STATE OF RHODE ISLAND DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
Office of Water Resources

Soil Evaluation Guidance Document

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This guidance document contains information from Appendices 1 and 2 of the *Rules and Regulations Establishing Minimum Standards Relating to Location, Design, Construction and Maintenance of Individual Sewage Disposal Systems*(2002). These Rules have been superseded by the *Rules Establishing Minimum Standards Relating to Location, Design, Construction, and Maintenance of Onsite Wastewater Treatment Systems*(2008). Additional information has been drawn from the United States Department of Agriculture's *Field Book for Describing and Sampling Soils,* Version 2.0, 2002.

I. MASTER HORIZONS

O Horizon

The O horizons in Figure 1 were formed from organic litter derived from plants and animals and overlie mineral surfaces. The uppermost part of this organic layer, which is called the Oi horizon, is unaltered except for some leaching of soluble constituents and discoloration. Most of the material in this horizon can be identified with the naked eye. The lower portion of the organic layer, which is called the Oa horizon, consists of decomposed plant and animal remains and is commonly referred to as humus. These organic horizons are present in the forested regions of Rhode Island, but may be destroyed by burning, erosion, pasturing, or cultivation. The horizons of organic soils are described as Oi (fibric), Oe (Hemic), or Oa (sapric), indicating whether the organic materials are undecomposed, moderately decomposed, or highly decomposed.

A Horizon

The A horizon is commonly referred to as the top soil or surface soil. It is the uppermost layer of the mineral soil profile and contains the most organic matter of any mineral horizon. The A horizon is also the most active biologically. Plant roots, bacteria, fungi, insects, and small animals are more common in the topsoil than in any other major horizon.

Because it lies at the surface, the A horizon is affected the most by falling rain. Some of the rainwater percolates directly into the soil and may remove or leach some of the soluble bases present. This results in quite acid (low pH) surface soils; therefore, lime and fertilizer are required to maintain a soil pH and fertility conducive to optimum plant growth. This is particularly true in Rhode Island soils. Not all of the rain falling on the soil surface percolates down through the soil profile. During severe rainstorms, runoff from sloping areas can result in erosion of the top soil.

Although most of the soils in Rhode Island have developed under forest vegetation, evidence of disturbance is very common due to cultivation. If the soil is very poorly drained, the thickness of the A horizon might be eight or ten inches.

If a soil has been cultivated, the O horizon, A horizon, E horizon, and some of the B horizons may have been destroyed. This condition is referred to as a plow layer and is identified as an Ap horizon. These plow layers are evident in many forested regions of Rhode Island which indicate that they were cultivated at one time.

E Horizon

The E horizon is commonly referred to as the zone of *eluviation* or leaching. This horizon has been leached of organic matter, iron and aluminum oxides, and other soluble constituents, and has a corresponding concentration of resistant minerals such as quartz. This lighter-colored layer, which occurs directly beneath the A horizon in some soils, is frequently destroyed by plowing and, therefore, is rarely present in Rhode Island soils.

B Horizon

The B horizon is commonly referred to as the subsoil and usually occurs immediately below the Ap horizon in Rhode Island soils. In well-drained soils, the B horizon is commonly yellowish-brown to reddish-brown in color. These brighter colors have resulted from the accumulation of iron oxides. The B horizon is generally referred to as the zone of maximum illuviation. In addition to iron, there may also be an accumulation of such constituents as aluminum, manganese, calcium, clay and organic matter in the subsurface horizons of some soils. The B horizons of soils classified as poorly or very poorly drained are usually gray.

The properties of the B horizon are important to agriculture and urban development because of their influence on root growth and water movement. Knowledge of the characteristics of this subsurface horizon is critical for the appropriate design of tile drain systems, sanitary landfills, on-site sewage disposal systems, and highway construction.

In soil profile descriptions, the B horizon may be subdivided with additional symbols which indicate different types of soil properties. For example, Bt, Bh, Bs, and Bk indicate subsurface accumulations of illuvial clay, humus, illuvial iron, and calcium carbonate, respectively. Most subsurface horizons in Rhode Island soils are designated as Bw, indicating that the subsoil is weakly developed and has a reddish-brown color and subangular blocky structure.

The solum is that portion of the soil profile which has undergone soil-forming processes and includes the O, A, E, and B horizons collectively.

C Horizon

The C horizon is a layer of unconsolidated material underlying the solum. This horizon is outside the zone of major biological activity and has been influenced only slightly by soil-forming processes. However, sufficient physical and chemical weathering has occurred to distinguish this material from the consolidated bedrock below. The C horizon material may have accumulated by the breakdown of bedrock, or it may have been moved to its present location by the action of water, wind, or ice. If the C horizon material is similar in chemical, physical, and mineralogical properties to the material from which the A and B horizons have developed, the C horizon is commonly referred to as the parent material.

