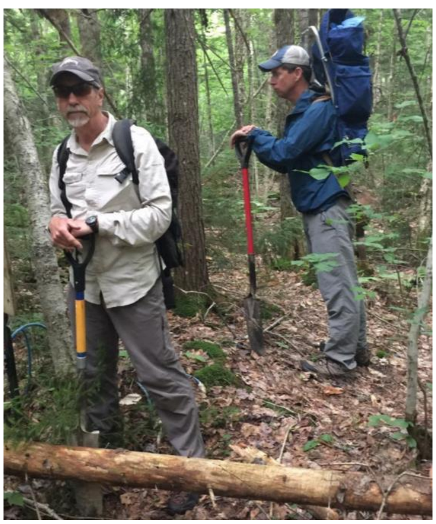
New Hampshire Soils Handbook



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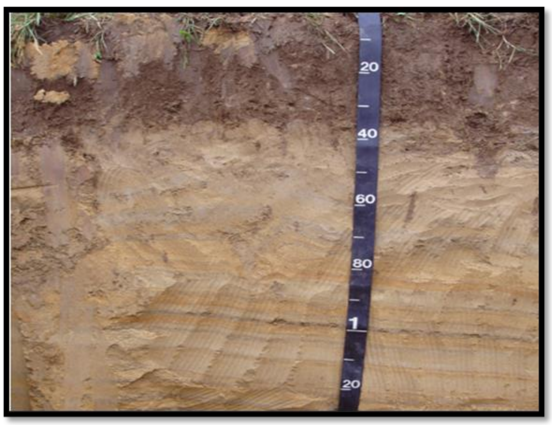
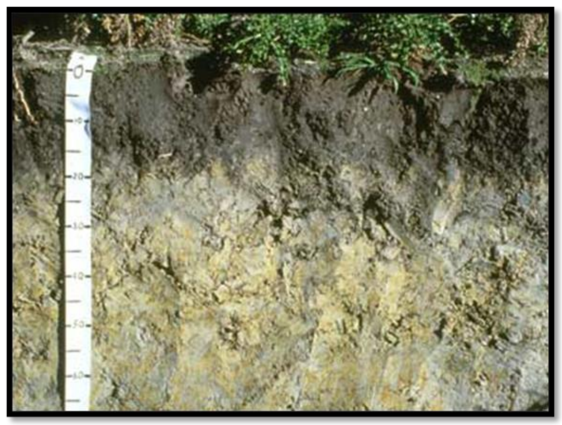
Introduction

This Reference provides information about New Hampshire soils. Important Soil Properties, such as texture, structure, slope, and color are explained and clarified. Soil Parent Materials are described, and associated landforms are specified. Soil Interpretations, such as drainage class, hydric criteria, important farmland, and hydrologic groups are defined.

The NH Soil Reference is also comprised of information, definitions, and terms to be used in conjunction with NRCS soil maps, providing essential information about the soil data available through Web Soil Survey (WSS) and the tables located on the NH NRCS website. All NRCS maps, descriptions, units of measure, and labeling of soil attributes conform to the standards of the National Cooperative Soil Survey (NCSS). The maps, tables and associated data located in Web Soil Survey is the official soil data for the nation and is updated and maintained as the single authoritative source of soil survey information.



Alluvial soil



Marine soil

Till soil

Outwash soil

Till soil with a reddish brown subsoil

Till soil with a thick E horizon

Till soil with a thin E horizon

Till soil developed from gray parent material

Soil Horizons

The **O horizon** (organic layer) is almost entirely composed of organic matter. This is a layer of leaves, pine needles, twigs, and other plant material ranging from slightly to highly decomposed. Typically found on undisturbed soils.

The **A horizon** (topsoil or surface layer) is composed of mineral material (sand, silt, and clay) that contains high amounts of organic matter and other nutrients and minerals. It furnishes the most favorable conditions for biologic and chemical activity. This layer is usually black, dark brown, gray brown, or a similar color. Roots are generally abundant. In many New Hampshire soils, it is usually only a few inches thick, except where the soil has been plowed, disturbed, or removed. A plow layer is referred to as an Ap horizon.

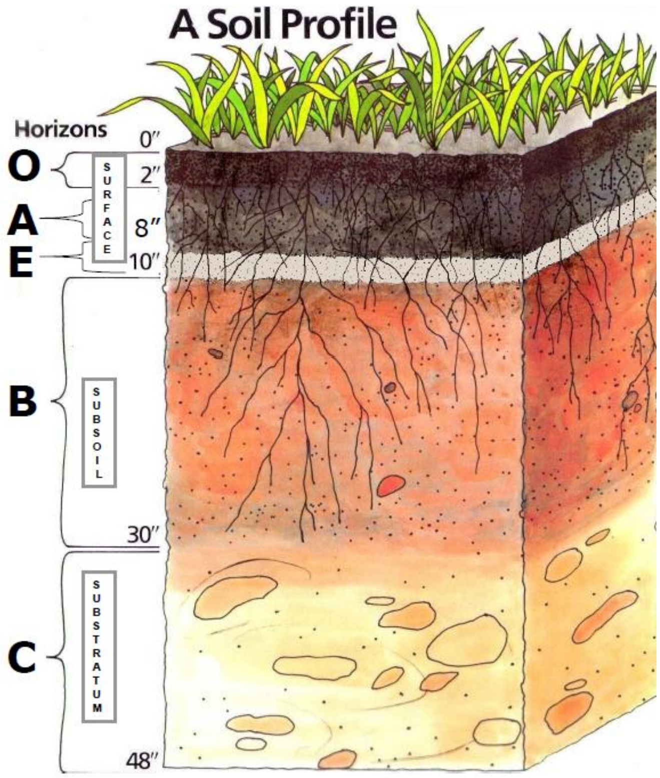
The **E horizon** (eluviation layer) is a layer where material has been removed (leached). Most of the minerals, organics, nutrients and color have been removed from this horizon, leaving a white or light gray layer. This horizon is not present in all of our soils, but is a feature often found in our northern forest soils.

The **B horizon** (subsoil) starts at the bottom of either the E horizon or the surface layer and continues down to the parent material. This is a horizon of alteration due to weathering and chemical reactions, where the organic matter, nutrients, and other minerals that have leached down from the O, A and E horizons will accumulate. This layer is usually yellowish brown, reddish brown, grayish brown, sometimes gray, or similar colors. Roots are generally common, but not nearly as abundant as in the surface layer. The B horizon is often separated into several sub-horizons (see Horizon Suffix section below).

The **C horizon** (substratum) typically starts at the bottom of the subsoil layer and extends down to the bedrock. This layer is also referred to as the parent material. This soil material contains little organic matter and, compared to the surface and subsoil layers, relatively few nutrients for plants. This layer is usually brownish gray, olive gray, or similar colors. Roots are not common in this layer. The parent material in most cases is the material from which the surface and subsoil layers developed.

The **R horizon** (rock layer) is hard bedrock. An R layer is sufficiently coherent to make hand-digging with a spade impractical, although it may be chipped or scraped. The bedrock may contain cracks, but these are generally too few and too small to allow roots to penetrate. Granite, gneiss, and schist are types of bedrock typically found in New Hampshire.

Master Horizons



Horizon suffix

Each master horizon may be subdivided into specific subordinate layers (sub-horizons) that have a unique identity. These subordinate layers are identified by using lower case letters as suffixes to the master horizon, such as an Ap. The most common sub-horizons in New Hampshire are: a, d, e, g, h, i, m, p, s, and w. They are further defined in the Glossary.

Note: Not all master horizons or sub-horizons may be present in a soil profile. Some soils may have repeating master horizons (such as an old A horizon buried underneath a younger A due to flooding or other disturbance). Some soils may have multiple suffixes, such as a Bhs.

Factors of Soil Formation

Soil formation and the development of soil horizons is a slow process that will take hundreds to thousands of years. Soils form from rocks, sediments, and organic material that have disintegrated and decomposed through the action of weathering and organisms. The five factors that control the formation of soils are: Climate, Organisms, Topography, Parent Material, and Time.

Climate

Climate, particularly temperature, precipitation and frost action have an influence on the formation of a soil. The climate largely determines the nature of the weathering processes that will occur and the rates of these chemical and physical processes. Climate is also a factor on the types of organisms living in the soil.

Organisms

All living organisms actively influence the soil forming process. Plants add organic matter and their roots help to improve soil structure. Animals, such as earthworms and burrowing animals (e.g., moles, gophers) mix the soil and change its physical characteristics. Their waste products add fertility and influence the aggregation of soil particles.

However, it may be the unseen life forms that have the most profound influence on soil. Bacteria, fungi and other microorganisms are the most abundant and species-rich biota in soils. In a single handful of soil, there can be hundreds of billions of these organisms, representing thousands of different species. In addition to performing critical functions which make plant life possible, soil microorganisms can change the chemistry of the soil, which in turn influences the type of soil forming processes that take place. Microbes also decompose organic materials and return the products of decomposition to the soil.

Topography

The slope, shape, aspect, and position on the landscape, greatly influences soil development. These topographical differences influence surface runoff, varying drainage conditions, and depth to water table.

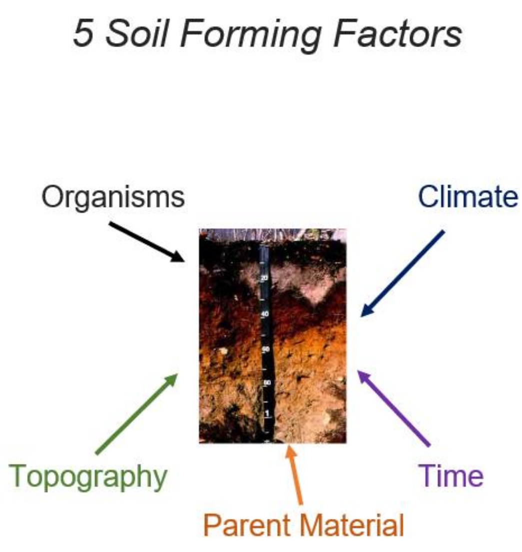
Soils that form at higher elevations or on north facing slopes are typically colder, with a shorter growing season and hold water longer. Soils on steep landscape positions are generally better drained and frequently prone to erosion, while soils that occur in lower or concave landscape positions are usually depositional, generally receive surface runoff, and often have a seasonal high water table at a shallow depth.

