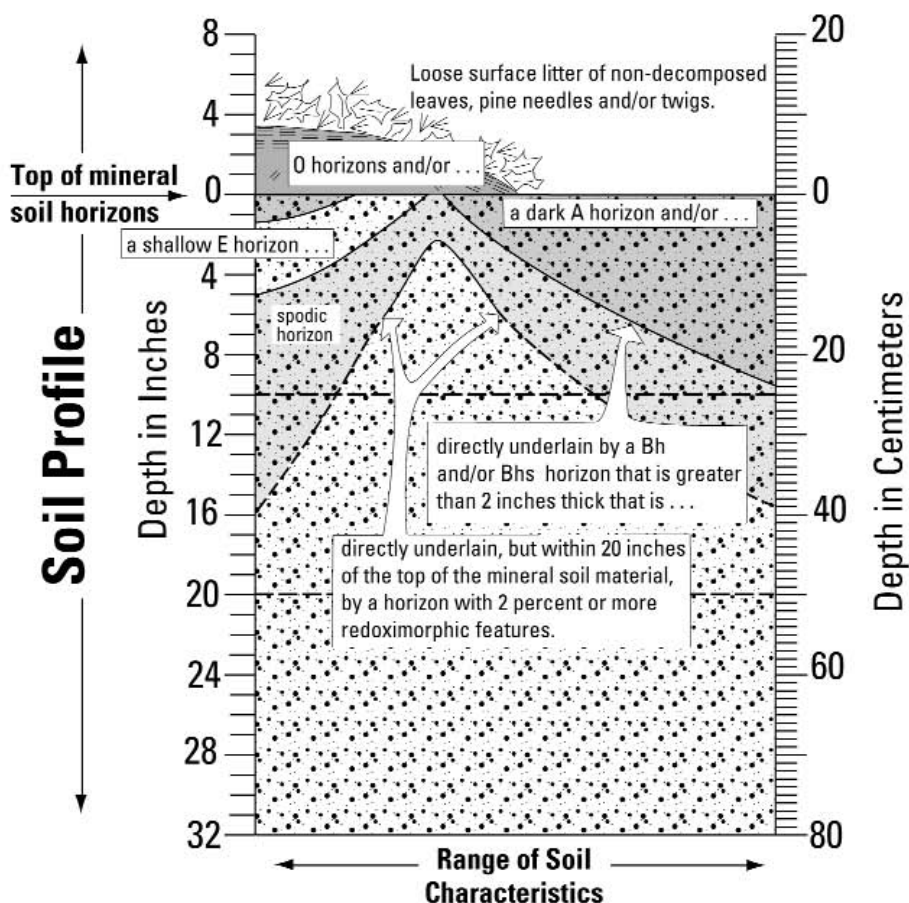


USER NOTE: Soils with an *E horizon* that have dark brown to reddish brown colors in the horizon directly underlying it are considered to have evidence of spodic development. The *E horizon* is often discontinuous across the landscape because of natural disturbances. Some soils will have a *dark A* or *Ap horizon* overlying a dark brown to reddish brown *spodic horizon*. Not all soils that show evidence of spodic development will classify taxonomically as having a *spodic horizon*. These soils are considered problem soils. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, the assistance of an experienced soil or wetland scientist may be needed to determine whether the soil is hydric.

4. This morphology can develop as a result of wetness, or in the *cryic temperature regime*, as a result of climate. See Section XIII for problem soil areas.

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

IX. B. Spodosols



Key for Soil Textures

Slightly to partially decomposed organic matter
 Well decomposed organic matter

Mucky mineral soil
 Loamy fine sand or coarser soil textures

Any mineral soil texture

IX. SPodosols. Mineral soils having a *spodic horizon* and one of the following morphologies:

C. beginning within 10 inches of the top of *the mineral soil material* and directly underlying a *dark A* or *Ap horizon*, is one of the following:

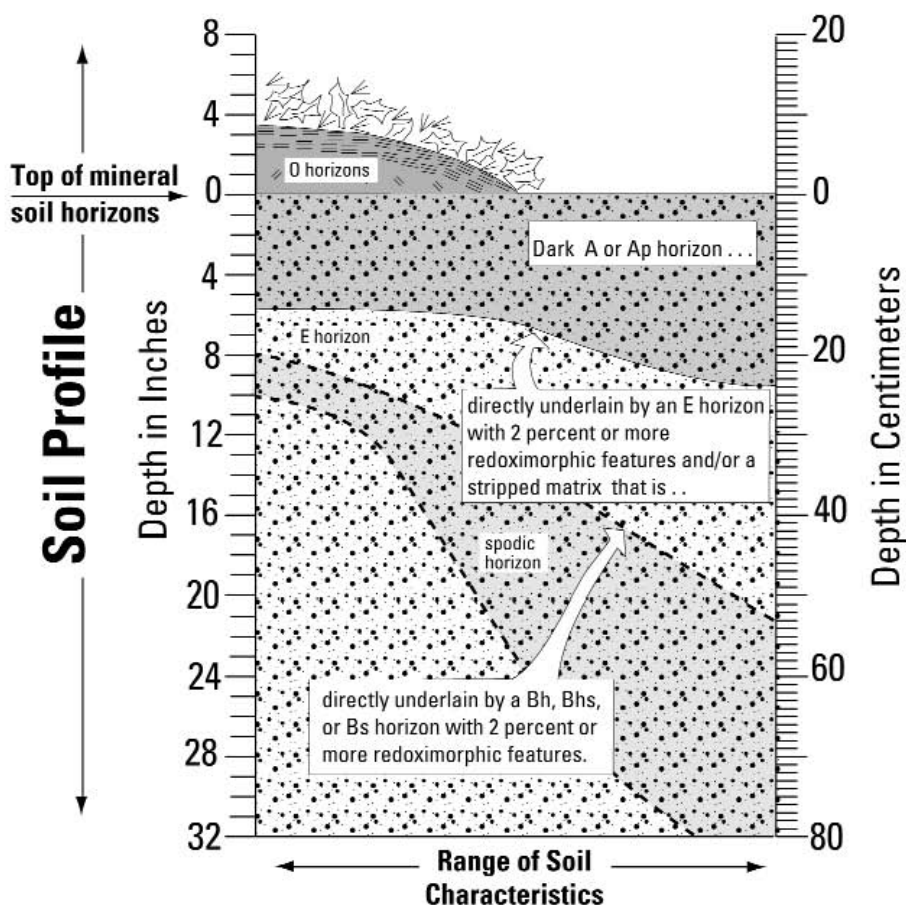
1. an *E horizon* with 2 percent or more *redoximorphic features* and/or a *stripped matrix* directly underlain by a *Bh, Bhs, or Bs horizon* with 2 percent or more *redoximorphic features*; or



USER NOTE: Soils with an *E horizon* that have dark brown to reddish brown colors in the horizon directly underlying it are considered to have evidence of spodic development. The *E horizon* is often discontinuous across the landscape because of natural disturbances. Some soils will have a *dark A* or *Ap horizon* overlying a dark brown to reddish brown *spodic horizon*. Not all soils that show evidence of spodic development will classify taxonomically as having a *spodic horizon*. These soils are considered problem soils. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, the assistance of an experienced soil or wetland scientist may be needed to determine whether the soil is hydric.

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

IX. C. 1. Spodosols



Key for Soil Textures

 Slightly to partially decomposed organic matter

 Well decomposed organic matter

 Mucky mineral soil

 Loamy fine sand or coarser soil textures

 Any mineral soil texture

IX. SPodosols. Mineral soils having a *spodic horizon* and one of the following morphologies:

C. beginning within 10 inches of the *top of the mineral soil material* and directly underlying a *dark A* or *Ap horizon*, is one of the following:

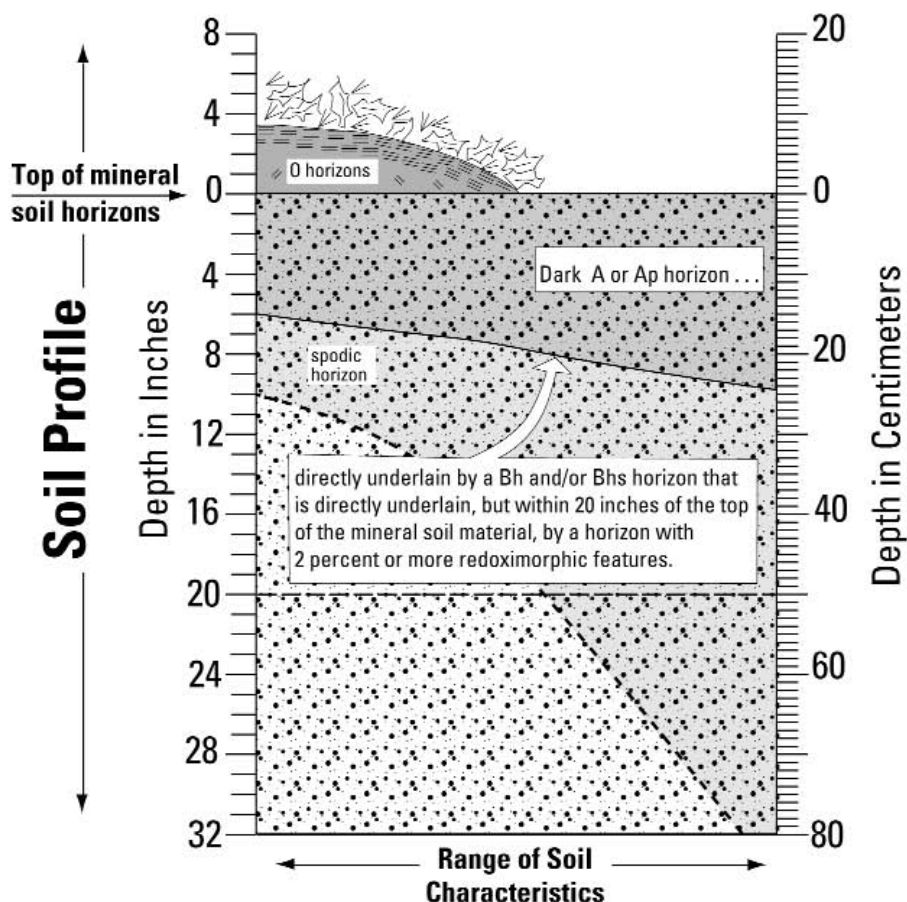
2. a *Bh* and/or *Bhs horizon* that is *directly underlain*, but within 20 inches of the *top of the mineral soil material*, by a horizon with 2 percent or more *redoximorphic features*; or



USER NOTE: Soils with an *E horizon* that have dark brown to reddish brown colors in the horizon directly underlying it are considered to have evidence of spodic development. The *E horizon* is often discontinuous across the landscape because of natural disturbances. Some soils will have a *dark A* or *Ap horizon* overlying a dark brown to reddish brown *spodic horizon*. Not all soils that show evidence of spodic development will classify taxonomically as having a *spodic horizon*. These soils are considered problem soils. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, the assistance of an experienced soil or wetland scientist may be needed to determine whether the soil is hydric.

