NEW HAMPSHIRE ENVIROTHON

SOIL GUIDE

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USDA – Natural Resources Conservation Service

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Envirothon Soil Guide

INTRODUCTION

Most of our daily activities and lives are related to and influenced by the soil around us. Life as we know it would not exist without soil. It is critical for us to understand the soil and its importance, as well as how to manage soil and other natural resources in regard to soil properties and behavior.

What is soil? The answer depends on who you are asking. In engineering and construction, soil is the usual name for earth that can be excavated without blasting. Geologists commonly use the term soil for a layer of weathered, unconsolidated material on top of bedrock. To soil scientists, soil is unconsolidated mixture of mineral and organic material at the surface of the earth that serves as a natural medium for growing plants.

Function of a soil

Soils perform many functions that are important to all of us. A healthy soil performs six critical functions:

- Filters and cleans our water
- Acts as a medium for plant growth and habitat for organisms
- Stores and regulates water flow
- Recycles nutrients and organic materials
- Helps to regulate the Earth's climate
- Is an engineering/structural medium

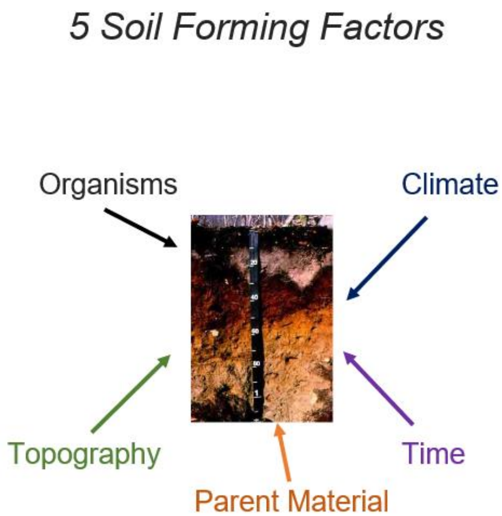
The Use of This Guide

The soil properties, soil conditions, and soil uses in this guide provide a brief overview. The definitions and information are not intended to be all encompassing – they simply provide a brief discussion of the subject covering most situations that will introduce participants to the idea of soil science. If more detailed information is needed, the County Conservation Districts have a list of professional soil scientists throughout the state who are available to serve as volunteer coaches for schools participating in the contest.

Students are encouraged to use this guide and the references for soils education and to prepare for the Envirothon. However, students will not be permitted to use this guide or the references during the competition.

Factors of Soil Formation

Most soils take a very long time to form. They may be millions of years old. They 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, Relief, 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 cause 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.

Relief (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.

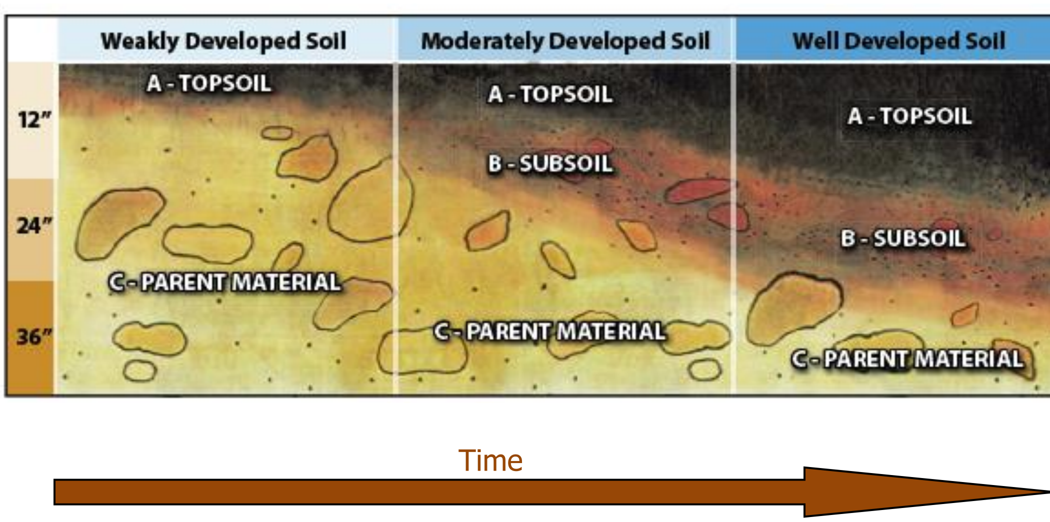
Soils that form on steep positions are generally better drained and tend to be more highly eroded, while soils that occur at lower positions such as in swales and depressions are depositional and generally receive surface runoff and often have a seasonal high water table at a shallow depth.