Parent Material

Parent material is the underlying geological and organic material in which the soil develops. Most soils commonly form in materials that have been transported by moving water, ice, or wind and then deposited. In the substratum, these materials will be relatively unchanged from the time they were deposited. More information about the types of parent material is described later in this handbook.

Time

The formation of soils is a slow continuing process which may take several thousand years for significant changes to occur. The soils of New Hampshire are relatively young, development started after the ice retreat of the last glaciation, approximately 10,000 to 14,000 years ago. In contrast, some soils in other parts of the world are over a million years old.



SOIL PROPERTIES

Soil properties are those characteristics which can be seen with the eye or felt between the thumb and fingers. Soil is made up of about 45% mineral particles, 25% water, 25% air, and 5% organic material. The mineral portion can be divided into three parts – sand, silt, and clay, which is known as soil texture.

Texture

Texture is the relative proportion of the **sand**, **silt**, and **clay** in a given soil sample. It is not based on any other factors, such as color, how difficult the soil is to dig, or the amount of water in the profile. By determining the proportions of sand, silt and clay, and a using textural triangle (see next page), soil can be divided into twelve different texture categories. The most common textures in New Hampshire are sandy loam and loamy sand, due to the high amounts of sand in glacial till and outwash. But the other textures are also present.

Texture is determined by taking a sample of soil (a ball about 1 inch in diameter), moistening it (if necessary), rubbing a small amount between the thumb and forefinger, and determining how it feels. The proper moisture content is important. The soil sample should be moist enough not to be dusty, but not so moist that water runs out when you squeeze it. Many soils are moist enough in spring of the year to be able to determine the texture, but in late summer and autumn, soils often need a small amount of water added to them in order to be able to determine the texture. If the ball holds together, then squeeze the soil sample between the thumb and forefinger to form a ribbon.

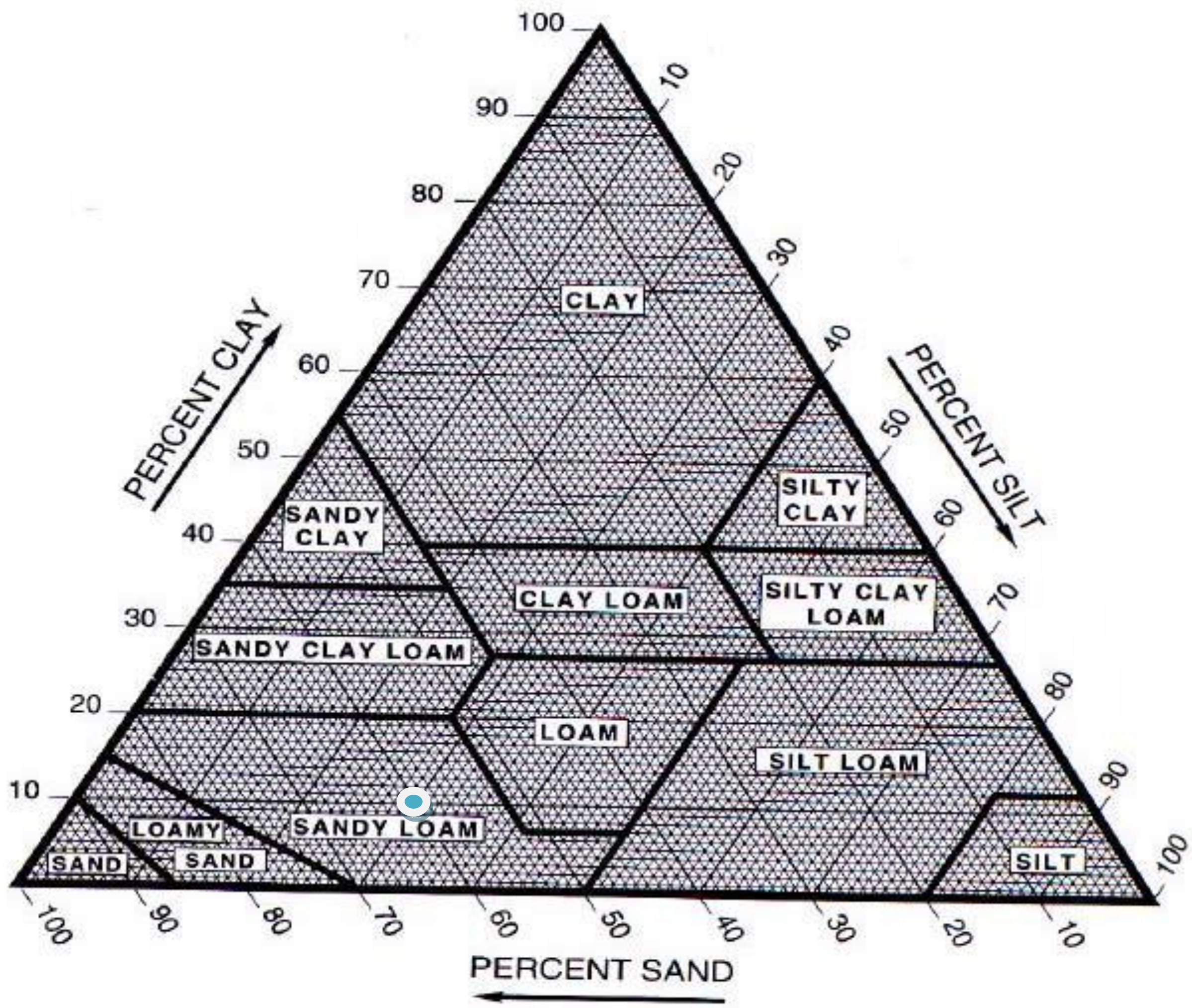
Sand feels very gritty, not sticky, and when squeezed does not hold together in a ball. Sand will leave very little stain on the fingers, if any. Sand does not form a ribbon when squeezed between the thumb and forefinger. Sand particles are between .05 mm and 2 mm in size.

Clay does not feel gritty. It is very sticky and forms a ball when squeezed. Clay will stain the fingers and a fingerprint will often remain on the ball. Clay will form a long ribbon (more than an inch long). The ribbon has a smooth surface. Clayey textures are usually found only in the Seacoast region of New Hampshire, due to deposits of marine sediments. Clay particles are less than .002 mm in size.

Silt feels moderately gritty to smooth (butter-like when moist or similar to baby powder when dry), is not sticky, but forms a ball when squeezed. Silts may form a short (up to 1 inch long) ribbon when squeezed between the thumb and forefinger, and if so, the ribbon will have a flaky surface. Silts are between .002 and 2 mm in size.

Loam is a term used to describe a mixture of all three particle sizes (sand, silt, and clay). Note: This is not the same meaning as "loam" that is used by landscapers for material sold for yards and gardens.

Soil Textural Triangle



Example: If a soil layer has 60% sand, 30% silt and 10% clay, then it is a sandy loam. (See the blue dot in the textural triangle above)

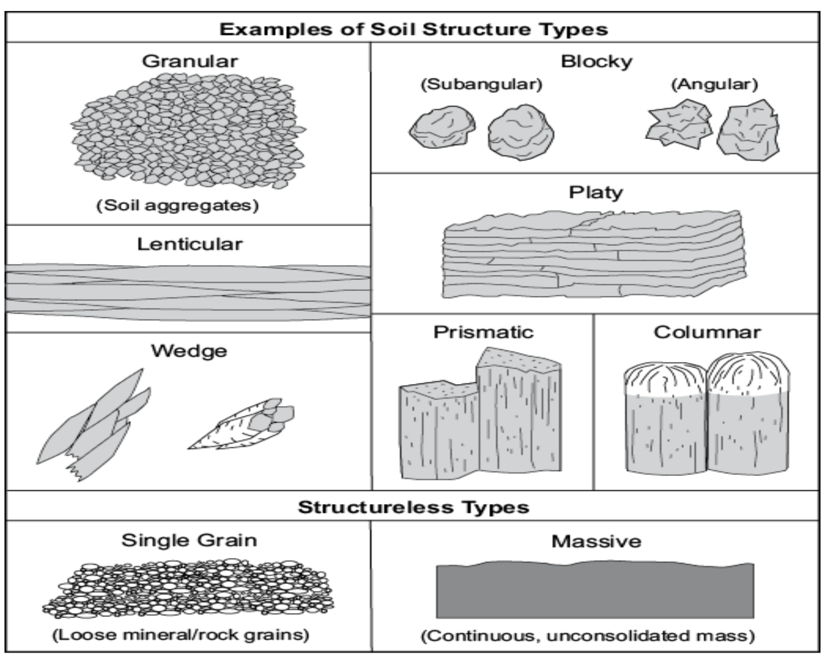
Rock Fragments are particles larger than 2 mm. The amount of rock fragments in a soil is used as a texture modifier. They are not considered when determining the amount of sand, silt and clay. For instance, if the soil layer described in the example above also has over 15 percent gravel, then the soil is a gravelly sandy loam. Gravel, cobbles, stones, boulders, channers, and flagstones are types of rock fragments.

Structure

The structure of the soil is the naturally occurring arrangement of soil particles into aggregates. In other words, it's the form that a soil ped takes when the sand silt and clay particles are bound or held together. Aggregate stability (the internal bonding of soil peds) is an important quality for good soil health.

<u>Types of structure:</u>

- Granular - The soil particles are held together to form small spheres or polyhedrons.
- Blocky - The soil particles are held together to form small blocks. The blocks can be rounded or sharp and angular.
- Platy - The soil particles are held together to form sheets or plates that form horizontally. These plates often impede water movement.
- Columnar or Prismatic - Soil particles are formed into vertical columns or pillars. These structures are not typically found in New Hampshire.
- Lenticular – The soil peds are overlapping lenses parallel to the soil surface. They are thickest in the middle and thin on the edges. These structures are not typically found in New Hampshire.
- Wedge – The soil peds are elliptical with interlocking lenses that terminate in acute angles. These structures are not typically found in New Hampshire.
- Massive or single grain – These soils are structureless. They may appear as a solid mass or as individual sand grains.