In many Rhode Island soils the C horizon consists of materials that are different from those in the solum. For example, the solum may have developed in wind-blown silt (*loess*) while the C horizon consists of stratified sand and gravel (glacial outwash). The presence of two or more different geologic materials in the same soil profile is referred to as a lithologic discontinuity. In profile descriptions these differences in geologic materials are designated by Arabic numeral prefixes such as 2C.

R Horizon

The underlying consolidated bedrock, such as granite, gneiss, or shale, is designated as the R horizon. If the bedrock is unlike the overlying soil material, the R is preceded by an Arabic numeral such as 2R. Although bedrock can be observed in many areas of Rhode Island, none of the soils in the State were formed in place from this material.

Transitional Horizons

Transitional horizons are layers of the soil between two master horizons. Horizons dominated by properties of one master horizon while having subordinate properties of an adjacent master horizon are designated by two master horizon capital letters. The first letter indicates the dominant master horizon characteristics and the second letter the subordinate characteristics. For example, an AB horizon indicates a transitional horizon between the A and B horizon, but more like the A horizon than the B horizon. For example, a BA horizon is a transitional horizon between the A and B master horizons but more like the B horizon than the A horizon. Other commonly designated transitional horizons include AE, EA, EB, BE, BC,CB, and AC.

A second type of transitional horizon (combination horizon) is recognized where separate components of two master horizons are recognizable in the horizon and at least one of the component materials is surrounded by the other. Such mixed transitional horizons are designated as A/B, B/A, E/B, B/E, and the like. The first symbol designates the material of greatest volume in the transitional horizon.

Subordinate Distinctions within Master Horizons

Further characterization of the above described master horizons is facilitated by the application of subordinate distinctions, denoted as lowercase characters. Subordinate distinctions provide for noting the presence of specific properties which are present within the master horizons. The list of subordinate distinctions appears below. Subordinate distinctions of importance relative to characterization of Rhode Island soils include: a, which denotes highly decomposed organic matter; b, which denotes a buried soil horizon and d, which denotes dense unconsolidated materials, such as those which are present in glacial till.

Lower case letters are used to designate specific features within master horizons.

a -- Highly decomposed organic material: Used only with the O master horizon; rubbed fiber content less than 17% by volume (referred to as Sapric).

b -- Buried genetic horizon: This designation is used only if the buried mineral horizon contains clearly identifiable features of a genetic soil horizon. It is not used in organic soils or to identify a buried O horizon.

c -- Concretions or hard nonconcretionary nodules: This symbol is used only for iron, aluminum, manganese, or titanium cemented nodules or concretions.

d -- Dense unconsolidated sediments or materials: This symbol is used to indicate naturally occurring or man-made unconsolidated sediments with high bulk density, such as basal till, plow plans, and other mechanically compacted zones. Roots do not enter except along fracture planes.

e -- Organic material of intermediate decomposition: Use only with O horizons with rubbed fiber content between 17 and 40% by volume (referred to as Hemic).

f -- Frozen soil: This is used only for Horizons, usually C horizons, that contain permanent ice.

g -- Reduced matrix: This symbol is used to indicate low chroma color, usually 2 or less with values ≥5, caused by *reduction* of iron in stagnant saturated conditions. The iron may or may not be present in the ferrous form. The g is used to indicate either a total reduced matrix or the presence of redox depletions in a patchwork pattern.

h -- Illuvial accumulation of organic matter: Used only in B horizons, the h indicates an accumulation of *illuvial, amorphous,* dispersible organic matter with or without A1 sesquioxide component. If the sesquioxide component contains enough iron so that color value and chroma is 3 or less, then hs, is used.

i -- Slightly decomposed organic material: Used only with the O horizon to designate that the rubbed fiber content is greater than 40% by volume (referred to as Fibric).

k -- Accumulation of carbonates: Used with B and C horizons, k indicates an accumulation of alkaline earth carbonates, usually calcium carbonate.

m -- Cementation or *induration*: Used with any master horizon, except R, where more than 90% of the horizon is cemented and roots penetrate only through cracks. The cementing material is identified by the appropriate letter, such as km = carbonate, qm = silica, sm = iron, ym = gypsum, kqm = both lime and silica, zm = salts more soluble than gypsum.

n -- Accumulation of sodium: This symbol is used on any master horizon showing morphological properties indicative of high levels of exchangeable sodium.

o -- Residual accumulation of *sesquoxides*: This symbol is used on any master horizon having properties indicative of sesquioxide residual after intense weathering.

p -- Plowing or other cultivation disturbance: Whereas plowing is the most common method of cultivating soil, hoeing and discing and a multitude of other practices that mix a surface layer are designated by this symbol. The symbol p is only used with the master horizon A or O, if organic, even if the material mixed by the cultivation is from an E, B, or C horizon.

q -- Accumulation of silica: This symbol is used with any master horizon, except R, where secondary silica has accumulated. It is frequently used with m if the horizon is more than 90% cemented.

r -- Weathered or soft bedrock: This symbol is only used with the master C horizon. It designates material often called saprolite that is hard enough that roots only penetrate along cracks, but soft enough that it can be dug with a spade or shovel.