Parent Material:

Parent material is the underlying geological and organic material in which the soil develops. More information about the types of parent material is described later in this guide.

Time:

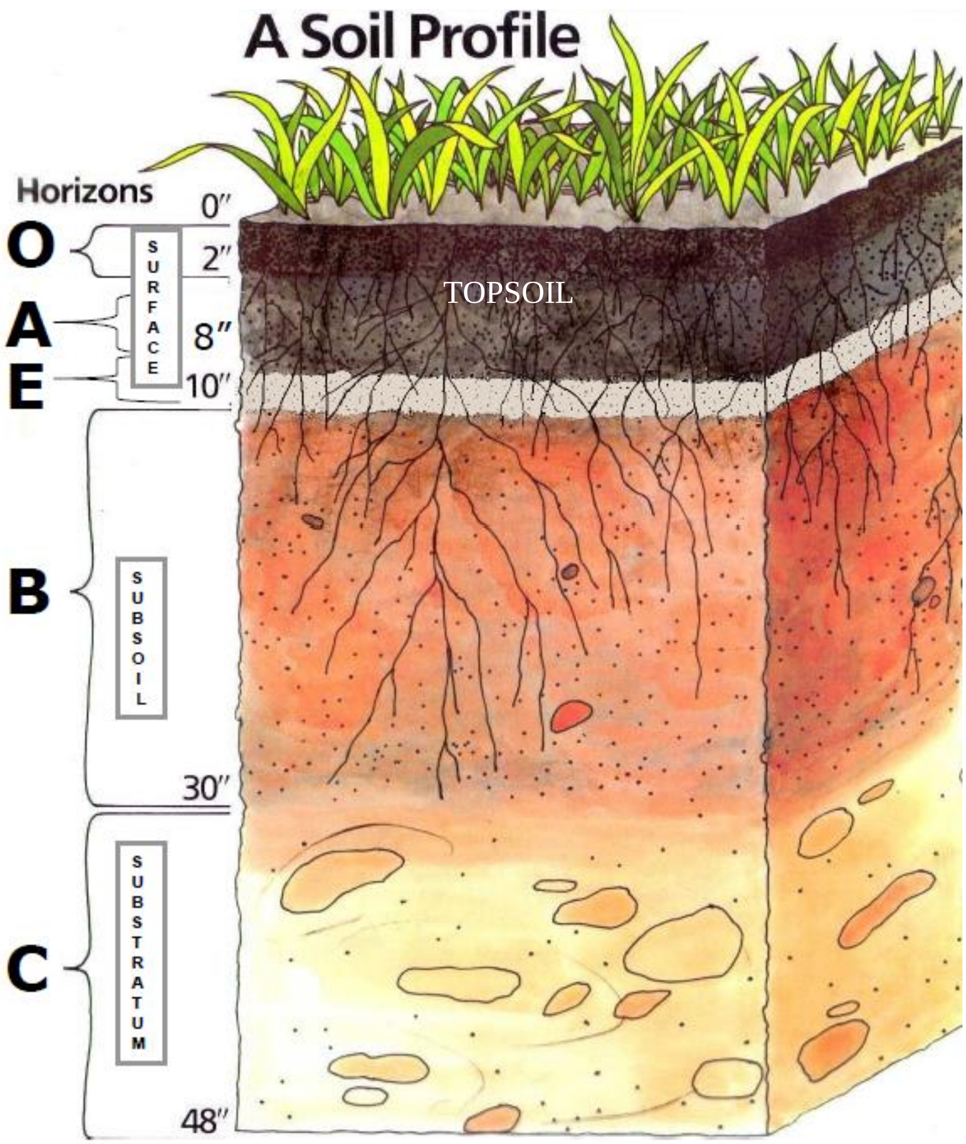
The formation of soils is a continuing process which may take several thousand years for significant changes to occur. The soils of New Hampshire are relatively young, development started after the ice retreat of the last glaciation, approximately 10,000 to 14,000 years ago. In contrast, some soils are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



PHYSICAL FEATURES OF THE SOIL

Soil Profile and Soil Horizons

When a pit is excavated in the soil, the soil profile is exposed on the sides of the pit. The profile is a vertical cross section through the horizons (layers) of soil that occur roughly parallel to the soil surface.