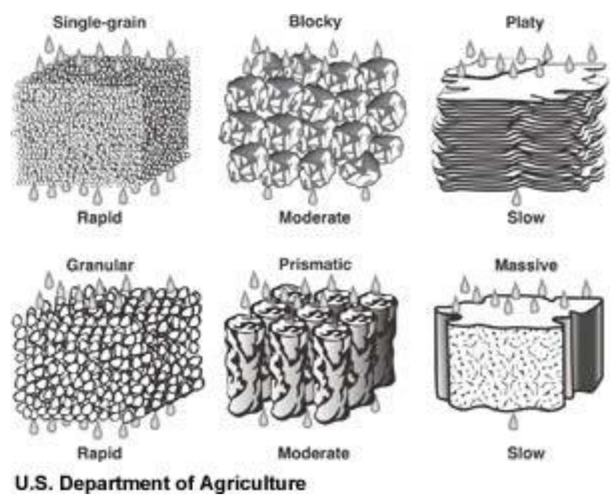
Permeability and saturated hydraulic conductivity

Permeability is the rate at which a soil layer can transmit and drain water. The hydraulic conductivity (Ksat) is the rate at which a saturated layer can transmit fluid. These rates are determined by a combination of soil texture, structure, and the amount of pore space. Permeability and hydraulic conductivity are very similar; however, permeability is qualitative and hydraulic conductivity is quantitative.

Soil layers with clay textures, hardpan, or platy structure have slow permeability. Those with loamy textures or blocky structures have moderate permeability, and those with sandy textures or granular structure have rapid permeability.

Structureless soils may have a range of permeabilities. However, single grain soils are usually rapid. Massive soils typically have slow permeability.

Relationship of structure to permeability:



Note: If the substratum is a hardpan, the permeability is slow regardless of the texture.

Slope

Slope is the inclination of the land surface from the horizontal. In other words, it is the vertical rise or fall of the surface in feet per 100 feet of horizontal distance. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. For example, a 6 percent slope means that you would rise or fall six feet if you walked 100 feet from your starting point.

In New Hampshire the slope classes for map units are typically:

A slope: 0 to 3 percent
B slope: 3 to 8 percent
C slope: 8 to 15 percent
D slope: 15 to 25 percent
E slope: 25 to 60 percent

Surface Fragments (formerly surface stoniness)

Surface fragments are loose rocks on the soil surface. However, not all soils have fragments on the surface. Stones are the fragments which are 250 to 600 mm (about 10 to 24 inches) in size (diameter). Rocks smaller than 250 mm (10 inches) are considered cobbles or gravels. Rocks larger than 600 mm (24 inches) are boulders. When stones and boulders are on the soil surface, they have may have a serious effect on soil use and management.

The Surface Fragment Classes are:

Nonstony:	Less than 0.01 percent covered
Stony or Bouldery:	0.01 to < 0.1 percent covered
Very Stony or Very Bouldery:	0.1 to < 3 percent covered
Extremely Stony or Ext Bouldery:	3 to 15 percent covered
Rubbly:	15 to 50 percent covered
Very Rubbly:	$\geq$ 50 percent covered

An area of extremely bouldery soil

Reaction Class

Reaction Class is a measure of acidity or alkalinity of a soil, expressed as pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline.

The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid: Less than 3.5
Extremely acid: 3.5 to 4.4
Very strongly acid: 4.5 to 5.0
Strongly acid: 5.1 to 5.5
Moderately acid: 5.6 to 6.0
Slightly acid: 6.1 to 6.5
Neutral: 6.6 to 7.3
Slightly alkaline: 7.4 to 7.8
Moderately alkaline: 7.9 to 8.4
Strongly alkaline: 8.5 to 9.0
Very strongly alkaline: 9.1 and higher

Most soils in New Hampshire are moderately acid to strongly acid. A pH of 6 to 7 is optimal for most plants.

Soil Color

Color development is part of weathering. As rocks weather, the elements oxidize and change color. Iron forms small yellow or red (rusty color) particles, organic matter decomposes into black humus, and manganese forms black mineral deposits. Color is also affected by the environment: aerobic environments produce brown and bright red subsoils, while anaerobic (lacking oxygen) conditions with wet environments often have mottled colors and a gray matrix. With depth below the soil surface, colors usually become lighter, yellower, or grayer.

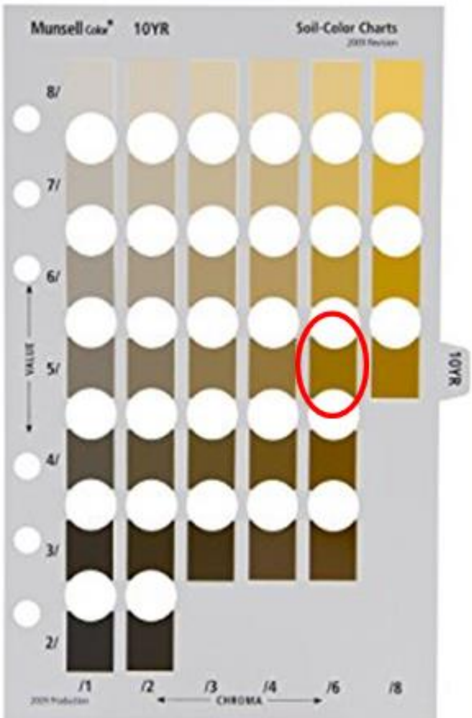
Therefore, a number of important soil characteristics can be inferred from soil color, such as organic matter content, mineral composition, and seasonal high water table.

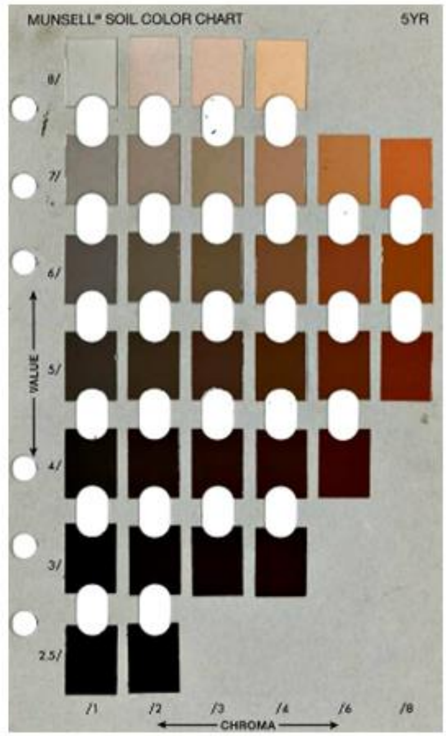
The Hue, Value and Chroma of a soil ped are used to measure the soil color.

- Hue – Indicates the grade of color, as represented by the amount of Red, Yellow, Green, Blue and Purple. Most common soil hues are R, Y, and YR.
- Value – The amount of lightness or darkness.

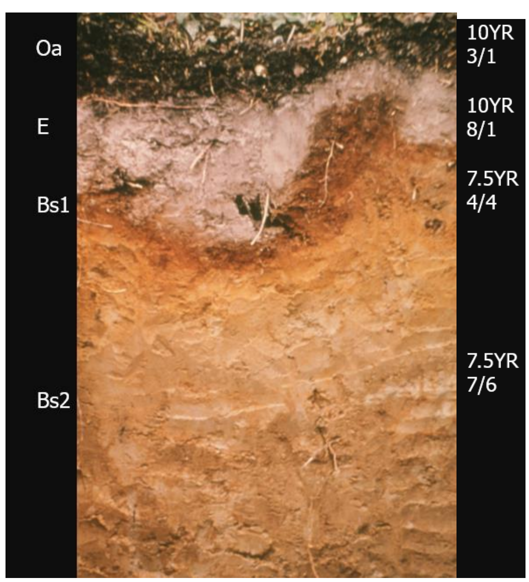
- Chroma – The degree of concentration of hue.

Color charts (such as Munsell) are used to determine the Hue, Value and Chroma of a soil ped, feature, or horizon.





Examples: A dark brown soil with a hue of 10YR, Value of 3, and Chroma of 1 is written as 10YR 3/1. A reddish yellow soil with a hue of 7.5YR, Value of 7 and Chroma of 6 is written as 7.5YR 7/6.



Notable soil colors:

Black – Black or dark colors are usually due to the presence of organic matter. Individual splotches of black or dark purple may be due to an accumulation of manganese.

White – A white or light color is usually due to uncoated sand grains, due to eluviation (see E horizon). In arid regions, white colors may be due accumulation of calcium carbonate, gypsum, or other salts.

Red – Red or rusty colors are usually due to oxidized iron (concentrations) in the soil.

Gray – Gray (or gley) colors are usually due to reduced iron (depletions).

Brown and Yellow – Yellow and browns are due to other forms of iron (such as geothite).