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

IX. C. 2. Spodosols



Key for Soil Textures

Slightly to partially decomposed organic matter
 Well decomposed organic matter

Mucky mineral soil
 Loamy fine sand or coarser soil textures

Any mineral soil texture

IX. SPodosols. Mineral soils having a *spodic horizon* and one of the following morphologies:

C. beginning within 10 inches of the *top of the mineral soil material* and directly underlying a *dark A or Ap horizon*, is one of the following:

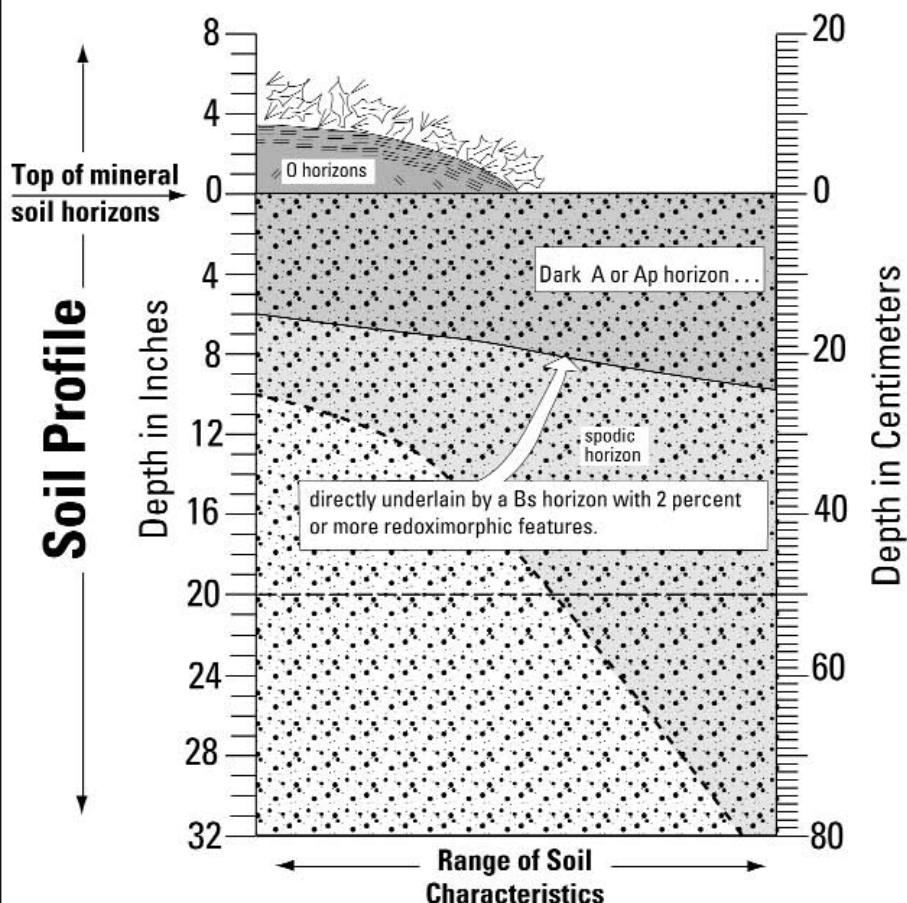
3. a *Bs horizon* with 2 percent or more *redoximorphic features*; or



USER NOTE: Soils with an *E horizon* that have dark brown to reddish brown colors in the horizon directly underlying it are considered to have evidence of spodic development. The *E horizon* is often discontinuous across the landscape because of natural disturbances. Some soils will have a *dark A or Ap horizon* overlying a dark brown to reddish brown *spodic horizon*. Not all soils that show evidence of spodic development will classify taxonomically as having a *spodic horizon*. These soils are considered problem soils. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, the assistance of an experienced soil or wetland scientist may be needed to determine whether the soil is hydric.

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

IX. C. 3. Spodosols



Key for Soil Textures

Slightly to partially decomposed organic matter

Well decomposed organic matter

Mucky mineral soil

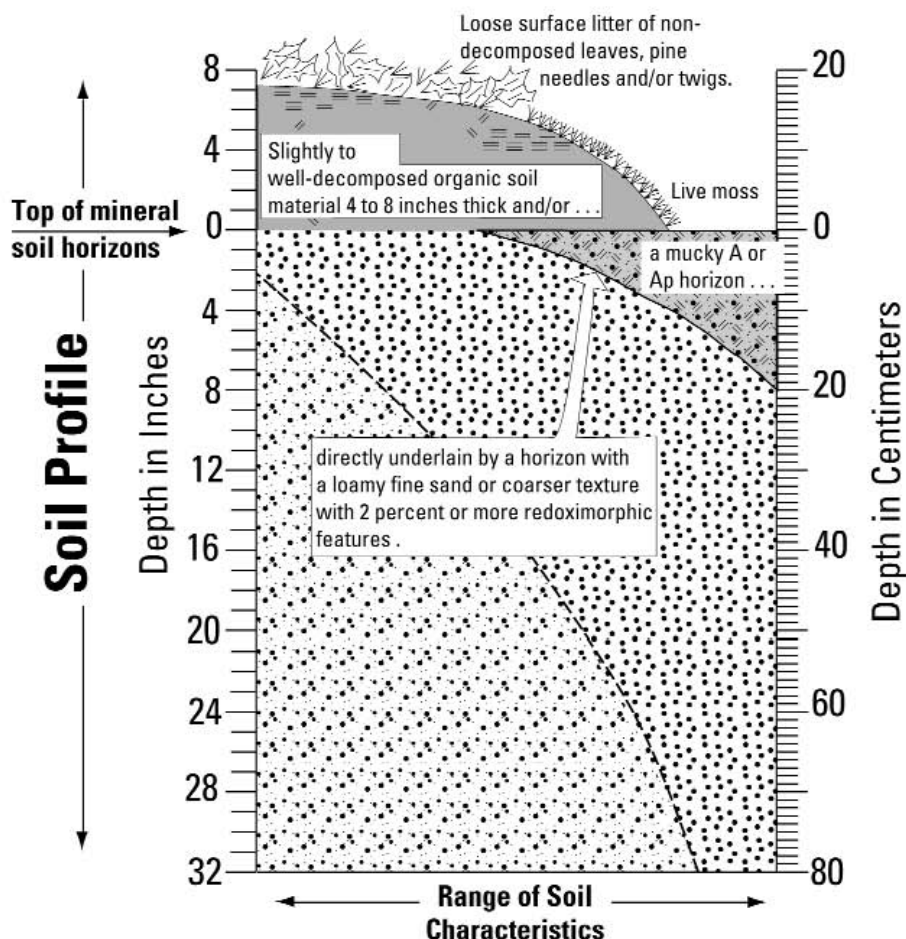
Loamy fine sand or coarser soil textures

Any mineral soil texture

- X. SANDY WITH REDOX.** *Soils that do not have a spodic horizon and:*
- A.** *have a layer 4 to 8 inches thick of slightly to well-decomposed organic soil material and/or a mucky A or Ap horizon; and are directly underlain by a horizon with a loamy fine sand or coarser texture with 2 percent or more redoximorphic features; or*

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

X. A. Sandy with Redox



Key for Soil Textures

 Slightly to partially decomposed organic matter	 Mucky mineral soil	 Any mineral soil texture
 Well decomposed organic matter	 Loamy fine sand or coarser soil textures	

X. SANDY WITH REDOX. Soils that do not have a *spodic horizon* and:

B. beginning within 10 inches of the *top of the mineral soil material* and *directly underlying a dark A or Ap horizon* (with or without an *O horizon*) is a horizon with a *loamy fine sand or coarser* texture with a *matrix color* due to wetness of chroma 3 or less, value 4 or more, with 2 percent or more *redoximorphic features*; or



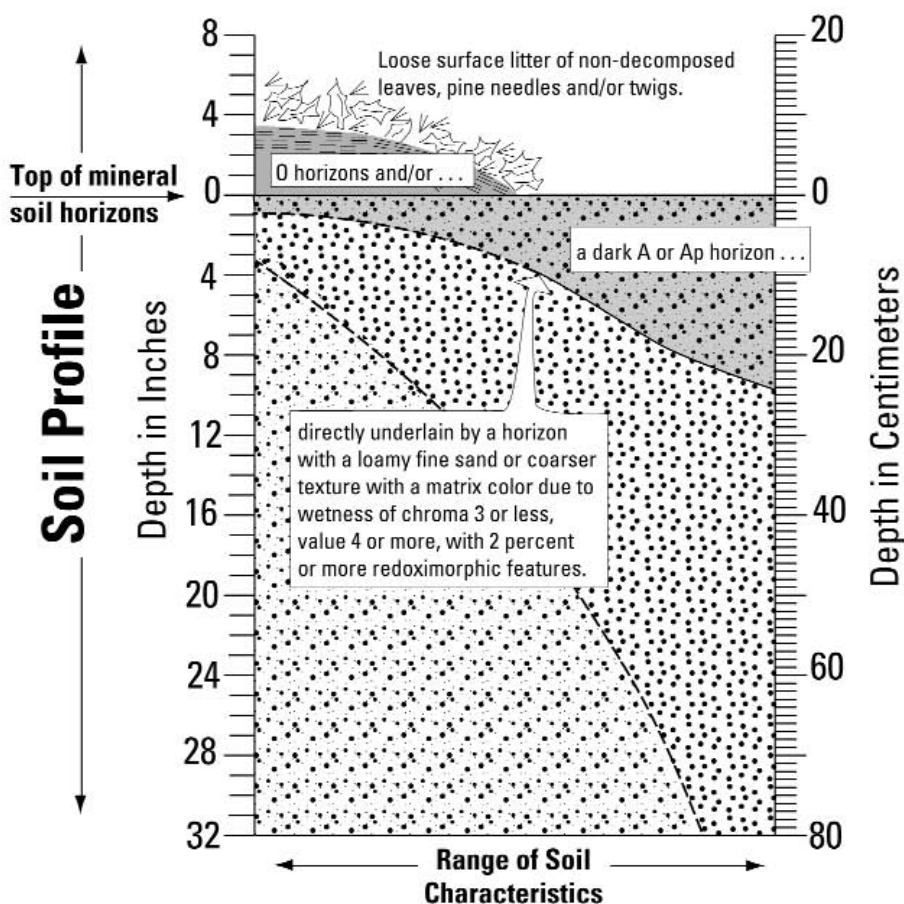
USER NOTE: Soil profiles may have soil textures that are stratified, requiring the use of multiple color criteria. When, for example, a soil has a layer of “loamy fine sand or coarser” overlying a layer with a texture of “finer than loamy fine sand,” color criteria for indicators associated with the “Sandy Soils” shall apply to the upper layer while color criteria for indicators associated with “Loamy or Clayey Soils” shall apply to the lower layer.