s -- Illuvial accumulation of sesquioxides: This symbol is only used with B horizons. It indicates the presence of illuviated iron oxides in contents sufficient to give a color of more than 3 for both value and chroma. It is often used in conjunction with h when the color is 3 or less for both value and chroma.

t -- Accumulation of silicate clay: The presence of silicate clay forming coatings on ped faces, in pores, or as bridges between sand sized mineral grains. The clay coats form by illuviation into B horizons. The symbol may also be used in C or R horizons.

v -- Plinthite: This symbol is used in B and C horizons that are humus poor and iron rich. The material usually has "reticulate mottling" of reds, yellows, and grey colors. Upon exposure as in a road cut, the material hardens irreversibly.

w -- Development of color and structure: This symbol is used for B horizons that have developed structure or color different from the A or C horizon, usually redder, but does not have apparent illuvial accumulations.

x -- Fragipan character: This symbol is used to designate genetically developed firmness, brittleness, or high bulk density in B and C horizons.

y -- Accumulation of gypsum: This symbol is used in B and C horizons to indicate genetically accumulated gypsum. Often used with m if horizon is cemented in more than 90% of its extent.

.z -- Accumulation of salts more soluble than gypsum: This symbol is used to identify soluble salt accumulations in B and C horizons.

Vertical Subdivisions

Frequently a horizon or layer designated by a master, transitional, and/or subordinate symbol needs to be subdivided. In most soils this subdivision is based on differences in morphological features such as structure, color, or texture. Arabic numbers are added as suffixes to the horizon symbols to identify subdivisions within horizons. For example, successive layers in a C horizon would be designated as C1, C2, C3, etc., or a horizon sequence of A, AB, Bt1, Bt2, Bt3, BC, C would indicate three (3) subdivisions of the Bt horizon.

Discontinuities

A lithologic discontinuity is a significant change in particle-size distribution and/or mineralogy in the vertical direction of a soil profile that was caused by geologic processes. For example, it is quite common for soils to exhibit a windblown silt mantle (loess) over glacial till or stratified glacial outwash deposits over glacial till. Such discontinuities are designated with Arabic numbers as prefixes to master horizons. The uppermost geologic material, which would be prefixed by a 1, is not numbered using this convention. For example, if a soil has developed in loess overlying glacial outwash, a typical profile might have the following horizon designations: A, Bw1, Bw2, BC, 2C1, 2C2, 2C3. The prefix 2 indicates that the upper part of the soil developed from a different geologic material than the C horizon.

Use of the prime

Occasionally, two (2) horizons may develop in a profile and have the same horizon designation but be separated by an unlike horizon. Where the investigator interprets this to be due to genetic processes, the lower of the two (2) horizons is designated as prime ('). For example, an A-E-Bh-E'-Bt profile indicates an eluviated E horizon formed in association with a Bt horizon and subsequently a Bh horizon has formed within the E horizon. Soils with such genetic scenarios are referred to as bisequal.

II. PROPERTIES OF SOILS

An experienced pedologist (soil scientist) can read a great deal from the morphology of a soil seen in the field. Many of the soil properties, such as color, structure, consistence, and sequence of horizons, are readily observable and the soil scientist can make many interpretations based on these properties. However, some soils may look alike but may have entirely different chemical and physical properties which could cause them to react quite differently to various uses. Thus, for modern soil science, quantitative field and laboratory data on the composition of soils are needed in order to make accurate interpretations related to the response of soils to different uses.

Color

Color is perhaps the most obvious and easily determined soil characteristic. This physical property has little effect on soil behavior beyond influencing the gain and loss of radiant energy; however, color is particularly useful for making a number of meaningful predictions about the soil. It is an indirect measure of such things as the intensity of mineral weathering, the amount and distribution of organic matter in the soil, and the state or degree of soil aeration.

Although color itself has little influence on the nature of soils, it is a property which soil scientists use to interpret and predict soil conditions and responses. Because soil colors reflect seasonally high water tables, they are a valuable tool in determining the suitability of soils for such uses as on-site sewage disposal systems, sanitary landfills, home sites, and other structures affected by wet soils.

The two (2) dominant coloring agents of soils are organic matter and iron oxides. The effects of organic compounds are most prevalent in surface horizons and give them their dark colors. Although organic matter is not the only coloring agent, and all organic mater is not the same color, there is generally a darkening of soils with increased organic content. The relationship between soil color and organic matter content may be somewhat obscured by the type of organic matter and its stage of decomposition. Raw peat (Oi) material is generally brown in color, whereas highly decomposed organic (Oa) materials, such as those found in muck soils, are black or nearly so. The amount of organic matter and thus the color of the soil is correlated quite well with the soil drainage class. As illustrated in Figure 2, as a soil becomes more poorly drained the A horizon becomes thicker, the organic matter content increases, and the color becomes darker.