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 layer. This horizon is not present in many of our 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, where the organic matter, nutrients, and other chemicals 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 **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 bedrock, which often occurs below observation depth.

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

Texture

Soil is made up of about 50% mineral particles, 25% water and 25% air. The mineral portion can be divided into three parts – sand, silt, and clay – which are dependent on the size of the mineral particles. Texture is the relative proportion of the **sand**, **silt**, and **clay** in a given soil sample. The proportions are expressed in percent and the total is always 100 percent.

Texture is not based on any other factors, such as how difficult the soil is to dig, the amount of water in the profile, or color. Soil scientists, using the proportions of sand, silt and clay, and a textural triangle (see next page), divide soils into twelve different textures. 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 other textures may also be 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.

The following is a brief description of what the soil particles feel and act like when rubbed between the thumb and forefinger:

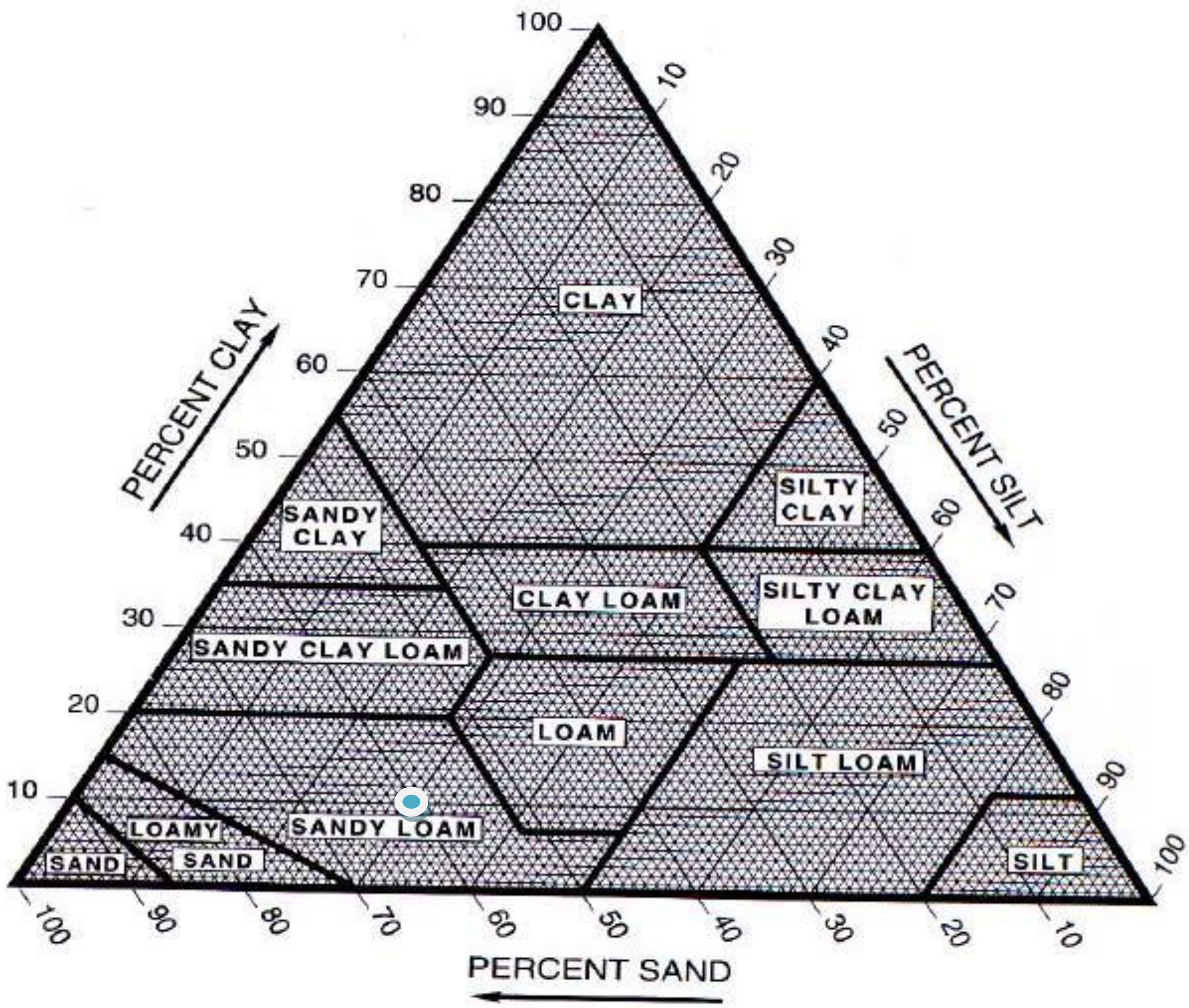
Sand feels very gritty, not sticky, and when squeezed does not hold together in a ball. Sand will leave very little stain on the fingers, if any. Sand does not form a ribbon when squeezed between the thumb and forefinger. Sand particles are between .05 mm and 2 mm in size.