USER NOTE: Field investigations have documented some situations where the conditions for a hydric soil are present and the matrix chroma directly underlying the *A or Ap horizon* is greater than 3. These soil conditions are associated with iron-enriched groundwater discharge areas. These soils are considered problem soils. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, the assistance of an experienced soil or wetland scientist may be needed to determine whether the soil is hydric.

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

X. B. Sandy with Redox



Key for Soil Textures

 Slightly to partially decomposed organic matter

 Well decomposed organic matter

 Mucky mineral soil

 Loamy fine sand or coarser soil textures

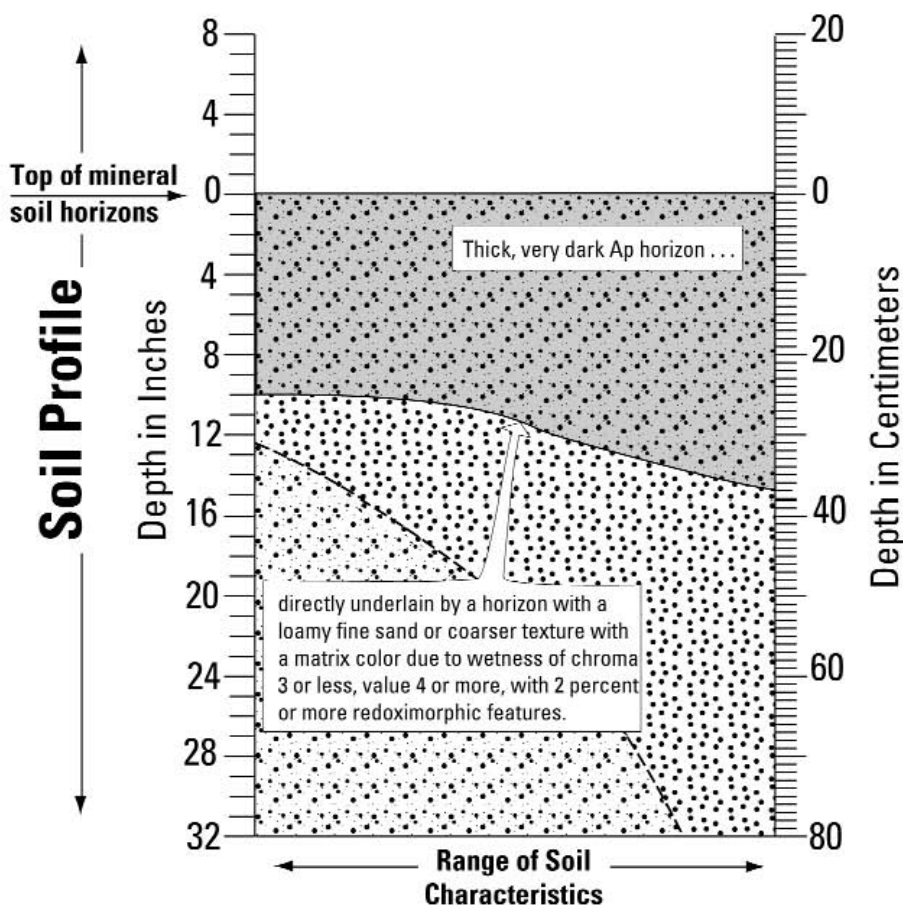
 Any mineral soil texture

- X. SANDY WITH REDOX.** Soils that do not have a *spodic horizon* and:
- C. beginning within 15 inches of the *top of the mineral soil material* and directly underlying a *thick, very dark A or Ap horizon* there is a horizon with a *loamy fine sand or coarser texture* with a *matrix color* due to wetness of chroma 3 or less, value 4 or more, with 2 percent or more *redoximorphic features*; or

 **USER NOTE:** Field investigations have documented some situations where the conditions for a hydric soil are present and the matrix chroma directly underlying the A or Ap horizon is greater than 3. These soil conditions are associated with iron-enriched groundwater discharge areas. These soils are considered problem soils. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, the assistance of an experienced soil or wetland scientist may be needed to determine whether the soil is hydric.

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

X. C. Sandy with Redox



Key for Soil Textures

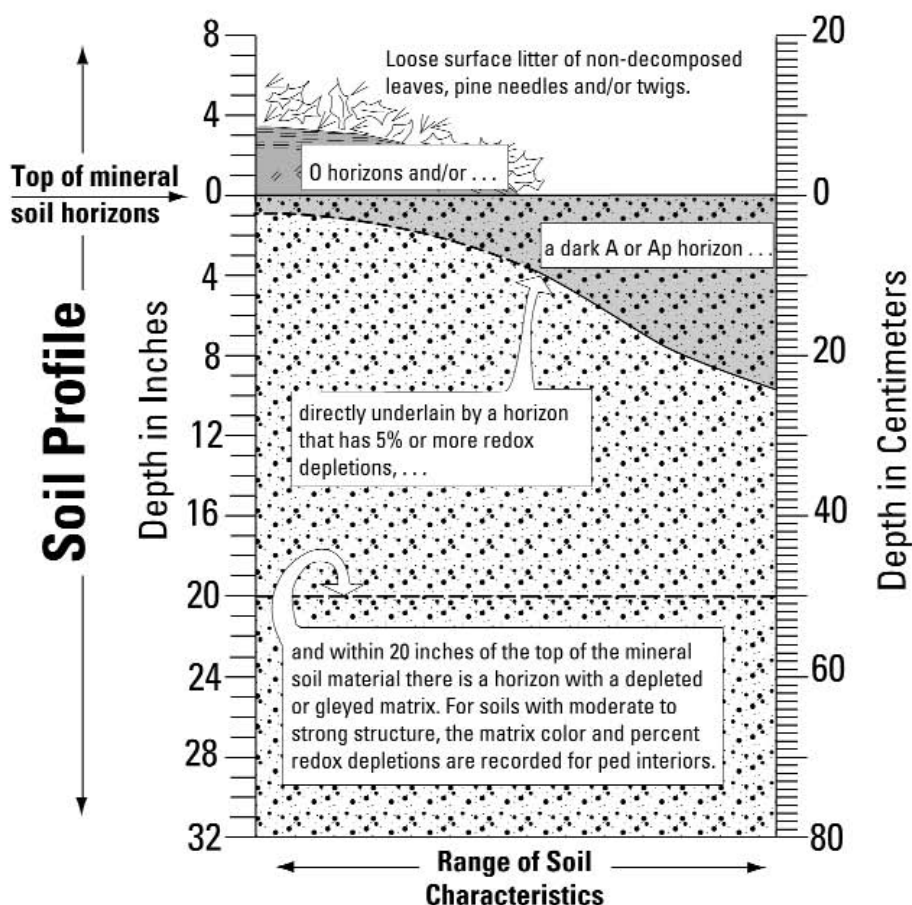
	Slightly to partially decomposed organic matter		Mucky mineral soil		Any mineral soil texture
	Well decomposed organic matter		Loamy fine sand or coarser soil textures		

XI. ANY TEXTURE. Soils that do not have a *spodic horizon* and

- A. beginning within 10 inches of the *top of the mineral soil material* and directly underlying a *dark A* or *Ap horizon* (with or without an *O horizon*) is a horizon with 5 percent or more *redox depletions*, and within 20 inches of the *top of the mineral soil material* there is a horizon with a *depleted* or *gleyed matrix* (for soils with *moderate to strong structure*, the *matrix color* and *percent redox depletions* are recorded for *ped interiors*); or