Subsoil or B horizon colors can range from gray to yellowish brown to reddish brown to red. These color differences can generally be attributed to the amount of iron present. Although the parent material may influence the color of some soils, particularly young soils, most subsoil colors are related to the intensity of weathering or the amount of oxidation which is controlled by drainage. Usually reddish soils are found in warm humid climates where the intensity of weathering has been high, as in the southeastern parts of the United States or in tropical areas. Some well-drained soils which have apparently undergone extensive weathering may be yellow rather than red. Laboratory analyses often reveal that these soils are just as high in iron as the red soils; but the iron occurs in a different form. A number of studies have suggested that red soils are occupied by iron oxides such as hematite, whereas the yellow soils are composed primarily of hydroxides such as goethite.

It is also important to realize that the color of a soil is influenced by its moisture content. Normally, moist soils will have lower values (darker colors) than dry soils. Unless indicated otherwise, all soil colors should be determined on moist samples.

Munsell color charts are utilized to determine a soil's color. The three (3) components used in describing soil color (Munsell Notation) are hue, value, and chroma.

Hue: Corresponds to the dominant spectral (rainbow) color and is related to the dominant wavelength of light. Each color chart (page) in the Munsell color book is of a different hue. The symbol for hue is the letter abbreviation for the dominant color (i.e., R - red, YR- yellow red, Y - yellow). The dominant hue is further subdivided into quarters which is identified with a numerated prefer (e.g., 2.5R, 5R, 7.5 R, and 10R).

Value: Refers to the lightness or darkness of color relative to gray and is a function of the intensity or amount of light reflected. The value ranges from 0 (black) to 10 (white).

Chroma: Refers to the relative purity or intensity of color. Chroma ranges from 0 for gray or dull colors, to 10 for bright colors.

The Munsell color notation is written as follows:

Example: 7.5YR 5/6
Hue = 7.5YR
Value = 5
Chroma = 6

This soil sample would have a color of Strong Brown.

Redoximorphic Features

Soils that have impeded drainage and/or have high water tables during certain periods of the year usually exhibit *redoximorphic features*. These features can be categorized as redox depletions and redox concentrations (formerly called low and high chroma mottles, respectively), and a gleyed matrix. The color of these redox features (Munsell Notation) should be given as well as a description of the pattern of redoximorphic features. Patterns to be noted are:

Abundance of Redox Depletions and/or Redox Concentrations:

Few (f): occupy less than 2 percent (2%) of the exposed horizon surface.

Common (c): occupy 2 to 20 percent (2-20%) of the exposed horizon surface.
Many (m): occupy greater than 20 percent (20%) of the exposed horizon surface.
A chart for estimating percentages of redox depletions or concentrations is given in Figure 3.

Size of Redox Depletions and/or Redox Concentrations:

Fine (1): less than 5 mm in diameter.
Medium (2): 5 to 15 mm in diameter.
Coarse (3): greater than 15 mm in diameter.

SIZES:		
5 mm	10 mm	15 mm

Contrast of Redox Depletions and/or Redox Concentrations

Faint (f): hue and chroma of matrix and redox concentration/depletion are closely related.

Distinct (d): Matrix and redox concentrations/depletion vary one to two (1-2) hues and several units in chroma and value.

Prominent (p): matrix and redox concentration/depletion vary several units in hue, value and chroma.

It is quite common for soil scientists to use shorthand or abbreviations when describing soils in the field. For example; 7.5YR 6/6 matrix and m3p 10YR 7/2 redox depletions would be written in longhand as:

Yellowish Brown (7.5YR 6/6) with many, coarse, prominent light gray (10YR 7/2) redox depletions.

Soil color is greatly influenced by the inter-relationships between water and air flow through the soil. Poor aeration results when soil pores remain filled with water for prolonged periods. When aeration is poor, iron assumes a chemically reduced form, (ferrous iron; Fe^{+2}). Ferrous forms of iron are quite soluble in water and are readily leached from the soil leaving uncoated mineral grains that imparts grayish to bluish hues to the soil body a gleyed matrix. These colors are indicative of poorly and very poorly drained soils.

The depth to water tables fluctuates from season to season. During the winter and spring, water tables are generally quite high resulting in a reduction of iron compounds to the ferrous form which imparts a gray color to the soil. Water tables generally drop during the summer months resulting in oxidizing conditions. This alternate reducing and oxidizing environment causes a mobilization and redeposition of iron compounds resulting in the formation of redox concentration and depletion features in the soil, formerly referred to as mottles. These rust-colored redox concentrations, and grey-colored, redox depletions, are generally indicative of seasonally high water tables.

The following kinds of redoximorphic features have been identified for use in profile descriptions. Redox features are one of the components that indicate aquic conditions exists. The other two (2) components of aquic conditions are saturation of the soil and reduction of the soil.

1. Redox Concentrations - Bodies of apparent accumulations of Fe and Mn oxides.

   a. **Nodules and Concretions**: Firm to extremely firm irregularly shaped bodies with diffuse boundaries. When broken in half, concretions have concentric layers, whereas nodules have a uniform internal fabric. However, the terms "nodules" and "concretions" have been used interchangeably.

b. **Masses**: Soft bodies, frequently within the matrix, whose shape is variable. Masses include features that formerly would have been called "reddish mottles."