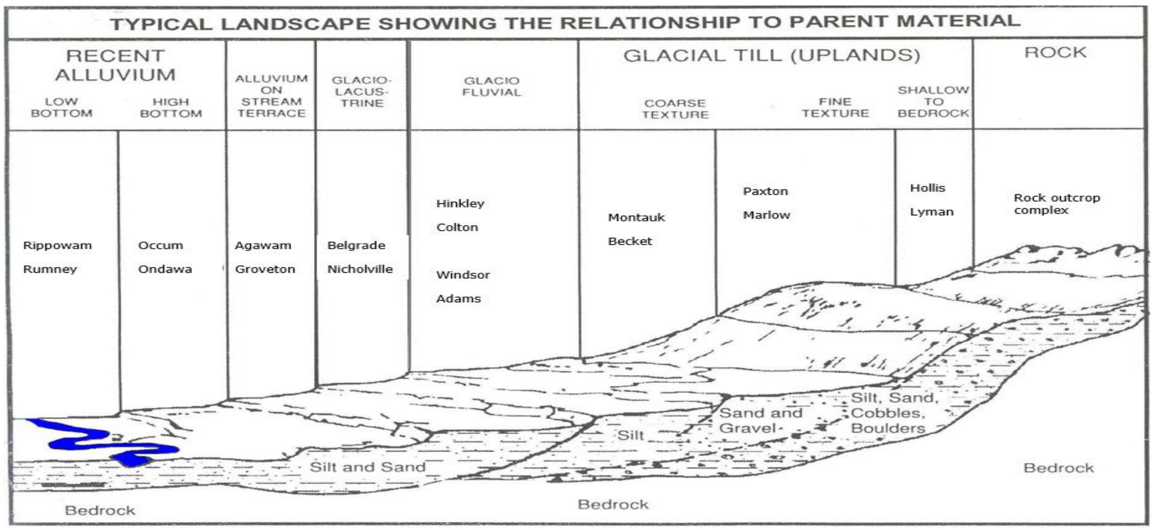
Redoximorphic Features – Redox or mottles are a combination of red and gray spots or splotches. These features indicate a fluctuating water table.

Redoximorphic features

Parent Material and Landforms

Parent material is the raw material from which a soil is developed and is often named by the method in which that material was deposited on the landscape.

Each type of parent material has a unique set of physical soil features and are found on specific landforms. Therefore, each soil develops in a particular parent material and is found only on certain landscapes. If you can determine the landform and where you are on the landscape, you should be able to narrow down the soils to only a handful of series. This is known as a soil catena.



In New Hampshire, glacial materials were deposited when the last continental glacier was melting 10,000 to 14,000 years ago. Aeolian and alluvial sediments have been deposited since that period and continue to be deposited every time the wind blows or a stream overflows its banks and floods the adjacent land.

A typical U-shaped glacial valley

Glacial striations in bedrock

Aeolian (Loess) **-** Aeolian materials are deposited by the wind and are found in dunes, typically on top of other landforms. They are not common in New Hampshire.

Soil profiles in this parent material generally have sandy or silt textures throughout the profile. They do not contain gravel and they do not have surface stones.

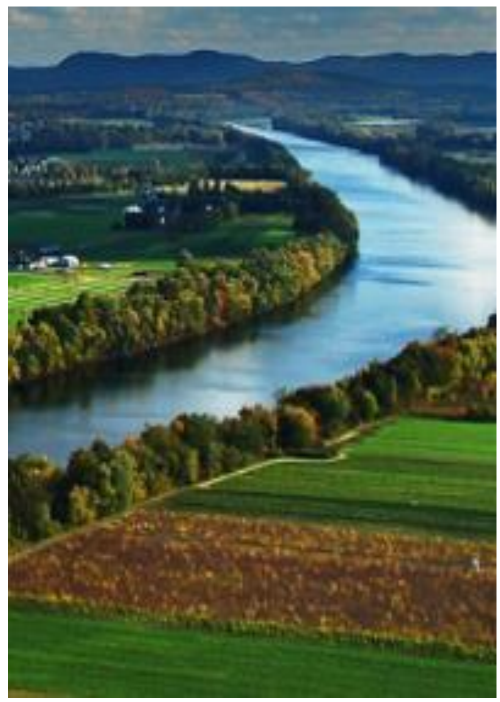
A New Hampshire sand dune (approximately 10,000 – 12,000 years old)

Sandy aeolian deposits

Alluvium - Alluvial sediments are, and continue to be, deposited by floodwaters from nearby streams on floodplains or alluvial terraces. The age of these sediments ranges from several hundred years to as recent as the last flood.

Soil profiles in this parent material generally have either loamy or sandy textures stratified throughout the profile. Gravelly layers may also occur in the substratum. There are typically no surface stones. Soils in floodplain sediments may contain dark colored layers (old A horizons) that are ¼ to 3 inches thick and high in organic material buried in the profile. These soils are normally adjacent to streams and rivers on nearly level landscapes.

Multiple layers in alluvium



Floodplains

Organic - Organic deposits were formed by the accumulation of partially decomposed organic matter from plant residues. Organic materials are typically found in depressional areas, such as swamps and bogs. They also are deposited on top of other soils as leaf litter and woody material.

Swamps and bogs

Saturated organic soils

Muck and peat

Outwash - Outwash deposits were deposited by moving water that melted from glaciers. They were the floodplains of 10,000 to 14,000 years ago. Now they are found on outwash terraces, kame terraces, deltas, and eskers.

Soil profiles in this parent material typically have sandy and gravelly textures throughout the profile. Sometimes the surface and subsoil textures may be loamy. Gravel, if present, is usually rounded in shape. There are typically no surface stones. The sand and gravel in these profiles may be arranged in layers ranging in thickness from ¼ inch to several feet thick.

Gravelly outwash

Sandy outwash

Esker

Lacustrine - Lacustrine sediments were deposited as the mud on the bottom of old lakes that existed when the last continental glacier was melting 10,000 to 14,000 years ago. When the ice receded, the glacial lakes drained and the lake bed deposits were exposed.

Soil profiles in this parent material have silty, loamy or clayey textures in the surface, subsoil and substratum layers. Substratum layers do not contain gravel and there are no surface stones. The substratum layer often has thinner (1/8 to ½ inch thick) horizontal layers, called varves, within it.

Lake bottom deposits of silt and clay

A glacial lake

Marine - Marine (seabed) sediments were deposited as mud in the tidal flats that existed about 12,000 to 14,000 years ago. The weight of the glacier compressed and submerged the New England landmass, resulting in many areas near the coast being inundated by ocean water. The land is still slowly rebounding to this day.

Soil profiles in this parent material have clayey textures in the surface, subsoil and substratum layers; the surface and subsoil occasionally have loamy textures. Substratum layers do not contain gravel, and while they may be firm and hard, they are not a hardpan. There are no surface stones.

Marine deposits of clay

Tidal marsh

Residuum – This is material that formed in place from the native bedrock. They are not common in New Hampshire.

Soil profiles in this parent material take on the characteristics of the bedrock they form from and will be the same texture as the rock. Typically, sandstone and granite will develop into sands, siltstone and phyllite will develop into silt, and shale and slate will develop into clay. Since all of New Hampshire was scoured and modified by glaciers, most residual material here has been removed.

Soil developing from bedrock in Texas

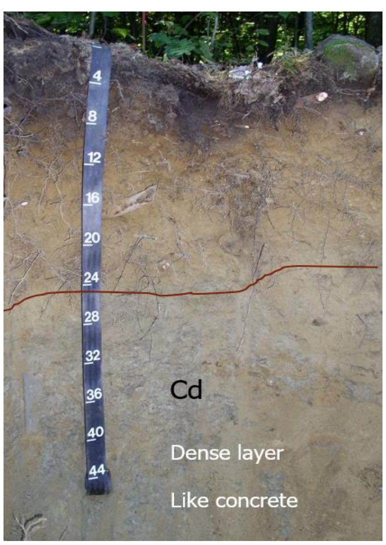

NH bedrock – a long way from becoming soil

Till – Till is material transported by the glaciers that wasted out of the ice sheet or was deposited under the ice during the advance and retreat of the last continental glaciation. Till deposits are found on hillslopes, ridges, and mountain slopes. Till may be either loose and permeable (Ablation till) or dense and impermeable (Dense basal till).

Soil profiles developed in till generally have a mixture of sandy to loamy textures. There is also usually a mixture of gravel, stones and boulders in various proportions throughout the soil profile. Surface stones and boulders are typically present on tills, unless they have been removed for agriculture. In areas of till that were once used for pasture or agriculture there are usually stone walls or stone piles nearby.

Ablation till

The substratum layer of many tills in New Hampshire may be a hardpan; if so, this hardpan layer is dense and often consists of very firm plates (platy structure) with a horizontal orientation and formed on smooth rounded hills that were compacted by the glacier. This dense layer is referred to as a Cd horizon.

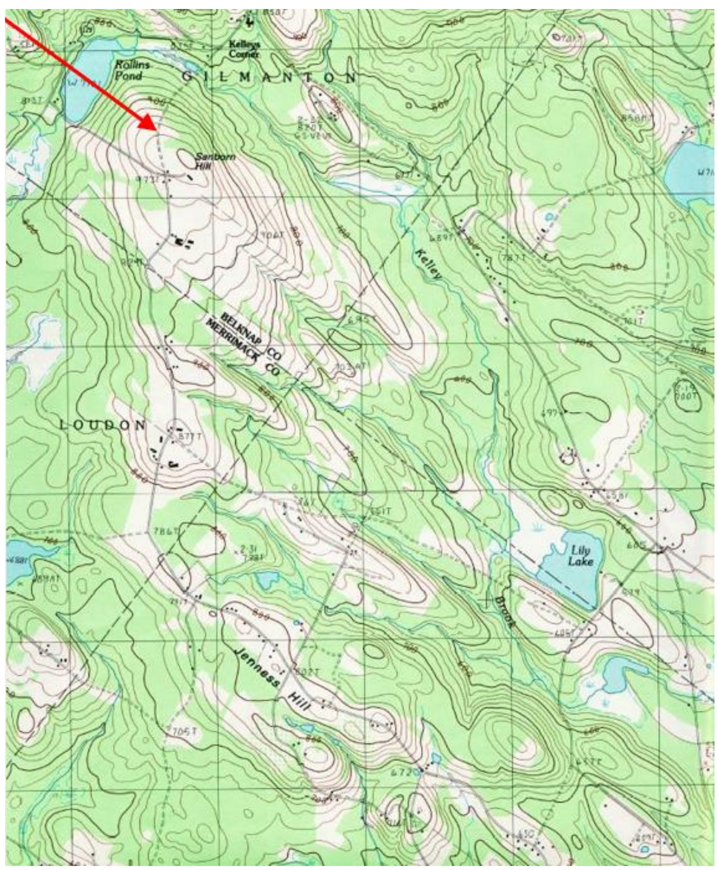


Cd horizon - dense basal till

Dense basal till with platy structure

Drumlins are the most common type of landform associated with dense basal till. Drumlins typically are smooth elongated oval-shaped hills, with the long axis parallel to the orientation of ice flow. In New Hamphire the glaciers generally flowed from the northwest to the southeast, so most drumlins in this area are also oriented in the same direction.