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

XI. A. Any Texture



Key for Soil Textures

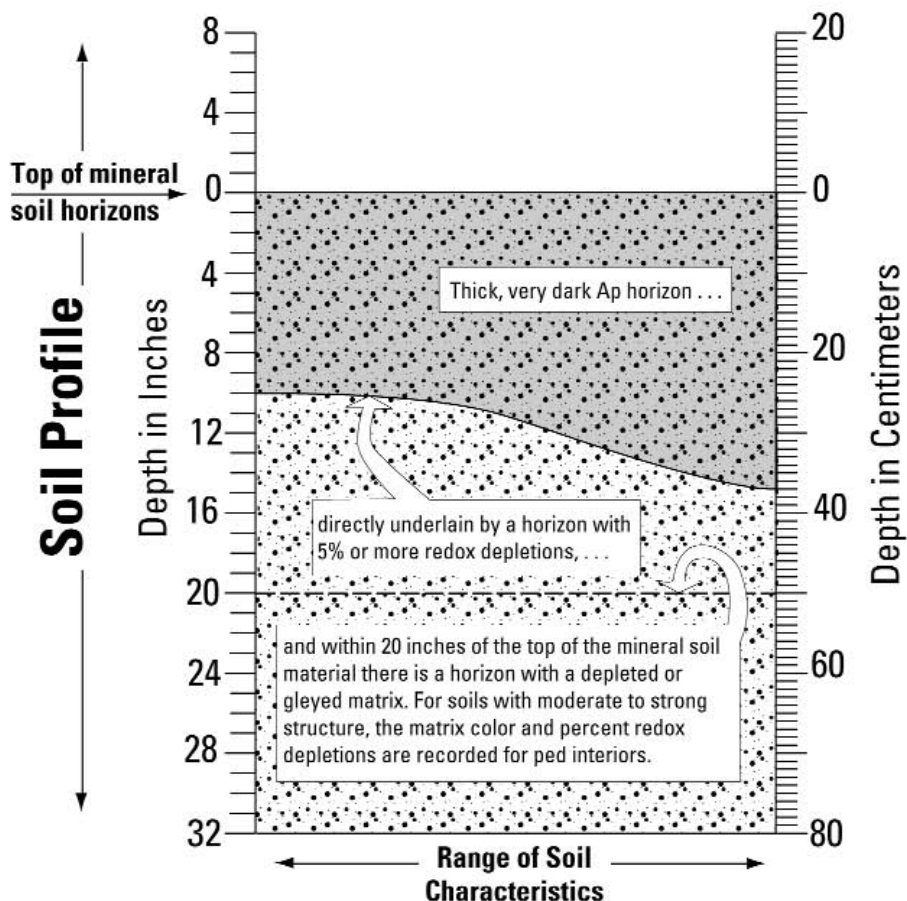
 Slightly to partially decomposed organic matter	 Mucky mineral soil	 Any mineral soil texture
 Well decomposed organic matter	 Loamy fine sand or coarser soil textures	

XI. ANY TEXTURE. Soils that do not have a *spodic horizon* and

B. beginning within 15 inches of the *top of the mineral soil material* and directly underlying a *thick, very dark Ap horizon*, is a horizon with 5 percent or more *redox depletions* and within 20 inches of the *top of the mineral soil material* there is a horizon with a *depleted or gleyed matrix* (for soils with *moderate to strong structure*, the *matrix color* and percent *redox depletions* are recorded for *ped interiors*); or

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

XI. B. Any Texture



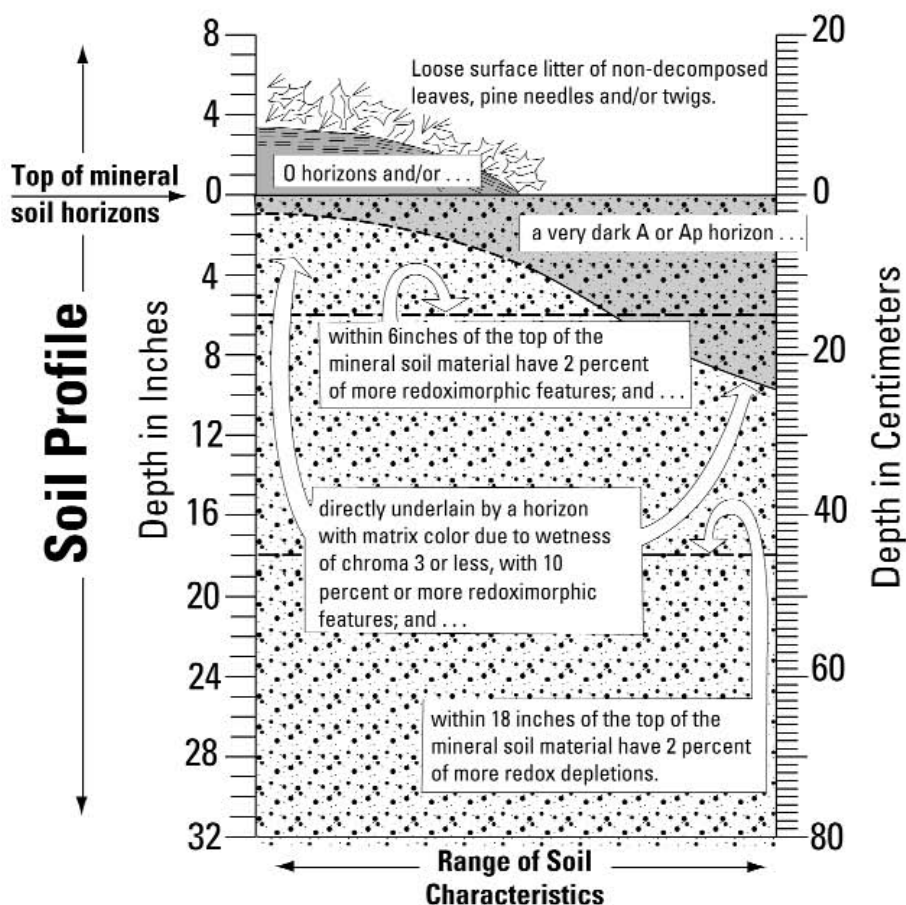
Key for Soil Textures

	Slightly to partially decomposed organic matter		Mucky mineral soil		Any mineral soil texture
	Well decomposed organic matter		Loamy fine sand or coarser soil textures		

XII. ANY TEXTURE. Soils that have a *very dark A* or *Ap horizon* less than 10 inches thick (with or without an *O horizon*) that are *directly underlain* by a horizon with a *matrix color* due to wetness of chroma 3 or less, with 10 percent or more *redoximorphic features*; and within 6 inches of the *top of the mineral soil material* have 2 percent or more *redoximorphic features*; and within 18 inches of the *top of the mineral soil material* have 2 percent or more *redox depletions*; or

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

XII. Any Texture



Key for Soil Textures

	Slightly to partially decomposed organic matter		Mucky mineral soil		Any mineral soil texture
	Well decomposed organic matter		Loamy fine sand or coarser soil textures		

XIII. “PROBLEM” SOIL AREAS

Disturbed soils

Specific map location of disturbed soils is impractical, since they occur throughout the region. The USDA STATSGO map on the NEIWPCC website (www.neiwpcc.org/hydricsoils.htm), is based on soil survey data, so that only significant acreage of mapped disturbed soils (such as the city of Boston) would be legible.

In many places soils have been altered by human activity, and such soils are referred to as *human-influenced*, *anthropogenic*, or *disturbed*. Altered soils are typically the result of earth-moving activities where: 1) soil material is removed from its natural position; 2) soil material is placed over existing soil; and/or 3) soil material has been re-graded from on-site material or material transported from other locations. Fill is common to construction sites, lawns, parking lots, highway and railroad embankments, refuse landfill, and dams. Sand and gravel pits, quarries, ditches, and highway and railroad cuts are examples of excavated soils. Other sources of disturbance include agricultural and forestry practices, motorized vehicles, and any practice that promotes accelerated erosion or deposition and mass wasting. Changes that affect local water tables and drainage may result in hydric soils lacking saturation or conversely soils that are saturated and anaerobic showing no morphologic evidence of wetness.

There are very few sites in New England that have not seen anthropogenic alterations of some kind. Much of the region was deforested for agriculture and non-sustainable forestry during the 19th Century. The effects of those activities can still be observed throughout our landscape. From a practical point of view, the older the disturbance the more difficult it is to recognize in the field. Fortunately, ***soil morphologies*** develop with time allowing the use of *Field Indicators for Identifying Hydric Soils in New England* for most soils without regard to whether they have been altered. Section VII., for instance, is intended to capture hydric soils with deep plow layers (Ap horizons).

The variability of soil fill material makes establishing a reliable key for every possible situation extremely difficult. The principal challenge for hydric soil classification at excavated sites is the lack of a definite reference to the original ground surface elevation coupled with the relatively short time the soil has been exposed to weathering and profile development. Filled or excavated sites that have been re-graded present additional complexity. Guidelines and indicators developed for *disturbed soils* will focus on interpretation of sites where alteration has occurred within the last few decades.

Folists and Soils with Folistic Epipedons

Folists are “more or less freely drained **Histosols** that consist primarily of **O horizons** derived from leaf litter, twigs and branches resting on rock or on fragmental materials that consist of gravel, stones and boulders in which the interstices are filled or partly filled with organic material” (USDA, 1999). **Folists** are “saturated with water for less than 30 cumulative days during normal years” (USDA, 1999). **Folistic Epipedons** are surface horizons that consist of organic material in a natural state or plowed horizons that have high organic carbon content as a result of mixing an organic soil surface with underlying mineral horizons.

Both **Folists** and **Folistic Epipedons** occur in cool (**Frigid** and **Cryic temperature regimes**) humid regions of the world. In New England they have significant distribution in high mountain elevations (usually above 2500 feet) and along the immediate coast of Maine and islands in the Gulf of Maine.

These soils occur in upland areas but they have thick organic surfaces that may be easily mistaken for the saturated **Histosols** (**Folists** are a Suborder of **Histosols**) or mineral soils with a **histic epipedon**. Often **Folists** and soils with **Folistic epipedons** lie adjacent to their wetter cousins (Fibristis, Sapristis and Hemists) with very subtle changes in topography and vegetation.

Soils formed in Dark Parent Materials

These soils formed in dark-colored (gray and black) parent materials derived from dark-colored carboniferous and phyllitic bedrock. These soils occur in the Narragansett basin of Rhode Island, parts of southeastern and western Massachusetts, throughout Vermont and in extreme western New Hampshire.

The soil colors commonly are low chroma and a low value. The inherited colors make it difficult to assess soil wetness using conventional models of morphology. ***Low chroma colors, depleted matrices, redox depletions***, etc. are typically masked by the dark mineralogy. Some features may be observable under magnification (Stolt et al, 2001). Indicator VIII. (Dark Parent Materials) was developed to address many of the soils forming in dark parent materials, however, this indicator does not solve the identification problems in all areas.

Soils formed in Red Parent Material

Soils formed in red parent materials are generally found in areas of Mesozoic geologic materials. Their most common occurrence is in the Connecticut River valley and adjacent highlands, extending from Long Island Sound north into southern Massachusetts. Typical soil series associated with red parent materials include: Cheshire, Hartford, Holyoke, Ludlow, Manchester, Meckesville, Menlo Penwood, Sunderland, Yalesville, Watchaug, Wethersfield and Wilbraham. If one is in an area where these soils are mapped you are likely to be dealing with red parent materials (see STATSGO map).