Clay does not feel gritty. It is very sticky and forms a ball when squeezed. A fingerprint will remain on the ball. Clay will stain the fingers. It will form a long ribbon (more than an inch long) when squeezed between the thumb and forefinger. The ribbon has a smooth surface. Clayey soil textures are usually found only in the Seacoast region of New Hampshire, where they are 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). Loamy soils will stain the fingers.

Soil Textural Triangle



For example: if a soil layer has 60% sand, 30% silt and 10% clay, then it is a sandy loam. (See the blue dot above)

- ***Rock Fragments***

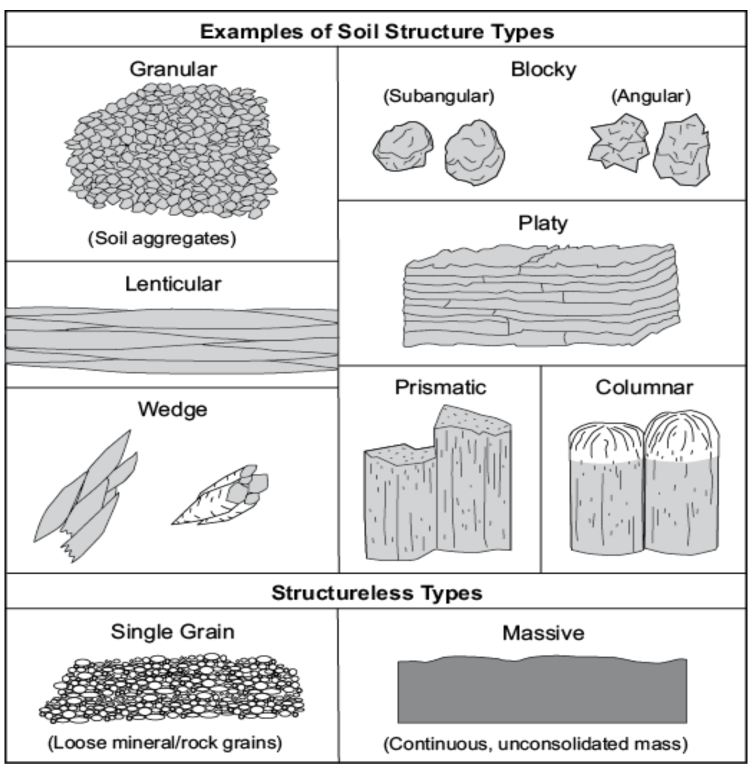
Particles larger than 2 mm are considered rock fragments. Gravel, cobbles, stones, boulders, channers, and flagstones are types of rock fragments. The amount of rock fragments is a texture modifier. They are not considered when determining the amount of sand, silt and clay. For instance, if the soil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

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.

Types of structure:

- 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.



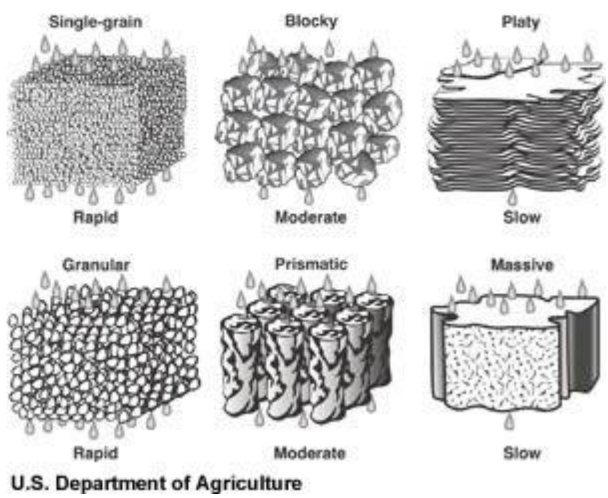
Permeability

The permeability of a soil layer is the rate at which air and water move through the layers. This rate is determined by a combination of soil texture, structure, and the amount of pore space.