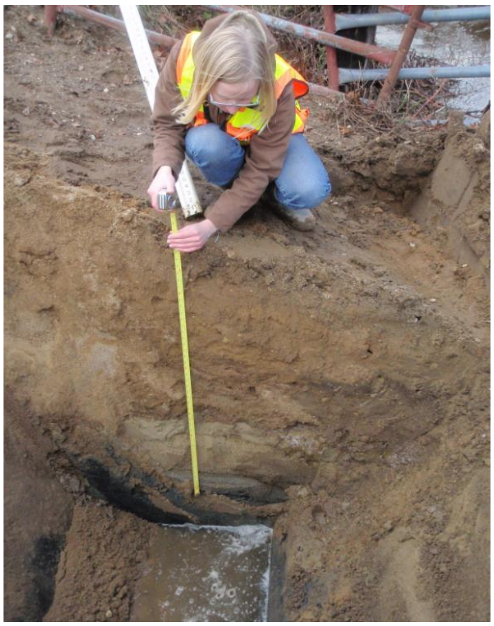
Drumlins – smooth rounded hills, with dense till



A topographic map with several drumlins evident

Disturbed Soils

These are areas where the original soil material has been excavated, filled, or manipulated by human activity. Soil properties are often highly variable and cannot be determined without an on-site investigation. Disturbed areas include dumps, landfills, filled wetlands, borrow pits, and urban areas.



Fill material in a barnyard

Fill material in a wetland

Sand and gravel Pit

Soil Interpretations

Soil interpretations predict soil behavior for specified soil uses, based on soil properties.

Hydric Soils

The three essential characteristics of wetlands are hydric soils, wetland hydrology, and hydrophytic vegetation.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a soil is hydric, more specific information, such as information about the depth and duration of the water table, is needed. Criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2014) and in the "Soil Survey Manual" (Soil Survey Division Staff, 2017).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Vasilas, Hurt and Berkowitz, 2018). Some of these properties include a gray matrix near the surface, a histic epipedon, a thick dark A horizon, and redoximorphic features.

Map units that are made up dominantly of hydric soils may have small areas of minor non-hydric components in the higher positions on the landform. In contrast, map units that are made up dominantly of non-hydric soils may have small areas of minor hydric components in the lower positions on the landform.

A hydric soil with a gray matrix.

Hydric soils are often a challenge to work in.

A hydric soil with a gray matrix and redox.

Depletion in a root channel

A wetland, with hydrophic vegetation, wetland hydrology, and hydric soil.

Hydrologic Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A - Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B - Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C - Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D - Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Hydrologic soil groups are used to estimate runoff potential of various soil types. The runoff potential is determined by how well rainwater can infiltrate into a soil when it is not protected by veg, is thoroughly wet, and receives precipitation from long-duration storms.

Drainage Class

Natural soil drainage classes are a means to summarize, in general terms, the internal drainage and depth to the water table in a soil. In other words, it indicates where the water is situated during the wettest time of the year (seasonal high water table) in that soil.

This soil characteristic may be the most confusing feature of a soil to many people, but can be fairly easy to determine by having an understanding of soil colors. Observations of the soil matrix color and the presence of redoximorphic features (formerly called mottles) will determine the depth to the seasonal high water table and the natural soil drainage class. The soil matrix color is the dominant color of each of the soil layers. Please refer to the section on "Soil Color" for more information.

Water tables in New Hampshire soils are generally highest in the spring (April) and lowest in the summer (July through August). In some soils, the water table will fluctuate as much as 6 feet between spring and fall. It is in this zone of fluctuation that redoximorphic features are formed.

Redoximorphic features are typically small splotches of red and/or gray colors within the soil matrix color in a moderately well drained, somewhat poorly drained, or poorly drained soil. They are usually 1/16 to 3/8 inch in size, and come in all shapes from long and narrow to round. Redoximorphic features are formed by the same process (oxidation and reduction of iron) as when a steel or iron tool is left out in the rain and splotches of rust form on it. Just as wetting and drying form rusty colors on these tools, wetting and drying form rusty reddish (oxidation) and gray colors (reduction) in the soil. The wetting and drying in the soil is caused by fluctuating seasonal water tables.


Redoximorphic features

Redoximorphic features due to a fluctuating water table will not occur as a single or individual splotch within a soil layer; there is always more than one splotch. Often individual spots or other color variations are a result of other soil processes that are not caused by a fluctuation water table. When soil mottles that are caused by a fluctuating water table do occur, there is always more than one; they are separated from each other by distances of about ¼ to 6 inches; and there may be upwards of 60 per square foot of soil profile. However, whenever a soil is continually inundated with water (very poorly drained soils), the iron will be reduced and matrix soil color will be gray.

To determine the depth to the seasonal high water table at any time of the year, use the location of the redoximorphic features in the soil profile, not the location of standing water. For example, if you identify redoximorphic features between depths of 14 and 45 inches from the soil surface in the soil profile, and the observed water table is at 50 inches, the depth to the seasonal high water table is 14 inches.

Oxidized rhizospheres are a type of redox feature that are sometimes found around the roots of plants in hydric soils. They indicate that a plant is living in anaerobic conditions and is pumping oxygen out of its roots into the surrounding root channel. The oxygen pumped out by the plant oxidizes the surrounding soil, causing it to turn reddish orange. This area where microbes are active around the plant roots is called the rhizosphere. The rhizosphere is important in soils because it is an area of increased biological activity. Often this is where the highest concentration of nutrients are found which makes it a good environment for microbes as well as plant roots that benefit from mutualistic relationships with the microbes. In saturated soils we often see a reddish orange ring around the plant roots which indicates that the roots have been secreting enough oxygen to oxidize the iron around the roots.

Oxidized rhizospheres

The following definitions from the *Field Book for Describing and Sampling Soils* are the national criteria for Natural Soil Drainage Classes:

excessively
Water moves through the soil very rapidly. Internal free water commonly is very rare or very deep. The soils are commonly coarse-textured, have very high saturated hydraulic conductivity, and lack redoximorphic features.

somewhat excessively
Water moves through the soil rapidly. Internal free water commonly is very rare or very deep. The soils are commonly coarse-textured, have high saturated hydraulic conductivity, and lack redoximorphic features.

well
Water moves through the soil readily, but not rapidly. Internal free-water commonly is deep or very deep; annual duration is not specified. Water is available to plants in humid regions during much of the growing season. Wetness does not inhibit growth of roots for significant periods during most growing seasons. The soil is deep to, or lacks redoximorphic features.

moderately well
Water is removed from the soil somewhat slowly during some periods of the year. Internal free water commonly is moderately deep and may be transitory or permanent. The soil is wet for only a short time within the rooting depth during the growing season but is wet enough that most mesophytic crops are affected. The soil commonly has a moderately low or lower saturated hydraulic conductivity class within 1 meter of the surface, periodically receives high rainfall or both.

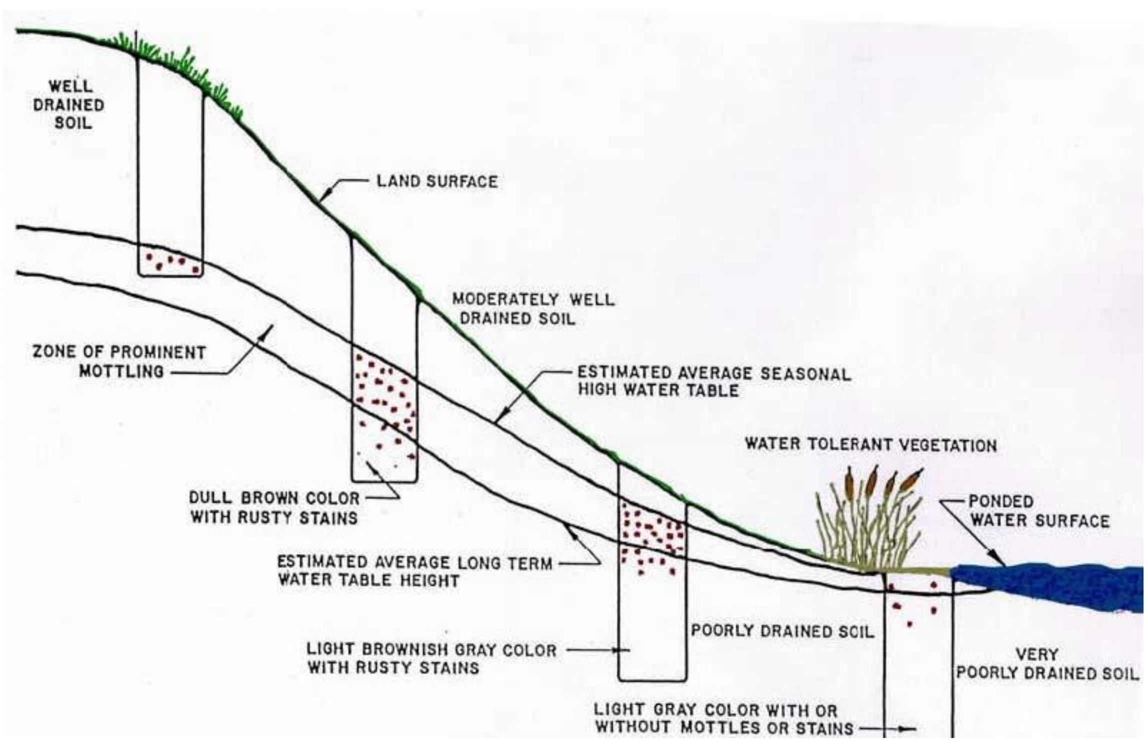
somewhat poorly
The soil is wet at a shallow depth for significant periods during the growing season. Internal freewater is commonly shallow to moderately deep and transitory to permanent. Unless the soil is artificially drained, the growth of most mesophytic plants is markedly restricted. The soil commonly has a low or very low saturated hydraulic conductivity class, or a high water table, or receives water from lateral flow, or persistent rainfall, or some combination of these factors.

poorly

The soil is wet at shallow depths periodically during the growing season or remains wet for long periods. Internal free-water is shallow or very shallow and common or persistent. Unless the soil is artificially drained, most mesophytic crops cannot be grown. The soil, however, is not continuously wet directly below plow depth. The water table is commonly the result of low or very low saturated hydraulic conductivity class or persistent rainfall, or a combination of both factors.

very poorly

Water is at or near the soil surface during much of the growing season. Internal free-water is shallow and persistent or permanent. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Commonly, the soil occupies a depression or is level. If rainfall is persistent or high, the soil can be sloping.