Soils developed in red parent materials challenge hydric soil identification because the iron-rich materials inhibit or mask the development of gray colors normally associated with hydric soils.

Examination of soils along transects that bisect the drainage catena, should be the first step to making an informed decision. Relative changes in the soil matrix chroma along the transect may help in identifying a soil boundary. Conventional models of soil morphology sometimes may be applied where the red mineralogy is not intensely expressed.

The National Technical Committee for Hydric Soils has developed a hydric soil “Test Indicator” for soils developed in these red parent materials. The NEHSTC is recommending that the test indicator be tested in New England:

TF2. Red Parent Material.

In parent material with a hue of 7.5YR or redder, a layer at least 10 cm (4 in) thick with a matrix value 4 or less and chroma 4 or less and 2 percent or more redox depletions or redox concentrations as soft masses or pore linings, or both. The layer is entirely within 30 cm (12in) of the soil surface. The minimum thickness requirement is 5 cm (2 in) if the layer is the mineral surface layer.(USDA, 2002)

Development of soil morphology keys for identifying hydric soils in these “problem areas” must be correlated with actual field measurements of hydrology. All of the NEHSTC subcommittees will be establishing research sites for this purpose. Detailed soil descriptions and vegetative data will be collected at each site. Saturation (monitoring wells), redox potential (Eh electrodes), precipitation, and in-situ pH will be measured through the wet-dry cycle.

The current need is to locate at least three sites representative of any proposed indicator. The sites must include locations that are obviously wetland, obviously upland and transitional. All three locations are to be monitored.

Anyone who would like to nominate a site is encouraged to contact the NEHSTC. Subcommittee chairmen are:

Disturbed soils: Tom Peragallo (*Peragallo@stompit.net*)

Folists and Soils with Folistic Epipedons: TBD

Soils formed in Dark Parent Material: Mark Stolt (*mstolt@uri.edu*)

Soils formed in Red Parent Material: Harvey Luce (*harveyluce@uconn.edu*)

References

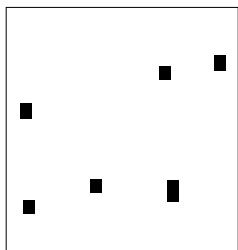
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Table of Contents—Appendix

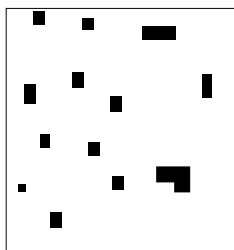
Appendix 1 Chart for Estimating Percent Redoximorphic Features	60
Appendix 2 Chart for Estimating 2 Percent Redoximorphic Features	61
Appendix 3 Chart for Estimating Size of Redoximorphic Features	62
Appendix 4 Table for Estimating Contrast of Redoximorphic Features	63
Appendix 5 Tabular Key for Contrast Determination using Munsell® Notation	64
Appendix 6 Chart for Determining Type of Soil Structure	65
Appendix 7 Table for Estimating Grade of Soil Structure	66
Appendix 8 Chart for Estimating Size of Granular Structure	67
Appendix 9 Chart for Estimating Size of Blocky Structure	68

APPENDIX 1

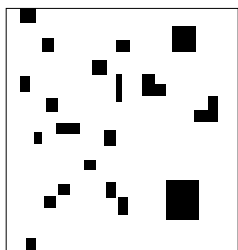
Chart for Estimating Percent Redoximorphic Features



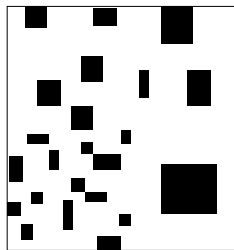
2%



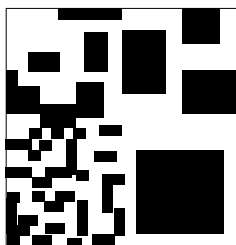
5%



10%



20%

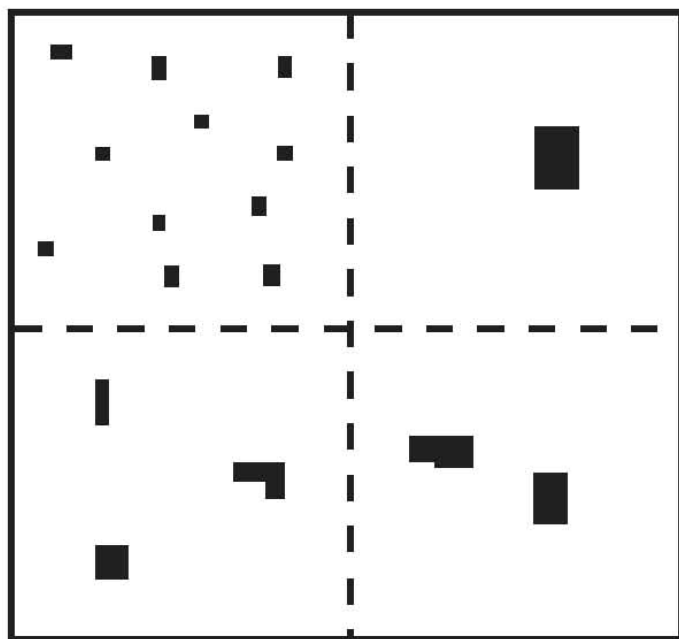


50%

NOTE: *The New England Hydric Soil Indicators may specify 2, 5, 10, or 20 percent redoximorphic features, and the conventional terms Few (<2%) and Common (2 to 20%) may not be specific enough.*

APPENDIX 2

Chart for Estimating 2 Percent Redoximorphic Features

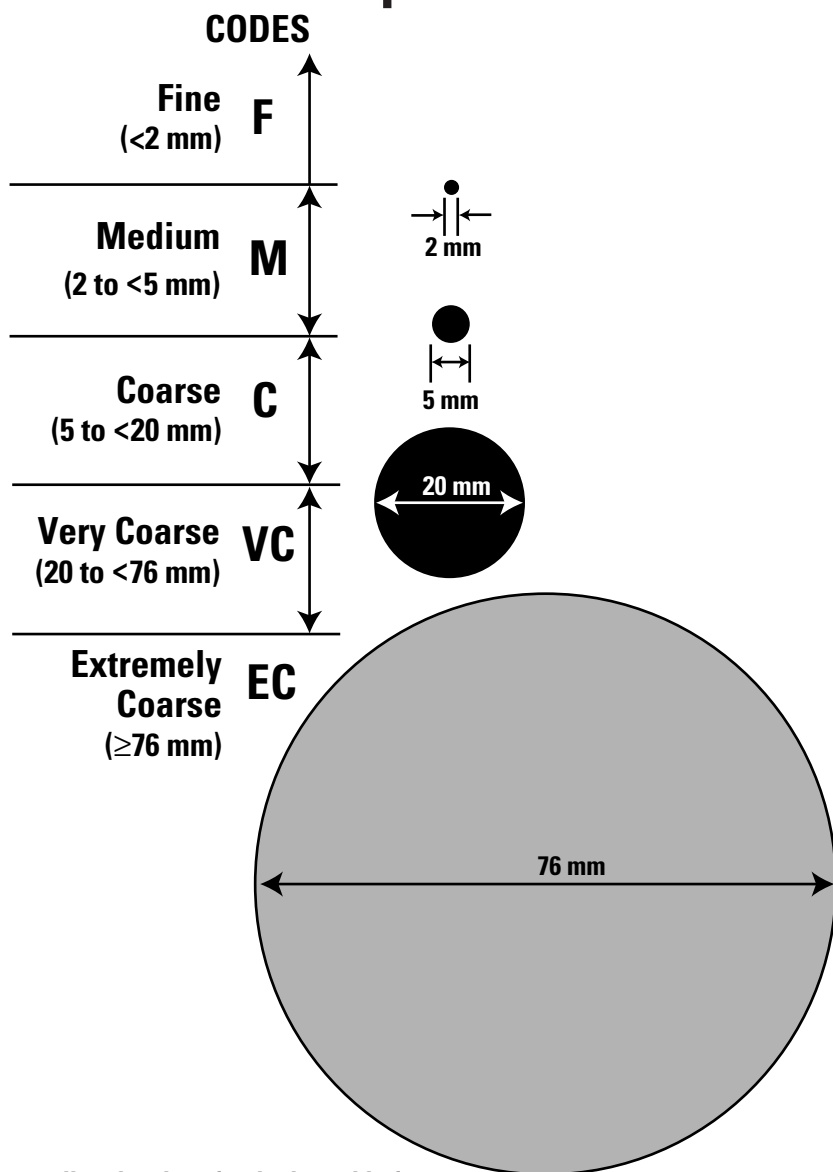


2%

Note: In each quadrant, the black areas represent 2 percent of the surface area.

APPENDIX 3

Chart for Estimating Size of Redoximorphic Features



When recording the size of redoximorphic features—

Use length if it's greater than 2 times the width; use width if the length is less than two times the width. Length is the greater of the two dimensions.

APPENDIX 4

Table for Estimating Contrast of Redoximorphic Features

Record the color difference between the redoximorphic feature (RMF) and the matrix color. Use this table or the tabular key on next page to determine the contrast.

Note: If the mottle and matrix both have **values** of ≤ 3 and **chromas** of ≤ 2 , the color contrast is **Faint**, regardless of the difference in hue.

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

- 1) difference in hue = 0, difference in value is ≤ 2 , and difference in chroma is ≤ 1 , or
- 2) difference in hue = 1, difference in value is ≤ 1 , and difference in chroma is ≤ 1 , or
- 3) difference in hue = 2, difference in value = 0, and difference in chroma = 0, or
- 4) difference in hue is ≥ 3 and both colors have values of ≤ 3 and chromas of ≤ 2 .

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

- 1) difference in hue = 0, and
 - a. difference in value is < 2 and difference in chroma is > 1 to < 4 , or
 - b. difference in value is > 2 to < 4 and difference in chroma is < 4 .
- 2) difference in hue = 1, and
 - a. difference in value is ≤ 1 and difference in chroma is > 1 to < 3 , or
 - b. difference in value is > 1 to < 3 , and difference in chroma is < 3 .
- 3) difference in hue = 2, and
 - a. difference in value = 0 and difference in chroma is > 0 to < 2 , or
 - b. difference in value is > 0 to < 2 and difference in chroma is < 2 .