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.

Hydraulic conductivity

The hydraulic conductivity (Ksat) of a soil layer is the rate at which a layer can transmit fluid. Ksat is similar to permeability.

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 hardpans include a plow pan, an iron pan, petrocalcic horizon, duripan, and fragipan. Plow pan formed in the topsoil by compaction from farm equipment. An iron pan is formed in subsoil layers by iron cementation due to wetness. Duripans are cemented by silica, petrocalcics are cemented by calcium carbonate, and fragipans are formed during pedogenesis. Duripan, petrocalics, and fragipan are typically not found in New Hampshire.

Hardpans may have any soil texture and they occur in soils that have any natural soil drainage class. Most hardpans have platy structure, but some may be prismatic or are massive. They are a root restricting layer and typically have slow permeability and low hydraulic conductivity (Ksat).

To determine if a substratum layer is a hardpan, compare the firmness of the substratum and subsoil layers.

To perform this comparison, a trowel is recommended. Poke the trowel into the subsoil and then the substratum in several different places. Compare the amount of difficulty. If the insertion of the trowel into the substratum layer is significantly more difficult than the subsoil layer, then the substratum is hardpan.

If a trowel is not available, this comparison can be done by squeezing a small clod from each of the layers between the thumb and forefinger to determine the firmness. If the clod crushes easily, when squeezed, the layer is not a hardpan; if the clod crushes suddenly when squeezed (like a small explosion) or if it takes a lot of pressure to crush the clod, the layer is a hardpan.

Natural Soil 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 (often 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 sections on "Soil Profile and Soil Horizons" and "Soil Color" for more on color.

Water tables in New Hampshire soils are generally highest in the spring (April) and lowest in the summer (July through September). 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 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.

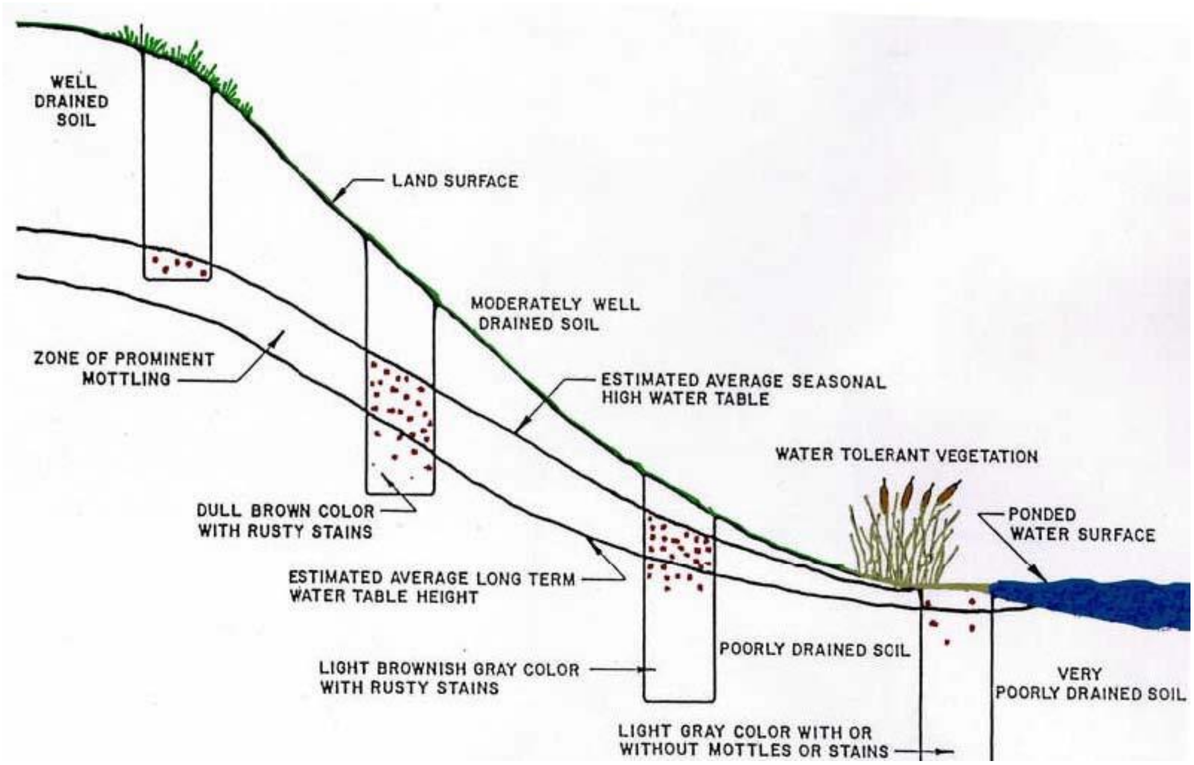
Not every soil will have redoximorphic features within the soil profile that you will observe (well drained, somewhat excessively drained, and excessively drained).