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

2. Redox Depletions - Bodies of low chroma (≤2) having values of 4 or more where iron and manganese oxides alone have been stripped out or where both iron and manganese oxides and clay have been stripped out.

a. **Iron Depletions**: Low chroma bodies with clay contents similar to that of the adjacent matrix. These features have sometimes been called "grey mottles," "gley mottles," "albans" or "neoalbans." They may occur along macropores and also within the matrix. When the soil matrix has a color chroma of ≤2, it can be considered an iron depleted matrix.

b. **Clay Depletions**: Low chroma bodies containing less Fe, Mn, and clay than an adjacent soil matrix. They have been described as "silt coatings" or "skeletans" formed along ped surfaces or lining channels. The clay eluviated from the clay depletions frequently is found coating ped surfaces in underlying horizons. Clay is not likely to be found in Rhode Island soils.

3. Reduced Matrices - Soil matrices that have a low chroma color in situ because of the presence of Fe(II), but whose color changes in hue or chroma when exposed to air as the Fe(II) is oxidized to Fe(III). The change in color usually occurs within 30 minutes or less after the sample is exposed to air. This period is variable and may have to be determined by local field studies.

*__Note__: Several conditions must exist in order for iron or manganese to be reduced resulting in a reduced matrix. Iron (III) and Mn (III and IV) are reduced by bacteria decomposing organic matter under *anaerobic* conditions. In a soil that is moist but not saturated, bacteria consume and reduce O_2 in air filled soil pores during the decomposition of organic tissue. Anaerobic soils are saturated such that most pores will be filled with water unless air has been entrapped in some pores. Bacteria in these soils consume O_2 dissolved in the soil water as they decompose the organic matter. When the dissolved O_2 is gone, the soil water is said to be reduced. As bacteria continues to decompose organic matter, NO_3- (nitrate) is converted to N_2 gas (*denitrification*), and reduction of minerals composed of Mn (IV) and Fe (III) oxides occurs. These chemical reactions occur in sequence, with O_2 being reduced first, then NO_3-, Mn(III or IV) oxides, and finally Fe(III) oxides. The Fe oxide minerals will not be reduced, and thus will not show a reduced matrix until after O_2, NO_3-, and Mn oxides that occur near the Fe oxides have been reduced. If for any reason this sequence is interrupted and Fe cannot be reduced, the matrix will not appear reduced.

4. Exceptions - there are at lest two (2) cases when the features listed above cannot reliably be considered as redoximorphic features reflecting current *aquic conditions*.

a. Low chroma matrix colors that do not indicate saturation and reduction. Several examples of these are known. Soils having a color value moist of 3 or less and found in horizons with organic matter accumulations cannot be used as indicators of redoximorphic features. Low chroma organic stains and low chroma carbonate accumulations are not considered to be redoximorphic features. Exceptions to the value limit do occur. Higher values may have to be excluded under some situations where measurements show saturation does not occur. In addition, low chroma colors may occur in some parent materials that contained little or no oxidized iron. Iron can also be stripped from soil particles by organic compounds such as chelates, and these reactions may not require saturated conditions. Low chroma colors not formed by saturation and reduction tend to be found more often in sandy soils than in finer-textured soils (Hyde and Ford, 1989). Accordingly, it is critical that saturation and reduction be confirmed by inspection or measurements before assuming that low chroma colors found in a soil indicate that the soil is seasonally saturated and reduced. Low chroma soil colors may also occur in soils formed from inherently dark parent materials such as shale or phyllite. In relatively young soils the parent material color masks any morphology that may indicate aquic conditions. This situation occurs in Narragansett Basin soils in the East Bay area of Rhode Island.

b. Nodules and concretions composed of Fe and Mn oxides are resistant features and may be relicts of wetter conditions many years before the present, or may have formed at other locations and were transported to the present site. Nodules and concretions with sharp boundaries usually did not form in the horizon in which they are observed, particularly if they occur in clay depletions. For this reason, nodules and concretions should not be used as redoximorphic features if they are the only features present, unless it is known by measurement of water saturation that they represent current conditions.

Texture

Soils, as they occur in the field, are mixtures of mineral particles of different sizes ranging from stones and gravel to microscopic clay. While stones and gravel, when present, give certain characteristics to a soil, from a biological and nutritional standpoint, the important fraction is the fine earth material (<2 mm). Table 1 lists limits of various particle size fractions as established by the United States Department of Agriculture. Sand grains are easily seen with the naked eye and feel gritty. Silt and clay particles, however, cannot be felt individually but they do have characteristics that permit their identification. Visually, silt particles fall within the range of an ordinary microscope. They are very smooth when moist and have the consistency of face powder or flour when dry. Clays, on the other hand, are too small to be observed with an ordinary microscope and are extremely sticky and plastic when wet and form hard clods when dry.