IMPORTANT FARMLAND

The Farmland Protection Policy Act of 1981 was established to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses, and to assure that Federal programs are administered in a manner that, to the extent practicable, will be compatible with state, unit of local government, and private programs and policies to protect farmland. The following criteria define farmland in New Hampshire for the purpose of carrying out the provisions of the Farmland Protection Policy Act.

Prime Farmland

Prime farmland is the land best suited for producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply necessary to produce sustained high yields of crops at a minimum cost when treated and managed according to modern farming methods.

- Soils that have an aquic or udic moisture regime and sufficient available water capacity within a depth of 40 inches to produce the commonly grown cultivated crops adapted to New Hampshire in 7 or more years out of 10.
- Soils that are in the frigid or mesic temperature regime.
- Soils that have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches.
- Soils that have either no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to New Hampshire to be grown.
- Soils that have a saturation extract less than 4 mmhoc/cm and the exchangeable sodium percentage is less than 15 in all horizons within a depth of 40 inches.
- Soils that are not frequently flooded during the growing season (less than a 50% chance in any year or the soil floods less than 50 years out of 100.)
- The product of the erodibility factor times the percent slope is less than 2.0 and the product of soil erodibility and the climate factor does not exceed 60.
- Soils that have a permeability rate of at least 0.06 inches per hour in the upper 20 inches.
- Soils, that have less than 10 percent of the upper 6 inches consisting of, rock fragments larger than 3 inches in diameter.

Unique Farmland

This is farmland other than prime that is used for the production of specific high-value food and fiber crops in New Hampshire. Sites represent a special combination of soil quality, location, growing season and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods. In order to qualify as unique farmland, a high-value food or fiber crop must be actively grown. In New Hampshire, unique farmland crops include, but are not necessarily limited to apples, peaches, pears, plums, strawberries, raspberries, cranberries, blueberries, pumpkins, squash, and tomatoes.

Areas of unique farmland are site specific and not cannot be related to soil map units, therefore they are not identified in the soil database.

Farmland of Statewide Importance

Land that is not prime or unique but is considered farmland of statewide importance for the production of food, feed, fiber, forage and oilseed crops. Criteria for defining and delineating farmland of statewide importance are determined by a state committee chaired by the Commissioner, New Hampshire Department of Agriculture, Markets and Food, with members representing the University of New Hampshire Cooperative Extension, New Hampshire Association of Conservation Districts and the New Hampshire Office of State Planning. The NRCS State Soil Scientist serves on this committee in an advisory capacity. The original criteria were established on June 20, 1983. It was updated on December 7, 2000.

Soils of statewide importance are soils that are not prime or unique and:

- Have slopes of less than 15 percent
- Are not stony, very stony or bouldery
- Are not somewhat poorly, poorly or very poorly drained
- Includes soil complexes comprised of less than 30 percent shallow soils and rock outcrop and slopes do not exceed 8 percent.
- Are not excessively drained soils developed in stratified glacial drift, generally having low available water holding capacity.

Farmland of Local Importance

Farmland of local importance is farmland that is not prime, unique or of statewide importance, but has local significance for the production of food, feed, fiber and forage. Criteria for the identification and delineation of local farmland is determined on a county-wide basis by the individual County Conservation District Boards.

NH Forest Soil Groups

NH Forest Soil Groups (NHFSG) consist of map units that are similar in their potential for commercial forest products, their suitability for native tree growth, and their use and management. The groups were initially assigned separately for each soil survey area in New Hampshire. Considered in grouping the map units are depth to bedrock, texture, saturated hydraulic conductivity, available water capacity, drainage class, and slope. The grouping applies only to soils in the State of New Hampshire.

The NHFSGs have been developed to help land users and managers in New Hampshire evaluate the relative productivity of soils and to better understand patterns of plant succession and how soil and site interactions influence management decisions. The soils are assigned to one of five groups (IA, IB, IC, IIA, and IIB). Several map units in New Hampshire either vary so greatly or have such a limited potential for commercial forest products that they have not been assigned an NHFSG. These soils are listed as NC (Not Classified). Examples of NC map units are very poorly drained soils and soils at high elevations. The kinds of tree species generally growing in climax stands in each of the five NHFSGs vary from county to county, and even area to area.

Forest Soil Groups

IA - This group consists of very deep, loamy, moderately well drained or well drained soils. Generally, these soils are more fertile than other soils and have the most favorable soil moisture relationships.

IB - The soils in this group are generally sandy or loamy over sandy material and are slightly less fertile than group IA soils. Group IB soils are moderately well drained or well drained. Their soil moisture is adequate for good tree growth, but it may not be quite as abundant as that in group IA soils.

IC - The soils in this group are in areas of outwash sand and gravel. They are moderately well to excessively drained. Their soil moisture is adequate for good softwood growth but is limited for hardwoods.

IIA - This diverse group includes many of the same soils as those in groups IA and IB. The soils are separated into a unique group, however, because they have physical limitations that make forest management more difficult and costly, i.e., steep slopes, bedrock outcrops, erosive textures, surface boulders, and extreme rockiness.

IIB - The soils in this group are poorly drained. The seasonal high water table is generally within 12 inches of the surface. Productivity is generally less than that of soils in the other groups.

NC - Not Classified. The map units in this category either vary so greatly or have such a limited potential for commercial forest products that they have not been assigned to an NHFSG. Commonly, onsite visit would be required to evaluate the situation.

Soil Health

Soil Health is the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. This definition speaks to the importance of managing soils so they are sustainable for future generations. Soil is an ecosystem that can be managed to provide nutrients for plant growth, absorb and hold rainwater for use during dryer periods, filter and buffer potential pollutants from leaving our fields, serve as a firm foundation for agricultural activities, and provide habitat for soil microbes to flourish and diversify to keep the ecosystem running smoothly.

There are numerous factors that impact the health and function of every ecosystem, which in turn may result in social, environmental, and economic issues and problems. For example, in areas of numerous buildings, construction sites, or those that have been paved for streets and parking lots, the summer temperatures are often higher than in the surrounding countryside and the water pollution is often more concentrated. A major adverse by-product of this disturbance is water pollution due to runoff, construction, stream modification, and soil compaction. Pollution predominantly occurs in the form of fertilizer and pesticides being carried by erosional sediment and leaching out of the soil into surface waters and the ground water.

The most significant type of pollution entering our water supply is soil sediment (a direct result of erosion), which makes up 47% of the non-point source pollution in this country. The leaching of nutrients makes up 13%, pathogens make up 9% and 3% are pesticides. Some of the other types of pollutants include salinity, acidity, and an increased biological oxygen demand.

One of the most detrimental effects of disturbance on a soil is the increased susceptibility to erosion. Several factors may attribute to this increased susceptibility. Destroying the organic surface layers, which act like a sponge and protect the mineral soil from eroding, is a major problem. The destruction of the organic surface layer is typically caused by adding or removing material to the soil surface. In forested areas the thickness and moisture content of the organic surface layers will vary considerably. Generally, the organic surface layer is typically thicker in colder wetter climates. Removal of the organic layer removes this layer of protection.

Organic layers and topsoil are the primary reservoirs that holds plant nutrients. If some of the organics are removed, then the capacity of the reservoir becomes smaller and the amount of available nutrients is decreased. Furthermore, the surface of the soil may lose its buffering capacity and have a detrimental decrease in pH due to manipulation.

There are many conservation practices that will help to reduce erosion. Knowing the soil properties will help determine the proper management practice to apply. Cover cropping, vegetative filter strips, and riparian buffer zones are three examples of conservation practices valuable in erosion control efforts.

Cover cropping

Soil Properties, Interpretations, and Land Use

Wise land use for agriculture, road and building site development, septic systems, waste deposal systems, and even recreation requires a thorough knowledge of all the soil properties when planning the project. The soil properties that would adversely affect the movement of water, affect the absorption of the waste, and the excavation, construction, and maintenance costs are important considerations. Building and maintaining a healthy soil along with wise land use will also produce many long-term benefits.

Bedrock within 60 inches of the soil surface affects the ease of construction of a homesite with a basement, and within 40 inches becomes a severe restriction. Areas that have bedrock within 60 inches also affects the thickness of the soil available for purifying the wastewater from a septic system. Bedrock within 20 inches of the soil surface affects the rooting depth and available water capacity of the soil for row crops, hayland, and forests, resulting in decreased yields and is a windthrow hazard in woodlands. Bedrock within 10 inches is a severe problem for virtually every type of land use.

Bedrock within 60 inches

Flooding occurs on soils developed in floodplain sediments (Alluvium). Flooding is a severe limitation for building site development and for the operation of a septic system. It is typically not feasible to attempt to overcome the flooding problem for these uses. Flooding usually does not occur during the growing or harvest season of row crops and hayland crops in New Hampshire, but if flooding occurs in harvested row crop fields, sever erosion may occur. Flooding does not typically affect hayland crops or woodland.

Permeability that is either slow or rapid in the substratum layer is a severe limitation to the operation of a septic system leach field. Slow permeability restricts the downward movement of wastewater into the soil. Rapid permeability results in wastewater moving too quickly downward, which may allow unpurified wastewater to pollute the ground water or nearby surface waters. Slow permeability in the topsoil or subsoil layer is a limitation for row and hayland crops. The slow permeability results in poor internal drainage, causing decreased crop yields, restricted crop choices, and increased costs associated with tillage.