Water moves so rapidly through excessively drained soils that they have no evidence of wetness, no redoximorphic features, and internal free water is very rare or very deep.

Every soil will fall into one of the natural soil drainage classes. Observations of the soil matrix color, the depth to redoximorphic features, and soil permeability will infer the natural soil drainage class.

The natural soil drainage classes are:

- Excessively Drained (ED)
- Somewhat Excessively Drained (SWE)
- Well Drained (WD)
- Moderately Well Drained (MWD)
- Somewhat Poorly Drained (SWPD)
- Poorly Drained (PD)
- Very Poorly Drained (VPD)



Bedrock

Bedrock is commonly known in New England as ledge. It is the rock that lies under the surface of the land everywhere. The depth to ledge in New Hampshire is highly variable, but in many places, bedrock is very near the surface (within 60 inches). When ledge is within 60 inches of the surface, it starts to have a negative effect on uses of the land.

Slope

The slope of the land is the vertical rise or fall of the surface in feet per 100 feet of horizontal distance. It is expressed in percent. For example, a 6 percent slope means that you would rise or fall six feet if you walked 100 feet from your starting point. Use a clinometer to determine the slope to the nearest 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:	≥ 50 percent covered

An area of extremely bouldery soil

Parent Material

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.

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

Each type of parent material has certain physical soil features that serve as clues to its identification.

Aeolian (Loess) **-** Aeolian materials are deposited by wind. 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.

Alluvium - Alluvial sediments are, and continue to be, deposited by floodwaters from nearby streams. The age of these sediments ranges from a few 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 on nearly level landscapes.

Outwash - Outwash deposits were deposited by moving water that melted from glaciers. They were the floodplains of 10,000 to 14,000 years ago.

Soil profiles in this parent material typically have sandy textures in the subsoil and substratum layers. Sometimes the surface and subsoil textures may be loamy. Gravelly layers may also occur in the subsoil and substratum. Gravel, if present, is usually rounded in shape. There are no surface stones. The sand and gravel in these profiles may be arranged in thin layers ranging in thickness from ¼ to 5 inches.

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.

Soil profiles in this parent material have silty or loamy 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 within it.

Marine - Marine (seabed) sediments were deposited as mud in the tidal flats that existed about 12,000 to 14,000 years ago.

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 maybe be hard, they are not a hardpan. There are no surface stones.

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.

Till - Till is material transported by the glaciers and deposited under the ice during the advance and retreat of the last continental glaciation.

Soil profiles in this parent material generally have loamy textures in the subsoil layer (sometimes sandy), and either loamy or sandy textures in the substratum layer. Gravelly layers do not occur in the substratum. There are surface stones; if they have been picked so that the land could be used for agriculture, there are usually stone walls or stone piles nearby. The substratum layer may be a hardpan; if so, this hardpan may consist of thin (1/6 to ¼ inch) plates (platy structure) with a horizontal orientation. There is usually a mixture of gravel, stones and boulders in various proportions throughout the soil profile.