Few soils consist of a single particle size and most contain varying proportions of sand, silt and clay. Some variation in texture can occur without causing a major change in the general character of the soil. Because of this, it is convenient to group soils into a limited number of textural classes, each representing a fairly narrow range in particle size composition and properties. Twelve textural classes are recognized in the United States and are listed by name on the textural triangle in Figure 4.

Table 1. U.S.D.A. Size Limits of Coarse Fragments and Soil Particles

NAME OF COMPONENT	DIAMETER	VISUAL SIZE COMPARISON OF MAXIMUM SIZE
Stones	Above 25.4 cm	
Cobbles	7.5 cm - 25.4 cm	
Gravel	2 mm - 7.5 cm	
Very Coarse Sand	1.0 - 2.0 mm	House Key Thickness
Coarse Sand	0.5 - 1.0 mm	Small Pin Head
Medium Sand	0.25 - 0.5 mm	Sugar or Salt Crystals
Fine Sand	0.1 - 0.25 mm	Thickness of Book Page
Very Fine Sand	0.05 - 0.1 mm	Invisible to the Eye
Coarse Silt	0.02 - 0.05 mm	Visible with Microscope
Fine Silt	0.002 - 0.02 mm	
Coarse Clay	0.0002 - 0.002 mm	Most Not Visible with a Microscope
Fine Clay	Below 0.0002 mm	

The textural class of a soil is determined by analyzing the particle size. Accurate measurements of particle size distributions are made in a laboratory, however, an experienced soil scientist can estimate texture fairly accurately by rubbing a small portion of moist soil between the thumb and forefinger. Soil texture classes can be determined by using the following descriptions:

* **Sand**: Soil consisting mostly of coarse to fine sand, and containing so little clay that is loose when dry and not sticky when wet. When rubbed it leaves no film on the fingers.

* **Loamy Sand**: Consisting mostly of sand, but with sufficient clay and silt to give the soil slight cohesion when very moist. Leaves a slight film of fine materials on the fingers when rubbed.

* **Sandy Loam**: Soil in which the sand fraction is still quite obvious, it molds readily when sufficiently moist, but in most cases does not stick appreciably to the fingers. Threads do not form easily.

* **Loam**: Soil in which the fractions are so blended that it molds readily when sufficiently moist, and sticks to the fingers to some extent. It can, with difficulty, be molded into threads.

* **Silt Loam**: Soil that is moderately plastic without being very sticky and in which the smooth, soapy feel of the silt is the most noticeable feature.

* **Silt**: Soil in which the smooth, soapy feel of silt is dominant.

Sandy Clay Loam: Soils containing sufficient clay to be distinctly sticky when moist, but in which the sand fraction is still an obvious feature.

Clay Loam: The soil is distinctly sticky when sufficiently moist, and the presence of sand fractions can only be detected with care.

Silty Clay Loam: The soil contains quite subordinate amounts of sand, but sufficient silt to confer something of a smooth, soapy feel. It is less sticky than silty clay or clay loam.

Sandy Clay: The soil is plastic and sticky when moistened sufficiently, but the sand fraction is still an obvious feature. Clay and sand are dominant and the intermediate grades of silt and very fine sand are less apparent.

Silty Clay: Soil which is composed almost entirely of very fine material, but in which the smooth, soapy feel of the silt fraction modifies to some extent the stickiness of the clay.

Clay: The soil is plastic and sticky when moistened sufficiently and gives a polished surface on rubbing. When moist, the soil can be rolled into threads. It is capable of being molded into any shape and takes clear fingerprints.

*These textural classes are typical of soils in Rhode Island. Textural classes not noted with an asterisk are not generally found in Rhode Island due to a lack of clay. Refer to the soil textural triangle for additional information.

Sand Size Modifiers

The 12 textural classes are based solely on the percentages of sand, silt and clay in the soil sample. If the textural class is sand, loamy sand, or sandy loam, a modifier may be added to indicate the dominant size of the sand fraction. The following is a list of textural classes with acceptable sand-size modifiers:

TEXTURAL CLASS	SAND-SIZE MODIFIERS
Coarse Sand:	25 Percent or More Very Coarse or Coarse Sand
Sand:	25 Percent or More Medium Sand
Fine Sand:	50 Percent or More Fine Sand
Very Fine Sand:	50 Percent or More Very Fine Sand
Loamy Coarse Sand:	25 Percent or More Very Coarse or Coarse Sand
Loamy Sand:	25 Percent or More Medium Sand
Loamy Fine Sand:	50 Percent or More Very Fine Sand
Loamy Very Fine Sand:	50 Percent or More Very Fine Sand
Coarse Sandy Loam:	25 Percent or More Very Coarse or Coarse Sand
Sandy Loam:	25 Percent or More Medium Sand
Fine Sandy Loam:	30 Percent or More Fine Sand
Very Fine Sandy Loam:	30 Percent or More Very Fine Sand

Coarse Fragment Modifiers

Coarse fragments or rock fragments apply to all pieces of rock larger than 2 mm in size. A modifier of the textural class name is applied if the soil contains a "significant" percentage of coarse fragments. The modifier used is based on the volume, shape and size of the dominant coarse fragment in the soil. Table 2 will be helpful in determining the appropriate coarse fragment modifier to use.