Prominent – Contrasts strongly with the color to which compared. Color contrasts that are not faint or distinct are prominent.

Table contents compiled from the Soil Survey Technical Note 2. For more information visit: <http://soils.usda.gov/technical/technotes/note2.html>

Note: The Appendix contains both a table and tabular key for estimating contrast of redoximorphic features.

APPENDIX 5

Tabular Key for Contrast Determination using Munsell® Notation

Note: If both colors have values of ≤ 3 and chromas of ≤ 2 , the color contrast is *Faint* (regardless of the difference in hue).

<i>Hues are the same ($\Delta h = 0$)</i>			<i>Hues differ by 2 ($\Delta h = 2$)</i>		
Δ Value	Δ Chroma	Contrast	Δ Value	Δ Chroma	Contrast
0	≤ 1	Faint	0	0	Faint
0	2	Distinct	0	1	Distinct
0	3	Distinct	0	≥ 2	Prominent
0	≥ 4	Prominent	1	≤ 1	Distinct
1	≤ 1	Faint	1	≥ 2	Prominent
1	2	Distinct	≥ 2	---	Prominent
1	3	Distinct			
1	≥ 4	Prominent			
≤ 2	≤ 1	Faint			
≤ 2	2	Distinct			
≤ 2	3	Distinct			
≤ 2	≥ 4	Prominent			
3	≤ 1	Distinct			
3	2	Distinct			
3	3	Distinct			
3	≥ 4	Prominent			
≥ 4	---	Prominent			
Hues differ by 1 ($\Delta h = 1$)			Hues differ by 3 or more ($\Delta h \geq 3$)		
Δ Value	Δ Chroma	Contrast	Δ Value	Δ Chroma	Contrast
0	≤ 1	Faint	Color contrast is prominent, except for low chroma and value.		Prominent
0	2	Distinct			
0	2	Distinct			
0	≥ 3	Prominent			
1	≤ 1	Faint			
1	2	Distinct			
1	≥ 3	Prominent			
2	≤ 1	Distinct			
2	2	Distinct			
2	≥ 3	Prominent			
≥ 3	---	Prominent			

Note: The Appendix contains both a table and tabular key for estimating contrast of redoximorphic features.

APPENDIX 6

Chart for Determining Type of Soil Structure

Granular 	Blocky (Subangular)  (Angular) 	
Platy 	Prismatic  Columnar 	
Wedge 		

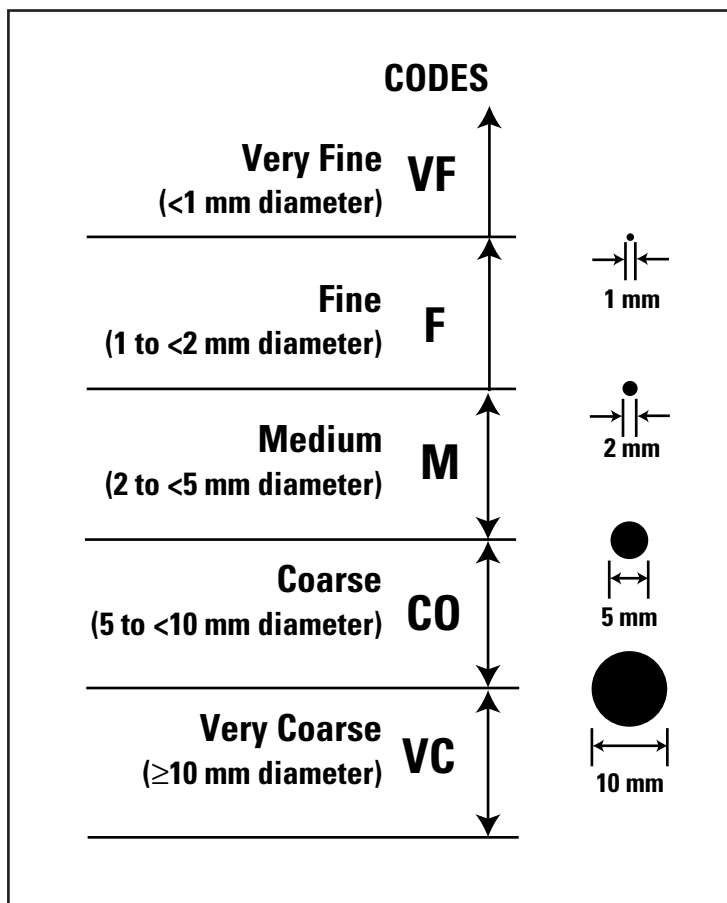
APPENDIX 7

**Table for Estimating Grade
of Soil Structure**

Grade	Code	Criteria
Structureless	0	No discrete units observable in place or in a hand sample.
Weak	1	Units are barely observable in place or in a hand sample.
Moderate	2	Units well-formed and evident in place or in a hand sample.
Strong	3	Units are distinct in place (undisturbed soil), and separate cleanly when disturbed.

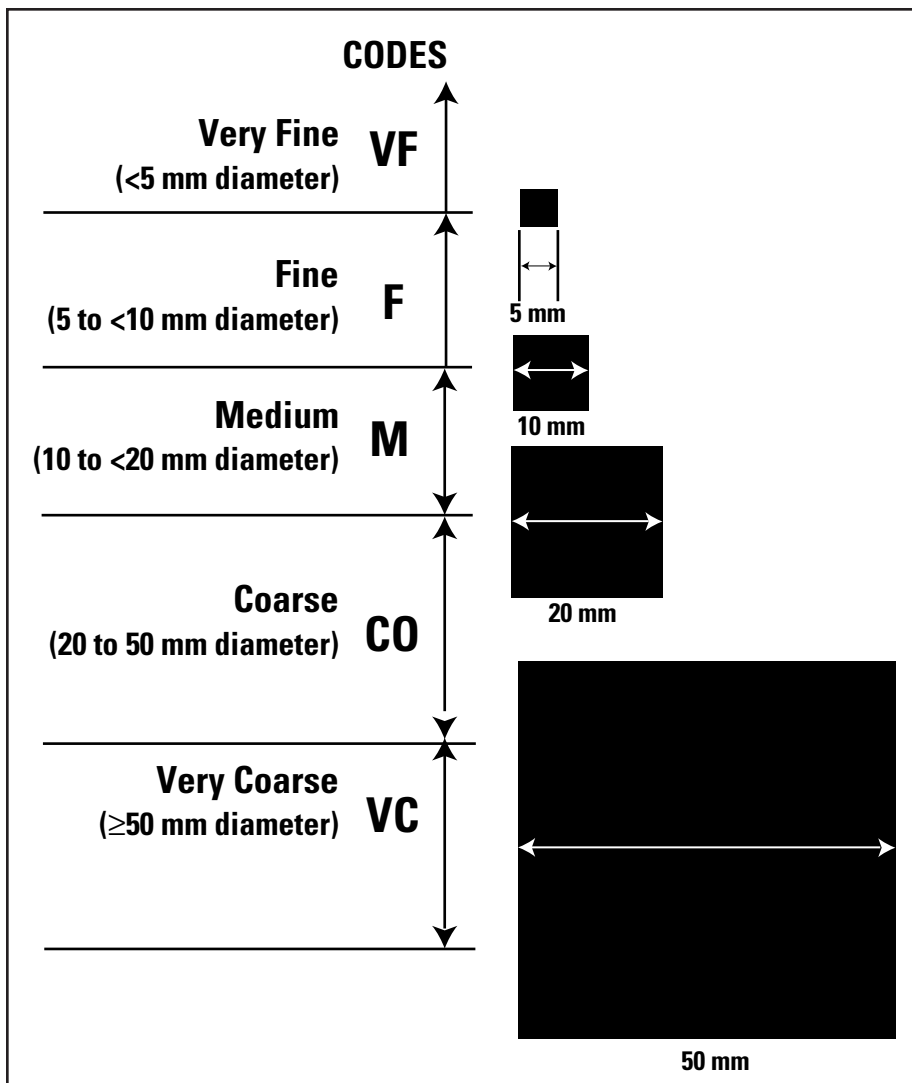
APPENDIX 8

Chart for Estimating Size of Granular Structure



APPENDIX 9

Chart for Estimating Size of Blocky Structure



Glossary Of Terms

A Horizon – *Mineral soil horizons* which have formed at the surface or below an **O horizon** which show an accumulation of humified organic matter intimately mixed with the mineral fraction. An **A horizon** has a morphology distinct from the C layer, although the mineral fraction is unaltered or slightly altered by weathering. Such a horizon is designated A because it is at the surface; however, recent alluvial or eolian deposits that retain rock structure are not considered to be an **A horizon** unless cultivated. See *Soil Survey Manual* (1993) for complete definition.

A or Ap Horizon, Dark⁵ – **A or Ap horizon** that has moist colors with chromas 2 or less and values 3 or less.

A or Ap Horizon, Very Dark – A or Ap horizon that has moist colors with chromas 2 or less and values less than 3.

Abundance, Redoximorphic Features – The percent of the surface area covered by *redoximorphic features*. Refer to Chart for Estimating Percent Redoximorphic Features, located in Appendix 1.

Albic Horizon – An eluvial horizon 0.4 inches (1 cm) or more thick that has 85% or more (by volume) *albic materials*. See *Keys to Soil Taxonomy* (2003).

Albic Materials – *Mineral soil materials* from which clay and free iron oxides have been removed or in which the oxides have been segregated to the extent that the color of the horizon is determined primarily by the color of the primary sand and silt particles rather than by the coatings on these particles. See *Keys to Soil Taxonomy* (2003).

Anaerobic Conditions – A condition when molecular oxygen is essentially absent from the soil.

Ap Horizon – An **A horizon** with properties resulting from cultivation, pasturing, or similar kinds of disturbance.

5. Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

Aquic Conditions – Soils with ***aquic conditions*** are those that currently undergo continuous or periodic saturation and reduction. The presence of these conditions is indicated by ***redoximorphic features***, except in ***Histosols***, and can be verified—except in artificially drained soils—by measuring saturation and reduction. See *Keys to Soil Taxonomy* (2003) for complete discussion.