Soil Color

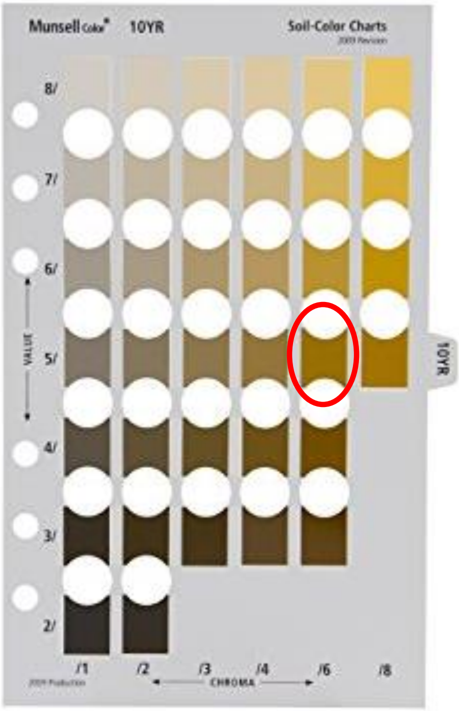
A number of important soil characteristics can be inferred from soil color, such as organic matter content, mineral composition, and seasonal high water table.

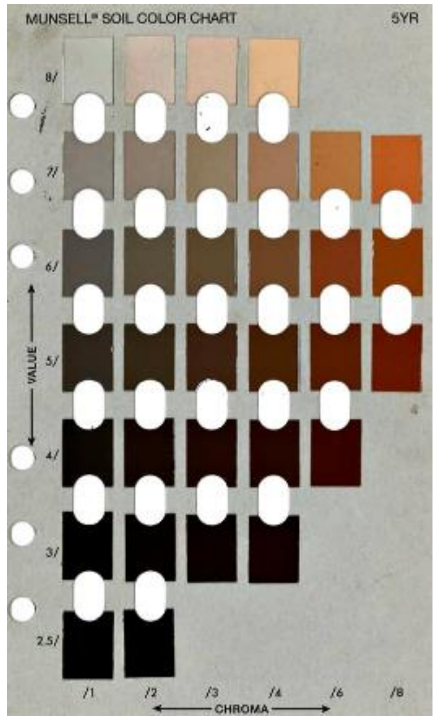
Notable soil colors:

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

Redoximorphic features

The Hue, Value and Chroma 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.

Example: A hue of 10YR, Value of 5, and Chroma of 6 is written as 10YR 5/6.

A Munsell color book is used to identify the color of each layer.

LAND USE and HEALTHY SOILS

Uses

The interaction between the soil and land use can have a profound effect on the soil and the quality and quantity of both surface and groundwater. Many common everyday uses, such as agriculture and urbanization, will impact our soil, our groundwater, and our health. These include the use of pesticides, fertilizers, animal manure, and storm water runoff which often contains metals, nutrients, salts and other chemicals that can leach into groundwater basins.

Soils have six primary roles within our environment: 1) they serve as an environmental buffer to pollutants; 2) they are a medium for plant growth; 3) they serve to regulate the flow of precipitation within a watershed, whether it percolates into the soil, becomes overland flow into lakes and streams, is taken up by plants, or evaporates back into the atmosphere; 4) they regulate the movement and uptake of nutrients; 5) they help to regulate the Earth's climate; and 6) they are a foundation for engineering and development, such as roads and buildings.

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

Properties of the Soil and Land use

Wise land use, including agriculture, road and building site development, septic systems, waste deposal systems, or even recreation requires a thorough knowledge of all the soil properties prior to construction. 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.

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 not feasible to attempt to overcome the flooding problem for these uses. Flooding does not typically affect the use of the soil for hayland crops, or woodland. Flooding usually does not occur during the growing or harvest season of row crops and hayland crops, but if flooding occurs in harvested row crop fields that have been left bare, erosion may occur. Flooding is usually of short duration, so its affect on woodland management and harvesting activities is minimal.

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. Bedrock within 60 inches of the soil surface also affects the thickness of the soil available for purifying the waste water from a septic system and within 40 inches is a severe problem that is difficult to overcome. Bedrock within 20 inches of the soil surface affects the rooting depth and available water capacity of the soil for row crops, hayland crops and forests, resulting in decreased yields and is a windthrow hazard in woodlands. Bedrock within 10 inches is a severe problem.

A seasonal high water table within 60 inches of the soil surface affects the ease of excavation, construction of, 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. Water tables within 48 inches of the soil surface are a severe problem. Water tables within 24 inches of the soil surface affect the rooting depth, choice of row and hayland crops, 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 severe limitation for woodland harvesting equipment.