Table 2. Names of Coarse Fragment Modifiers

SHAPE	SIZE AND NAME			
	0.2 - 7.6 cm	**7.6 - 25 cm**	**25 - 60 cm**	**> 60 cm**
Rounded	Gravelly	Cobbly	Stony	Bouldery
Flat	Channery	Flaggy	Stony	Bouldery

Adjectives are also used to indicate the estimated volume of the coarse fragments.

Less Than 15 Percent by Volume	No Adjective
15 to 35 Percent by Volume	Name of Coarse Fragment
35 to 60 Percent by Volume	Very Plus Coarse Fragment Name
Greater Than 60 Percent by Volume	Extremely Plus Coarse Fragment Name

For Example: A sandy loam soil that has 40 percent by volume of rounded coarse fragments, averaging 5 cm in diameter would be classified as very Gravelly Sandy Loam.

As with color and redoximorphic features, it is common practice to use textural abbreviations when making profile descriptions. Accepted textural abbreviations are as follows:

Textural Classes

s:	sand	**sicl:**	silty clay loam
ls:	loamy sand	**cl:**	clay loam
sl:	sandy loam	**scl:**	sandy clay loam
l:	loam	**sc:**	sandy clay
sil:	silt loam	**sic:**	silty clay
si:	silt	**c:**	clay

Coarse Fragments

g:	gravelly	**ch:**	channery
cb:	cobbly	**fl:**	flaggy
st:	stony	**v:**	very
bd:	bouldery	**ex:**	extremely

For example: A very gravelly sandy loam soil would have a field abbreviation of ...vgsl.

Structure

Soil structure refers to the arrangement or grouping of individual soil particles into aggregates or clusters called peds. These are naturally occurring units with specific shape and size which are the result of the soil forming processes of wetting, drying, freezing and thawing, and other physical and chemical changes. These processes have created planes of weakness in the soil which form the surface of peds. Organic matter, clay, and other cementing agents, such as iron oxides, may act as forces of attraction in stabilizing structural peds.

Soil scientists describe structure in terms in their grade size and shape.

Type:
The four primary structural types are granular, platy, blocky, and prismatic (see Figure 5).

> **Granular structure** is spheroidal and particles are arranged around a central point bounded by rounded or curved surfaces. This type of structure is common in most surface horizons.
>
> **Platy structure** results when particles are arranged along a horizontal plane approximately parallel to the soil surface. This type of structure resembles thick sheets of paper and is common in E, Bx, and Cd horizons.
>
> **Blocky structure** is composed of particles arranged around a point and bounded by flat or slightly rounded surfaces. These cube-like peds are the dominant structural units found in most subsurface B horizons. Faces can have angular or subangular surfaces.
>
> **Prismatic structure** results when particles are arranged around a vertical line and bounded by relatively flat vertical surfaces. This type of structure, although not typical of Rhode Island soils, is common elsewhere in some subsoils, particularly Bx horizons.

Size:
Structural peds are classified according to their size. Figures 6 and 7 illustrate the various sizes for each of the primary structural types.

Grade:
Grade describes the distinctness of structure or how obvious each structural unit (ped) is to the naked eye.

Structureless:	No observable aggregation; distinct peds are nonexistent.
Weak:	Peds are barely observable in place. When gently disturbed, the soil material parts into weakly defined Structural units.
Moderate:	Peds are well formed and distinct structural units are evident in undisturbed soil.
Strong:	Peds are distinct and extremely well formed. Individual structural units are easily observed in undisturbed soils.

As with other morphological properties, an abbreviated nomenclature is used during the field description of soil structure.

Grade		**Size**	
0…	Structureless	**vf…**	Very Fine[1]
1…	Weak	**f…**	Fine[1]
2…	Moderate	**M…**	Medium
3…	Strong	**C…**	Coarse[1]
		vc…	Very Coarse[1]

Type

gr…	Granular	**sbk…**	Subangular Blocky
pl…	Platy	**pr…**	Prismatic
abk…	Angular Blocky	**sg…**	Single Grain[2]
		m…	Massive[2]

For Example: Weak, coarse, subangular blocky structure would be designated as lcsbk.

[1]For platy structure use thin or thick modifiers.
[2]Single grain (sandy) and massive are used only with structureless soils.

Consistence

Soil consistence refers to the resistance of soil aggregates to deformation or rupture. Consistence properties are manifested by cohesion, or the attraction of soil particles to each other, and adhesion, the ability of particles to cling to other objects. Thus, the consistence of a soil is dependent upon such factors as clay, organic matter, and iron oxide content.