A **Seasonal High Water Table** within 60 inches of the soil surface affects the ease of excavation, construction, and maintenance cost of a homesite with a basement, and within 30 inches becomes a severe restriction. Water tables within 60 inches of the soil surface affect the thickness of unsaturated soil available for purifying wastewater from a septic system leach field and within 48 inches is a severe problem. Water tables within 24 inches affect the rooting depth, choice of crop, reduce yields, and reduce the ease of operation of planting and harvesting equipment for agriculture and forestry. Water tables within 20 inches of the soil surface are a limitation for woodland harvesting equipment.

Slope of 8 to 15 percent affects the ease of excavation and construction of a homesite with a basement and a septic system, while slopes greater than 15 percent are a severe limitation. For row crops, slopes of 3 to 15 percent result in an increased erosion hazard, and affect the ease and safety of planting, tillage, and operating harvesting equipment. Slopes greater than 15 percent are a severe limitation for row crops. For hayland crops, slopes of 8 to 15 percent affect the ease and safety of operating farm equipment. Slopes of greater than 25 percent are a severe limitation. For woodland, slopes of 15 to 35 percent result in an increased erosion hazard during planting and harvesting activities and affect the ease and safety of operating equipment. Slopes of greater than 35 percent are a severe limitation for woodland use.

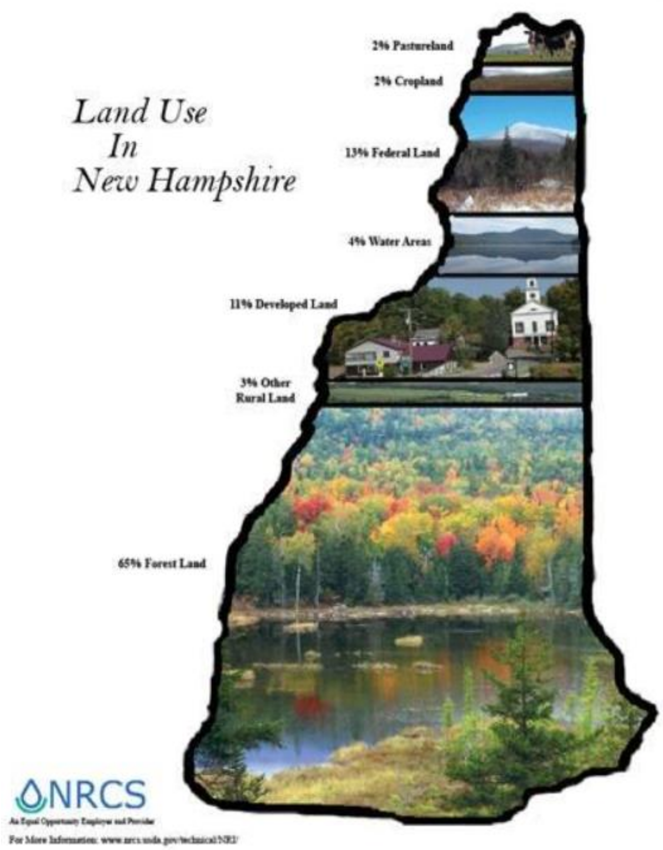
Structure that is prismatic or platy will restrict water movement which can limit root growth and rooting depth. Platy structure may create a perched water table which will also affect the thickness of unsaturated soil available for purifying wastewater from a septic system leach field.

Platy structure caused by compaction

Platy structure of the till in the C horizon

Surface Stones have a severe impact on the ease of operating equipment for woodlands, the construction of a homesite or a septic system if the soils are extremely stony or bouldery. For row crops and hayland crops, stony soils are a moderate limitation for the ease of equipment operation and very stony soils are a severe limitation.

Texture that is sandy or clayey can have an adverse effect on plant growth. For hayland and row crops, sandy surface textures reduce the water holding capacity of the soil, which affects the choice of crop species and reduces yields. Clayey textures become hard when dry and form clods if cultivated when too wet. This also results in reduced row crop yields. For woodland, sandy textures reduce the water holding capacity of the soil. This results in high seedling mortality. Sandy or clayey textures may also adversely affect the operation of woodland equipment.



Data from the National Resources Inventory

Soil Maps and Soil Data

Soils maps and the associated data are valuable tools in natural resource planning and site assessment. Each individual map unit identified on a soil map will have its own unique set of components, horizons, and properties.

A soil map is a representation of areas (Map units) which have similar soil properties, such as: flooding frequency, depth to bedrock, parent material, and drainage class. The delineated areas may show one dominant soil series or may be a group of several soil series (called a soil complex or association). Soil maps are typically shown with an aerial photograph background and includes a description (Map Unit Description) of the properties and landscape found within the delineation and an explanation of the use and management (interpretations). The soil interpretations are based on the various soil properties found for each soil series in each map unit.

Soil maps may be made at different scales and will have small inclusions of other soils within each map unit delineation. An example of this is when a well drained soil is mapped next to a poorly drained soil. Both map units will typically have some inclusions of moderately well drained and somewhat poorly drained soils within their boundaries. As you go from one delineation to another the properties will grade from one to another. The soil line does not mean that the soils suddenly change but represents a transitional zone. If the scale of the map was increased, it may be possible to separate each drainage class. But at virtually any scale some inclusions will be present. NRCS maps in New Hampshire are typically made at a 1:24,000 scale.

Types of Map units

Consociation - A soil map unit in which a single soil series or miscellaneous land type (such as Rock outcrop or Urban land) dominates the delineated area.

Complex - A soil map unit consisting of two or more soils (or miscellaneous land types) in an intricate pattern that is not practical to map separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Association - A soil map unit of two or more soils (miscellaneous land types) that are geographically associated in a repeating pattern. Soils typically could be mapped as consociations at a scale of 1:24,000 or less.

Undifferentiated Group - Two or more soils (or miscellaneous land types) that are mapped as one map unit because they are not Group consistent in their pattern or soil-landscape relationship and their differences are not significant to the purpose of the survey or to soil management.

Web Soil Survey

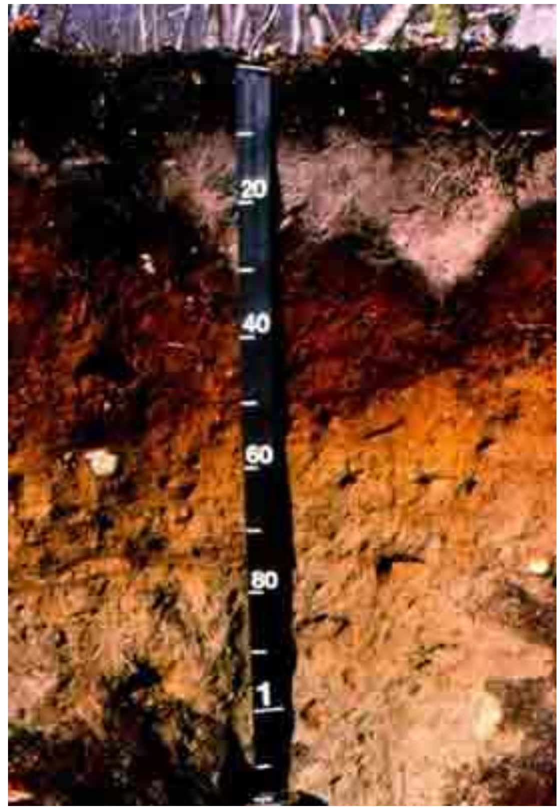
Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation's counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information.

Soil surveys can be used for general farm, local, and wider area planning. Onsite investigation is needed in some cases, such as soil quality assessments and certain conservation and engineering applications.

To access official USDA soil maps and data go to Web Soil Survey at:
https://websoilsurvey.nrcs.usda.gov

State Soil

Marlow - The New Hampshire State Soil



The broad, gently sloping hillsides and summits of loamy drumlins provide some of the most productive soils for farmers and foresters in the harsh granitic landscapes of New Hampshire. We call these important soils Marlow.

Marlow was established as a soil series in 1939 in the town of Marlow in Cheshire County, NH. It is a well-drained soil that has a very firm substratum of basal till that was deposited by the glacier during its last advances over the northeast about 15,000 years ago.

From rock-lined rolling fields to the steep forested uplands of the White Mountains, Marlow soils underlie much of the picturesque backdrop of rural New Hampshire. Many of the State’s current farms are located on this same land that the early settlers cleared of trees and picked of stones. Marlow soils are also economically important soils for timber products, where the climax forest typically consists of shade-tolerant hardwoods such as sugar maple and beech.

Marlow Soil is found on landscapes such as the one pictured above, on areas where the glacier left smooth rounded hills called "drumlins" (in background) in the hilly and mountainous uplands of northern and western New Hampshire.

Other common New Hampshire soils

Paxton series

Woodbridge series


Hinckley series

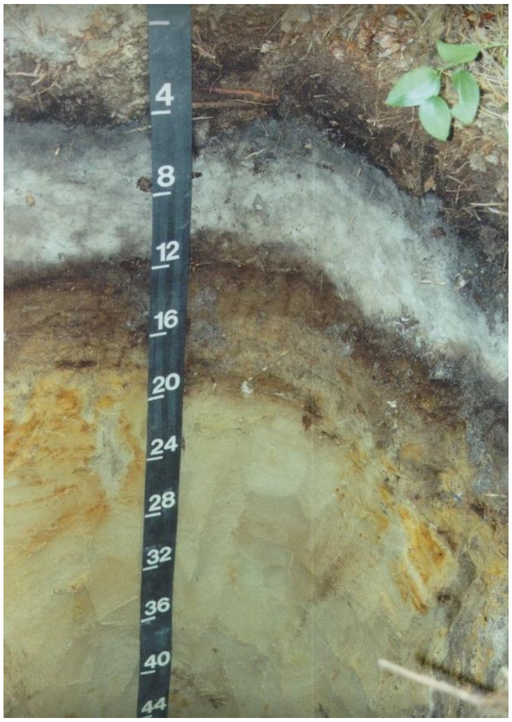
Deerfield series

Limerick series

Eldridge series

Montauk series

Gloucester series



Mashpee series


Ridgebury series

Squamscott series


Pittstown series


Chatfield series

Canton series

Howland series


Nicholville series

Lyme series

Adams series

Masardis series

Ondawa series


Berkshire series with weak spodic


Bershire series with excellent spodic development


Till/Outwash Interface


Subaqueous soils

Glossary

Aeolian (Eolian) **-** material deposited by wind. Also known as loess.