Slow or rapid permeability in the substratum layer is a severe limitation to the operation of a septic system leach field. The slow permeability results in wastewater moving too slowly, restricting its downward movement into the soil. A rapid permeability results in wastewater moving too quickly downward, which may allow unpurified wastewater to pollute the ground water or nearby surface waters. A slow permeability in the subsoil layer is a severe 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 slope of 8 to 15 percent affects the ease of excavation and construction of a homesite with a basement and a septic system. 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.

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.

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

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.

The physical features of the soil used in this contest to determine whether a soil is prime farmland are: (a soil must have all these features to be considered prime farmland).

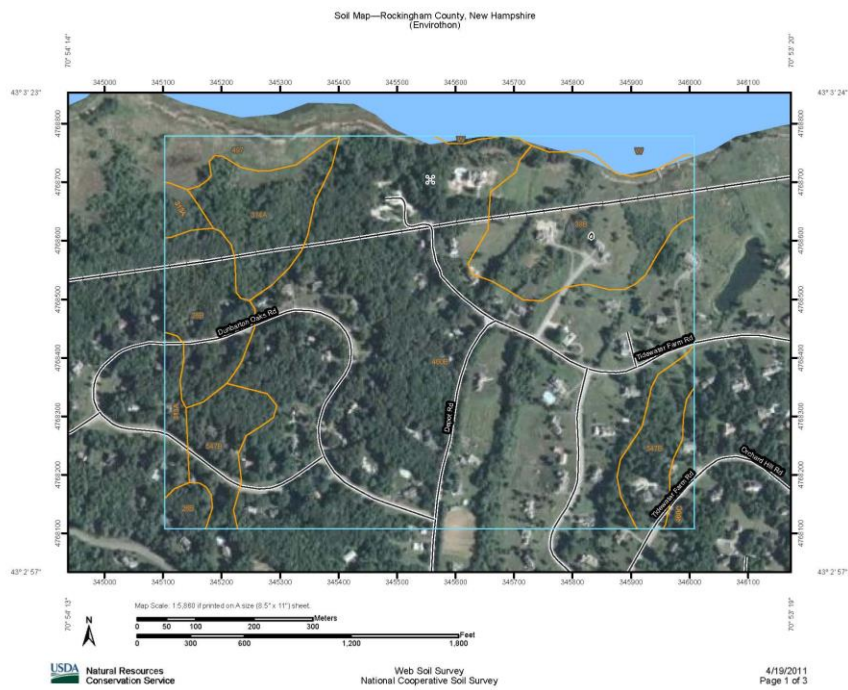
- Loamy texture – in both the surface and subsurface layers.
- Moderate permeability in both the surface and subsoil layers.
- Depth to seasonal high water table that is greater than 30 inches.
- Natural soil drainage class of well drained or moderately well drained.
- Depth to bedrock that is greater than 60 inches.
- Slopes less than 5 percent.
- Surface fragment class is Nonstony.

SOIL MAPS and INTERPRETATIONS

Soils maps and the soil interpretations are valuable tools in natural resource planning and site assessment. Each individual soil identified on a soil map will have its own unique set of properties and horizons (layers).

A soil map is a representation of areas which have similar soil properties (Map Units), such as: flooding frequency, depth to bedrock, parent material, and drainage class. The delineated areas may show one dominant soil or may be a group of several soils (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 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.



Example of a Map Unit Description:

26B - Windsor loamy sand, 3 to 8 percent slopes

Setting
Elevation: 0 to 1000 feet
Mean annual precipitation: 28 to 55 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 120 to 200 days

Composition
Windsor and similar soils: 85 percent
Minor components: 15 percent

Description of Windsor
Landform: Outwash terraces
Parent Material: Sandy outwash
Slope: 3 to 8 percent
Depth to restrictive feature: None
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High or very high
Depth to water table: Greater than 60 inches
Frequency of flooding: None
Frequency of Ponding: None
Available water capacity: Low (about 4.8 inches)

Typical Profile
0 to 12 inches: loamy sand
12 to 21 inches: loamy sand
21 to 60 inches: stratified coarse sand to sand to fine sand

References

To obtain a soil map, visit Web Soil Survey at: https://websoilsurvey.nrcs.usda.gov

Field Guide for Describing and Sampling Soils:
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052523.pdf

Soil Color:
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054286

Know Soil Know Life:
https://www.soils4teachers.org/know-soil-know-life