The three elements of ***aquic conditions*** are:

1. **Saturation** – Characterized by zero or positive pressure in the soil-water and can generally be determined by observing free water in an unlined auger hole.
2. **Reduction** – The degree of reduction in a soil can be characterized by the direct measure of redox potential. The a,a'-dipyridyl test (Childs, C.W., 1981) may be used in the field to determine the presence of reduced iron (ferrous, Fe^{+2}) ions.
3. **Redoximorphic features** – Associated with wetness; result from the reduction and often oxidation of iron and manganese compounds in the soil after saturation with water and desaturation, respectively.

B Horizon – Horizon that forms below an ***A***, ***E***, or ***O horizon*** that shows evidence of soil formation, i.e. illuviation, development of soil color, formation of ***soil structure***, etc. See *Soil Survey Manual* (1993) for complete definition.

Bh and Bhs Horizons – ***B horizons*** with an accumulation of illuvial, amorphous, dispersible organic matter (sesquioxide complexes). The sesquioxide component coats sand and silt particles. The symbol “h” is used in combination with “s” as Bhs if the amount of sesquioxide component is significant but value and chroma of the horizon are 3 or less. These horizon designations are often used to identify and describe ***spodic horizons***. See *Soil Survey Manual* (1993) for complete definition.

Biological Zero – the soil temperature, at a depth of 50 cm (19.7”), below which the growth and function of locally adapted plants are negligible. (Reference: NRCS Hydric Soil Criteria as posted on <http://soils.usda.gov/use/hydric/criteria.html>.) For the purposes of this manual, a temperature of 5°C (41°F) is used.

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

Bs Horizon – *B horizon* with an accumulation of illuvial, amorphous, dispersible organic matter – sesquioxide complexes if both the organic matter and sesquioxide components are significant, and if either the moist color value or chroma of the horizon is more than 3. This horizon designation is often used to identify and describe ***spodic horizons***. See *Soil Survey Manual* (1993) for complete definition.

Common, Redoximorphic Features – *Redoximorphic features* comprising from 2 to 20 percent of the observed surface area.

Concretion (Fe/Mn) – A cemented concentration of a chemical compound of iron and manganese that can be removed from the soil intact and that has a crude internal symmetry organized around a point, a line, or a plane.

Contrast, Redoximorphic Features – The contrast in color between the ***redoximorphic feature*** and the ***matrix color***. See ***faint, distinct***, and ***prominent redoximorphic features***. Refer to both the Chart and the Table for Estimating Contrast of Redoximorphic Features, located in Appendices 3 and 4.

Crushed and Smoothed Color – A soil color recorded for a moist soil sample that has been broken up, and then lightly compressed and smoothed with one's thumb. This is used when documenting colors of spodic horizons.

Cryic Temperature Regime – A soil temperature regime that has mean annual soil temperatures of less than 8 oC. Mean summer soil temperature for saturated mineral soils with ***O horizons*** is lower than 6 oC. See *Keys to Soil Taxonomy* (2003) for complete definition.

Dark A or Ap Horizon⁶ – Refer to ***A or Ap Horizon, Dark***.

Depleted Matrix⁶ – A ***depleted matrix*** makes up more than 50% of the horizon or subhorizon from which iron has been removed or transformed by processes of reduction and often translocation to create colors of low chroma and high value. ***A*** and ***E horizons*** may have low chromas and high values and may therefore be mistaken

6. Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

for a **depleted matrix**; however, they are excluded from the definition, unless, in the case of an **E horizon**, it has 2 percent or more **redoximorphic concentrations**. In some places the **depleted matrix** may change color upon exposure to air (**reduced matrix**); this phenomenon is included in the concept of **depleted matrix**.

The following combinations of value and chroma identify a **depleted matrix**:

1. Matrix value 4 or more and chroma 1 with or without other **redoximorphic features**; or
2. Matrix value 6 or more and chroma 1 or 2 with or without other **redoximorphic features**; or
3. Matrix value 4 or 5 and chroma 2 or less with 2 percent or more **redoximorphic features**. When features are faint, extra care and professional judgment should be exercised as to whether or not they are an indication of a hydric soil.

For **matrix color** matching those on the color pages labeled “Gley,” refer to **gleyed matrix** definition.

Directly Underlain, Horizon – A **soil horizon** which lies immediately beneath, and is in direct contact with, another **soil horizon**. When such a horizon is required to have specific soil morphological features, those features must be present throughout that horizon.

Distinct, Redoximorphic Feature – A term used to describe the contrast in color between a **redoximorphic feature** and the **matrix color**. Refer to both the chart and tabular key for estimating contrast of redoximorphic features, located in Appendices 4 and 5.

E Horizon – A **mineral soil horizon** in which the main feature is loss of organic matter, silicate clay, iron, or aluminum, or some combination of these, leaving a concentration of sand and silt particles. See *Soil Survey Manual* (1993) for complete definition. This horizon designation is often used to identify and describe **albic horizons**.

Faint, Redoximorphic Feature – A term used to describe the contrast in color between a **redoximorphic feature** and the **matrix**

Terms or phrases in **bold italics** are defined in the **Glossary of Terms**

color. Refer to both the chart and tabular key for estimating contrast of redoximorphic features, located in Appendices 4 and 5.

Fe/Mn Concretion – See *Concretion*.

Fe/Mn Nodule – See *Nodule*.

Few, Redoximorphic Features – *Redoximorphic features* comprising less than 2 percent of the observed surface area.

Fibers (Organic) – Pieces of plant tissue in *organic soil material*, excluding live roots. The amount of *fibers* after rubbing (rubbed fiber content) is used to differentiate *fibric*, *hemic* and *sapric organic soil materials*. See *Keys to Soil Taxonomy* (2003) for complete description.

Fibric Soil Material – *Organic soil material* with a *fiber* content after rubbing of two fifths or more recognizable *fibers* of undecomposed plant remains, excluding live roots. The *soil horizon* notation for fibric soil material is Oi. See *Soil Survey Manual* (1993) for complete definition.

Finer Than Loamy Fine Sand – Includes USDA Textural classes: very fine sand, loamy very fine sand, all sandy loam textures, loam, silt loam, silt, sandy clay loam, silty clay loam, clay loam, sandy clay, silty clay, and clay.

Flooded – A condition in which the ground surface is temporarily covered with flowing water from sources such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of sources.

Folists – *Histosols* which are saturated with water for less than 30 cumulative days during normal years (and are not artificially drained). See *Keys to Soil Taxonomy* (2003) for complete definition.

Folistic epipedon – A surface layer that is saturated for less than 30 days cumulatively in a normal year and consists of either *organic soil material* or is an *Ap horizon* that, when mixed to a depth of 10 inches (25 cm), has an organic carbon content of 8 percent or more if the mineral fraction contains no clay, at least 16 percent organic carbon content of the clay content is 60 percent or

greater and intermediate organic carbon contents for intermediate clay contents. See *Keys to Soil Taxonomy* (2003).

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

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

Frigid Temperature Regime – A soil temperature regime that is warmer in the summer than a soil with a ***cryic regime***, but has a mean annual soil temperature lower than 8°C. The difference between mean summer and mean winter soil temperatures is more than 6°C at a depth of 50 cm from the ***soil surface*** or at a ***restrictive feature*** in the soil. See *Keys to Soil Taxonomy* (2003) for complete definition.

Gleyed Matrix – A ***soil horizon matrix color*** resulting from prolonged periods of wetness that makes up more than 50% of the horizon or subhorizon where iron has been reduced and removed, or where saturation with stagnant water has preserved a reduced state.

Gley colors include:

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

In some places, the ***gleyed matrix*** may change color upon exposure to air. This is called a ***reduced matrix***. This phenomenon is included in the concept of ***gleyed matrix*** in this manual.

NOTE: “g” is a horizon suffix indicating the horizon has low chroma colors due to wetness, but does not necessarily have ***gleyed matrix*** colors. All gleyed matrices should have the suffix “g”; however, all horizons that have the “g” suffix are not gleyed. For example, a horizon with the color 10YR 6/2 that is at least seasonally wet, with or without other ***redoximorphic features***, may have the “g” suffix.

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

Growing Season – The portion of the year when the soil temperature is at or above **biological zero** at a depth of 50 cm (19.7 inches) below the **soil surface** (Reference: NRCS Hydric Soil Criteria as posted on <http://soils.usda.gov/use/hydric/criteria.html>). For purposes of this manual (specifically Category I in the “Key to Hydric Soil Indicators”), the growing season may be approximated by calculating the number of frost-free days. This information is available through local offices of the Natural Resources Conservation Service. This can include published county soil survey reports (USDA-NRCS) in the table(s) entitled “Freeze Dates in Spring and Fall.” Using this method (Row: 5 of 10 years, Column 28°F or lower), the length of the growing season would extend from the last freezing temperature in spring through the first freezing temperature in fall. (Reference: “Memorandum for Distribution”, subject: Clarification and Interpretation of the 1987 Manual, U.S. Army Corps of Engineers, Washington, D.C., March 6, 1992, Section 3.b. “Hydrology”).

Hemic Soil Material – **Organic soil material** with a **fiber** content after rubbing ranging from greater than one sixth (by volume) to less than two fifths, excluding live roots. The **soil horizon** notation for hemic soil material is Oe. It is intermediate decomposition between fibric and sapric.

High Value – Color values of 4 or more.

Histic Epipedon – An organic layer generally between 8 (20 cm) and 16 inches (40 cm) thick (one or more horizons) that is characterized by saturation (for 30 days or more, cumulative, in a normal year) and reduction for some time during normal years. Refer to *Keys to Soil Taxonomy* (2003) for complete definition.

Histosols – Organic soils that have **organic soil material** in more than half of the upper 80 cm (32 inches), or that are of any thickness if overlying rock or fragmental materials have interstices filled with **organic soil material**. When overlying unconsolidated **mineral soil material**, organic soils are typically greater than 16 inches thick. Refer to *Keys to Soil Taxonomy* (2003) for complete definition.

Horizon – See **Soil Horizon**.

Hydric Soil Definition (1994) – A soil that formed under conditions of saturation, flooding, or ponding long enough during the **growing season** to develop **anaerobic conditions** in the upper part. See *Federal Register*, July 13, 1994.