Ablation till – unsorted loose material deposited by the melting of glacial ice.

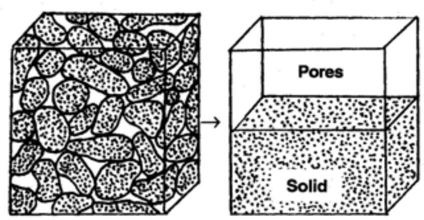
Alluvium - sediments deposited by floodwaters.

Basal till – unsorted material deposited and compacted beneath a glacier and having a relatively high bulk density.

Bedrock - the solid rock that underlies the soil and or is exposed at the surface. The depth to bedrock in New Hampshire is highly variable, but in many places, bedrock outcrops are common or is shallow (within 20 inches). Commonly known in New England as ledge.

Boulder – a rock fragment larger than 2 feet (60 centimeters) in diameter.

Bulk Density – the mass of dry soil per unit bulk volume.



Bulk Density

50% solid, 50% pore space
Weight = 1.33 g
Volume = 1 cm^3

Carbon Sequestration - the process by which carbon dioxide from the atmosphere is converted to organic carbon by photosynthesis and the decomposition of that plant carbon into organic matter stored in the soil.

Catena - a sequence of different soil profiles that occur down a slope. They occur on hill slopes where the geology is uniform and there is no marked difference in climate from the top to the bottom of the slope.

Channer – a thin, flat fragment of sandstone, limestone, slate, shale, or (rarely) schist up to 6 inches (15 centimeters) long.

Cobble (or cobblestone) – A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Consistence – the degree and kind of cohesion and adhesion that soil exhibits and/or the resistance of soil to deformation or rupture under applied stress. For moist soils use loose, very friable, friable, firm, very firm and extremely firm.

Dense layer – a very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer is not easy to dig, is root restricting, and may perch water (impermeable layer).

Drumlin – a smooth elongated oval-shaped hill of glacial till, with the long axis parallel to the orientation of ice flow.

Erratic - a rock of unspecified shape and size, transported by a glacier and deposited on top of the till by melting of the ice. They range in size from pebbles to boulders.

Glacial Erratic

Escarpment – a relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces, typically resulting from erosion.

Esker – a long, narrow, sinuous, steep-sided ridge of stratified sand and gravel deposited as the bed of a stream flowing in an ice tunnel within or below the ice (subglacial) or between ice walls on top of the ice of a wasting glacier and left behind as high ground when the ice melted.

Fibric - organic soil material that contains 3/4 or more recognizable fibers (after rubbing between fingers) of undecomposed plant remains. Bulk density is usually very low and water holding capacity very high.

Flag (or flagstone) – a thin, flat fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flooding - Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Flooding Frequency Class
None - flooding is not probable. The chance of flooding is nearly 0 percent in any year. Flooding occurs less than once in 500 years.

Very rare - flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1 percent in any year.

Rare - flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1 to 5 percent in any year.

Occasional - flooding occurs infrequently under normal weather conditions. The chance of flooding is 5 to 50 percent in any year.

Frequent - flooding is likely to occur often under normal weather conditions. The chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year.

Very frequent - flooding is likely to occur very often under normal weather conditions. The chance of flooding is more than 50 percent in all months of any year.

Flood plain – the nearly level area that borders a stream and is subject to flooding unless protected artificially.

Glaciofluvial deposits (outwash) – material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

Gravel – a rounded or angular fragment of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter.

Ground water table - upper level of an underground surface in which the soil or rocks are permanently saturated with water. The water table separates the groundwater zone that lies below it from the capillary fringe, or zone of aeration, that lies above it.

Hardpan – In New Hampshire, hardpan typically refers to a dense, firm or hard layer (Dense Basal Till), which occurs in the substratum of some glacial till soils. This layer of till was deposited at the base of the glacier and then compacted by the weight of the ice. Please note that not all substratum layers in glacial till soils have hardpans. Other types of hardpan include a plow pan, which may form in the topsoil by compaction from farm equipment. An iron pan is formed in subsoil layers by iron cementation due to wetness. Hardpans may have any soil texture. Most hardpans have platy structure, but some may be prismatic or are massive. They are typically a root restricting layer and typically have slow permeability and low hydraulic conductivity (Ksat).

Hemic – organic soil material characterized by decomposition that is intermediate between that of fibric material and that of sapric material. Bulk density is normally between 0.1 and 0.2 g/cm3.

Histosols - organic soils that have organic soil materials in more than half of the upper 80 cm, or that are of any thickness if overlying rock or fragmental materials that have interstices filled with organic soil materials.

Horizon – A layer, approximately parallel to the surface of the soil, distinguishable from adjacent layers by a distinctive set of properties produced by soil-forming processes.

Horizon Suffix – designate specific subordinate distinctions within master horizons and layers.

a – highly decomposed organic material
b – buried horizon
c – concretions or nodules
d – densic layer
e – moderately decomposed organic material
g – gley
h – organic matter accumulation (humus)
i – slightly decomposed organic material
k – calcium carbonate accumulation
m – cementation (continuous)
p – plow layer
r – soft bedrock
s – sesquioxide (and organic matter) accumulation
t – translocated clay
w – weak color or structure

Kame – a mound, knob, hummock, or short irregular ridge composed of stratified sand and gravel deposited by a subglacial stream as a fan or delta at the margin of a melting glacier; by a supraglacial stream in a low place or hole on the surface of the glacier; or as a ponded deposit on the surface or at the margin of stagnant ice.

Kettle hole - a depression that forms in an outwash plain or other glacial deposit by the melting of an isolated block of glacier ice.

Lacustrine - sediments deposited on the bottom of a lake.

Marine - sediments deposited in tidal flats or on the seabed.

Miscellaneous land type - land that has little or no identifiable soil and thus supports little or no vegetation without major reclamation. Examples of miscellaneous areas are Rock outcrop, Urban land, and Water.

Moraine - unstratified and unsorted deposits of sediment that form from contact with glacier ice.

Muck - organic soil material in which the original plant parts are not recognizable (sapric material).

Ortstein – a cemented spodic horizon.

Outwash (glaciofluvial deposits) - material deposited by moving water that melted from glaciers.

Peat - organic soil material which is the least decomposed (fibric soil material).

Ped – an individual natural soil aggregate, such as a granule, a plate, or a block.

Perched water table - an accumulation of groundwater located above a water table in an unsaturated zone. The groundwater is usually trapped above a soil layer that is impermeable and forms a lens of saturated material in the unsaturated zone.

Permeability - the rate at which a layer can transmit fluid.

Ponding – standing water on a soil in closed depressions. Unless the soil is artificially drained, the water can be removed only by percolation or evapotranspiration.

Porosity - a measure of the void spaces in a soil, represented as the volume of voids divided by the total volume of soil. In an ideal soil, the total pore space should be about 50% (composed of air and water) while the solid phases (sand, silt, clay, and organic matter) make up the other 50% of soil volume.

Reaction, Soil – a measure of acidity or alkalinity of a soil, expressed as pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline.

Redoximorphic features (formerly mottles) – features formed by the process of reduction, translocation, and/or oxidation of iron and manganese oxides.

Residuum – material that formed in place from bedrock.

Rhizosphere – The area of the soil surrounding the plant roots where biological and chemical processes are influenced by the roots. Plants take up water and nutrients through the rhizosphere. Microbes flourish in greater numbers in this zone and have more activity than in the bulk soil. The rhizosphere typically supports 1000 to 2000 times more microbes than the bulk soil without live roots. Roots give off many root exudates which supply food for the microbes and increases microbial activity.

Sapric (muck) - organic soil material that contains less than 1/6 recognizable fibers (after rubbing) of undecomposed plant remains. Bulk density is usually very low, and water holding capacity very high.

Saturated hydraulic conductivity (Ksat) - the rate at which a saturated layer can transmit fluid.

Soil Color – measured by comparison with a color chart. Munsell sol color charts are the most typically utilized.

Soil Health - the capacity of a soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation.

Soil Series – are established by the National Cooperative Soil Survey (NCSS) of the United States Department of Agriculture. Each series consists of pedons having soil horizons that are similar in soil color, soil texture, soil structure, soil pH, consistence, mineral and chemical composition, and arrangement in the soil profile. These similar properties result in soils which perform similarly for land use purposes.

Soil Strength – a soil’s (or localized portion of the soil; for example a horizon) measure of its adhesive and cohesive status. Basically, it is the soils resistance to deformation.

Spodic - mineral soil horizon that is characterized by the illuvial accumulation of amorphous materials composed of aluminum and organic carbon with or without iron.

Stone – a rock fragment 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Striation - multiple, generally parallel, linear grooves, carved by rocks frozen in the bed of a glacier into the bedrock over which it flows.

Structure – the naturally occurring arrangement of soil particles into aggregates that results from pedogenic processes. Examples – granular, blocky, platy.

Subaqueous soils - have perennial water on the soil surface. These soils occur in shallow freshwater and marine environments, such as ponds, lakes, and the subtidal areas of estuaries and tidal embayments.

Texture – the relative proportions, by weight, of sand, silt and clay particles in the soil material less than 2 mm in size (gravels are >2 mm).

Till - material transported by the glaciers and deposited under the ice. The till may be loose or compacted.

U-shaped glacial valley - a valley with a parabolic or "U" shaped cross-section, steep walls and generally a broad and flat floor. It is formed when a glacier widens and cuts into the sides of a V-shaped stream valley.

Varve - thin layers of clay and silt that represent the deposit of a single year (summer and winter) in a lake. Such layers can be used to determine the chronology of glacial lake sediments.

Wetland - land that has a predominance of hydric soils; and is inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions.

References and Websites

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