Standards for defining a functionally hydric soil are maintained by the National Technical Committee at the following website:
<http://soils.usda.gov/use/hydric/criteria.html>.

Loamy Fine Sand or Coarser – Includes USDA Textural Classes: sands (except very fine sand) and loamy sand textures excluding loamy very fine sand.

Long Duration – A duration class in which inundation for a single event ranges from 7 to 30 days.

Low Chroma Colors – Any soil color, when using the Munsell Color System, with a chroma of 2 or less.

Many, Redoximorphic Features – **Redoximorphic features** comprising 20 percent or more of the observed surface area.

Masses, Soft – **Redox** that are not cemented and whose shapes are variable. **Soft masses** include features that formerly would have been called “high chroma mottles.”

Matrix Color – Dominant soil color as determined by 50 percent or more with two colors, or the highest percentage with more than two colors.

Mesic Temperature Regime – A soil temperature regime that has a mean annual soil temperature of greater than or equal to 8°C but lower than 15°C and the difference between mean summer and mean winter soil temperatures is more than 6°C at a depth of 50 cm from the **soil surface** or at a **restrictive feature** in the soil. See *Keys to Soil Taxonomy* (2003) for complete definition.

Mineral Soil Horizon – **Soil horizon** consisting of **mineral soil material** (e.g., A, E, and **B horizons**).

Mineral Soil Material – Soil comprised mostly of mineral material with a relatively low content of organic matter (less than 12 to 18 percent of organic carbon by dry weight, depending upon the clay

content). See *Soil Survey Manual* (1993) for complete definition. ***See Top of the Mineral Soil Material.***

Moderate Structure – Well-formed ***distinct peds*** evident in undisturbed soil. When disturbed, soil material parts into a mixture of whole units, broken units, and material that is not in units. See *Soil Survey Manual* (1993) and *Field Book for Describing and Sampling Soils* (2002) for further description.

Mottling: –

- 1) A defunct term no longer used; previously used to describe certain ***redoximorphic features***.
- 2) Current usage: areas of color that differ from the matrix color or attributes retained from the geologic source rather than from pedogenesis. See *Field Book for Describing and Sampling Soils* (2002).

Muck – ***Sapric soil material*** that formed under wet conditions.

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

Nodule (Fe/Mn) – A cemented concentration of a chemical compound of iron and manganese that can be removed from the soil intact and that has no orderly internal organization.

O Horizon – ***Soil horizon*** consisting of ***organic soil material***.

Organic Soil Material – Soil material usually formed under wet conditions that has a minimum of 12 to 18 percent organic carbon by dry weight, depending upon the percent of clay content. See *Soil Taxonomy* (2001).

Organic Streaking – See ***stripped matrix***.

Ortstein – ***Spodic materials*** that are 50% or more cemented. See *Keys to Soil Taxonomy* (2003).

Parent Material – The unconsolidated and more or less chemically weathered mineral or organic material from which the **solum** of soils has developed by pedogenic processes.

Ped – A unit of soil structure such as a block, column, granule, plate, or prism, formed by natural processes (in contrast with a clod, which is formed artificially).

Ped Interior – The interior of a soil structural unit or **ped** such as a block or a plate.

Pedon – A three-dimensional body of soil with lateral dimensions large enough to permit the study of horizon shapes and relations. See *Soil Survey Manual* (1993) for a complete definition.

Ponded – A condition in which water stands in a closed depression. The water is removed only by percolation, evaporation and/or transpiration.

Pore Linings – Zones of accumulation of Fe and/or Mn that occur as either coatings on a pore surface or impregnations of the matrix adjacent to the pore. See Vepraskas (1996) or Richardson and Vepraskas (2001) for complete discussion. Some pore linings are strongly expressed oxidized rhizospheres.

Profile – A vertical exposure of the soil.

Prominent, Redoximorphic Feature – A term used to describe the contrast in color between a **redoximorphic feature** and the **matrix color**. Refer to both the chart and tabular key for estimating contrast of redoximorphic features, located in Appendices 4 and 5.

Redox Concentrations – Features formed when Fe [or Mn] oxides or hydroxides have accumulated at a point or around a large pore such as a root channel. They appear to have formed by Fe or Mn moving into an area, oxidizing, and precipitating. **Redox concentrations** contain more Fe³⁺ [or Mn⁴⁺] than were found in the soil matrix originally. Three groups of **redox concentrations** are recognized: 1) Fe [or Mn] masses, 2) **pore linings**, and 3) **nodules** and **concretions**. See Richardson and Vepraskas (2001)

Redox Depletions – Zones of low chroma (2 or less) having value 4 or more where Fe-Mn oxides have been stripped or where both

Fe-Mn oxides and clay have been stripped. **Redox depletions** include features that would formerly have been called “gray mottles.” See Richardson and Vepraskas (2001) for more complete discussion.

Redoximorphic Features – Features associated with wetness formed by the processes of reduction, translocation, and/or oxidation of Fe and Mn oxides. Formerly called mottling and **low chroma colors**. **Redoximorphic features** include: **soft masses**, **pore linings**, **nodules** and **concretions**, iron depletions, clay depletions, **depleted matrices**, **gleyed matrices**, and **reduced matrices**. See Vepraskas (1996) for more complete discussion.

Redoximorphic Features, Abundance of – See **Abundance, Redoximorphic Features**.

Redoximorphic Features, Contrast of – See **Contrast, Redoximorphic Features**.

Redoximorphic Features, Size of – See **Size, Redoximorphic Features**.

Reduced Matrix – Soil matrices that have **low chroma** and **high value colors**, but whose color changes in hue or chroma when exposed to air. See **gleyed matrix**. See Richardson and Vepraskas (2001) for complete discussion.

Restrictive feature – A root-limiting layer in the soil profile such as a lithic contact (bedrock) or densic materials. See *Keys to Soil Taxonomy* (2003) for complete definition.

Sapric Soil Material – **Organic soil material** that has a **fiber** content after rubbing of less than one sixth (by volume), excluding live roots. The **soil horizon** notation for **sapric soil material** is Oa.

Shallow E Horizon – An E **horizon** which does not extend below a depth of 6 inches. Measurement is made from the **top of the mineral soil material**.

Size, Redoximorphic Features – The size of **redoximorphic features** (fine, medium, coarse, very coarse, and extremely coarse). Refer to the Chart for Estimating Size of Redoximorphic Features, located in Appendix 2.

Slightly Decomposed Organic Soil Material – Refer to ***fibric soil material***.

Soil – Soil is a natural body comprised of mineral and organic matter, liquid, and gases that occurs on the land surface. Soils are characterized by one or both of the following: 1) horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or 2) the ability to support rooted plants in a natural environment.

Soil Horizon – A relatively uniform layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics such as color, structure, texture, consistence, degree of acidity, and presence or absence of ***redoximorphic features***, etc.

Soil Morphology – The physical constitution of a soil profile as exhibited by the kinds, thicknesses, and arrangements of the horizons in the profile, and by the texture, structure, consistence, porosity and color of each horizon.

Soil Structure – The combination or arrangement of primary soil particles into secondary units or peds. The secondary units are characterized on the basis of size, shape, and grade (degree of distinctness). See Appendix 5.

Soil Surface – The top of the uppermost ***soil horizon*** (ground surface). Fresh leaf or needle fall that has not undergone observable decomposition is excluded from soil and may be described separately.

Solum – A set of horizons that are related through the same cycle of pedogenic processes; the solum may include the ***O, A, E, and B horizons***.

Spodic Horizon – An illuvial layer that is 1 in. (2.5 cm) or more thick, is not part of an ***Ap horizon***, and contains 85 percent or more ***spodic materials***. For field conditions where an ***albic (E) horizon*** extends horizontally through 50 percent or more of each ***pedon***, the moist, ***crushed and smoothed colors*** directly under the ***albic horizon*** are as follows:

Terms or phrases in ***bold italics*** are defined in the ***Glossary of Terms***

1. a hue 5YR or redder (i.e., 2.5YR, etc.); or
2. 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
3. a hue of 10YR or neutral and color value and chroma 2 or less;
or
4. a color of 10YR 3/1.

See *Keys to Soil Taxonomy* (2003) for complete definition.

Spodic Materials – Mineral soil materials that are dominated by illuvial active amorphous materials composed of organic matter and aluminum with or without iron. Color criteria are given in the definition of **spodic horizon** above. See *Keys to Soil Taxonomy* (2003) for complete definition.

Stripped Matrix – A layer with features associated with wetness in which iron/manganese oxides and/or organic matter have been stripped, exposing the primary base color of the soil materials. The stripped areas and translocated oxides and/or organic matter form a diffuse splotchy pattern of two or more colors. Commonly the splotches of color are shades of gray or grayish brown. See *Field Indicators* (2002).

Strong Structure – Peds are **distinct** in undisturbed soil. They separate cleanly when soil is disturbed, and the soil material separates mainly into whole units when removed.

Sulfidic Materials – Mineral or organic soil material that contains oxidizable sulfur compounds. **Sulfidic materials** most commonly accumulate in coastal marshes, but they may occur in freshwater marshes if there is sulfur in the water. Presence of hydrogen sulfide gas is a field indicator for identifying **sulfidic materials**. It is detected in the field by a rotten egg smell. See *Keys to Soil Taxonomy* (2003) for a complete definition.

Thick, A and Ap Horizons – For the purposes of this manual, **thick** means greater than 10 inches and less than or equal to 15 inches.

Top of the Mineral Soil Material – Typically the top of the uppermost *mineral soil horizon*. An exception may be an area of *organic soil material* buried beneath *mineral soil material*. See *Keys to Soil Taxonomy* (2003) for complete discussion. This was referred to as the “mineral soil surface” in previous versions of this key.

Upper Part of the Soil – That portion of the soil that supports the majority of plant roots. In general, in wetlands this zone is limited to the upper 12 inches (30 cm).

Very Dark A or Ap Horizon – Refer to *A* or *Ap Horizon*, *Very Dark*.

Very Long Duration – This is a duration class in which inundation for a single event is greater than 30 days.

Very Thick, A and Ap Horizons – For the purposes of this manual, *very thick* means greater than 15 inches (38 cm).

Well-Decomposed Organic Soil Material – Refers to *sapric soil material*.

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