For any particular soil, consistence varies with the water content. For example, moistening a hard, dry clod may soften it by reducing the attraction between particles. With increasing water content, the soil will approach a plastic state and may even become sticky. For this reason, soil scientists describe consistence under three moisture conditions -- dry, moist and wet.

Terms such as loose, soft, and hard are used to describe the consistence of air-dry soil. Loose consistence applies to sandy materials. Soft suggests that the soil would crush to powder if worked in a dry condition, and cultivation of a dry soil with hard consistence would leave the surface rough and cloddy. If soils are wet, consistence is expressed in terms of plasticity and stickiness which is an indication of the amount of clay.

The consistence of most soils is determined under a field-moist condition. It is intended to represent a soil in a condition suitable for plowing. Consistence terms used at this moisture content are loose, friable, and firm. A loose consistence generally refers to non-coherent, coarse-textured soils. Friable soils are in aggregate form, but they crumble readily under gentle pressure. These soils are desirable in the preparation of a seedbed prior to planting crops. Soils described as firm when moist are usually relatively dense. This may be the result of compaction or cementation. These types of soils are generally difficult to work, and roots, air, or water may have difficulty moving through the soil. Degrees of moist consistence are determined by attempting to crush a piece of soil and are defined as:

l… Loose: Non-Coherent
vfr… Very Friable: Soil material crushes easily under gentle pressure between thumb and forefinger.
fr… Friable: Soil material crushes easily under moderate pressure between thumb and forefinger.
fi… Firm: Soil material crushes under moderate pressure but resistance is distinctly noticeable.
vfi… Very Firm: Soil material crushes under strong pressure; barely crushable between thumb and forefinger.
efi.. Extremely Firm: Soil material crushes only under very strong pressure; cannot be crushed between thumb and forefinger.

It is extremely important to be aware that consistence of soil can change when removed from the soil profile. The consistence thus may be described as one consistence breaking to another (e.g., extremely firm in place and friable when removed).

III. EXCAVATION DIFFICULTY

(Taken from in part from "Field Book for Describing and Sampling Soils" Version 2.0, USDA, 2002, page 2-55.)

Each soil horizon in a test hole shall be assigned to a soil category in accordance with Rule 15.11 of the OWTS Rules. Excavation difficulty is one of several characteristics used to assign the appropriate category and may be determined utilizing the guidelines in the following table. Excavation difficulty is the relative force or energy required to dig soil out of place.

Class	Code	Criteria
Low	L	Excavation by tile spade requires arm pressure only; impact energy or foot pressure is not needed.
Moderate	M	Excavation by tile spade requires impact energy or foot pressure; arm pressure is insufficient.
High	H	Excavation by tile spade is difficult, but easily done by pick using over-the-head swing.
Very High	VH	Excavation by pick with over-the-head swing is moderately to markedly difficult. Backhoe excavation by a 50-80 hp tractor can be made in a moderate time.
Extremely High	EH	Excavation via pick is nearly impossible. Backhoe High excavation by a 50-80 hp tractor cannot be made in a reasonable time.

IV. HORIZON DEPTHS

A description of a pedon includes the thickness and the depth limits of each horizon or layer. Depths are measured from the soil surface for all mineral soils with no organic horizon and all organic soils. For soils with an O horizon that is not saturated for prolonged periods (i.e., Oi), the soil surface is the top of the mineral horizon, with the O horizon measured up from the mineral surface. If the uppermost layer is an O horizon that is or has been saturated for prolonged periods, depths are measured from the top of either the Oe or Oa horizon, whichever is highest in the profile.

V. HORIZON BOUNDARIES

A boundary is a surface or transitional zone, approximately parallel to the soil surface, between two adjoining horizons or layers. Boundaries are described in terms of their distinctness and topography.

Distinctness: Distinctness refers to the ease of determining the zone between two adjacent horizons. The distinctness of a boundary depends partly on the degree of contrast between adjacent layers and partly on the thickness of the transition zone between them. Distinctness is defined in terms of the thickness of the transition zone:

abrupt (a)… less than 2 cm thick
clear (c)… 2 - 5 cm thick
gradual (g)… 5 - 15 cm thick
diffuse (d)… greater than 15 cm thick

Topography: Topography refers to the irregularity of the boundary between adjacent layers as viewed in a soil profile:

smooth (s)… boundary is nearly a plane
wavy (w)… boundary has undulations in which depressions are wider than their depth
irregular (i)… boundary has depressions or pockets that are deeper than their width
broken (b)… a discontinuous boundary

The abbreviation method used for field descriptions would use aw to designate an abrupt wavy boundary.

Miscellaneous

Depending on the soil and/or the purpose of the profile description, additional soil properties may be included in the soil's description:

Soil Pores:	Indicates the abundance and size of pores in each horizon.
Roots:	Indicates the abundance, size, and whether fibrous, woody, or live roots are present in each horizon.
Clay Films:	Indicates the presence of clay films, clay skins, or clay coatings on the surface of peds.
Reaction:	Indicates whether the soil is acid, neutral or alkaline.

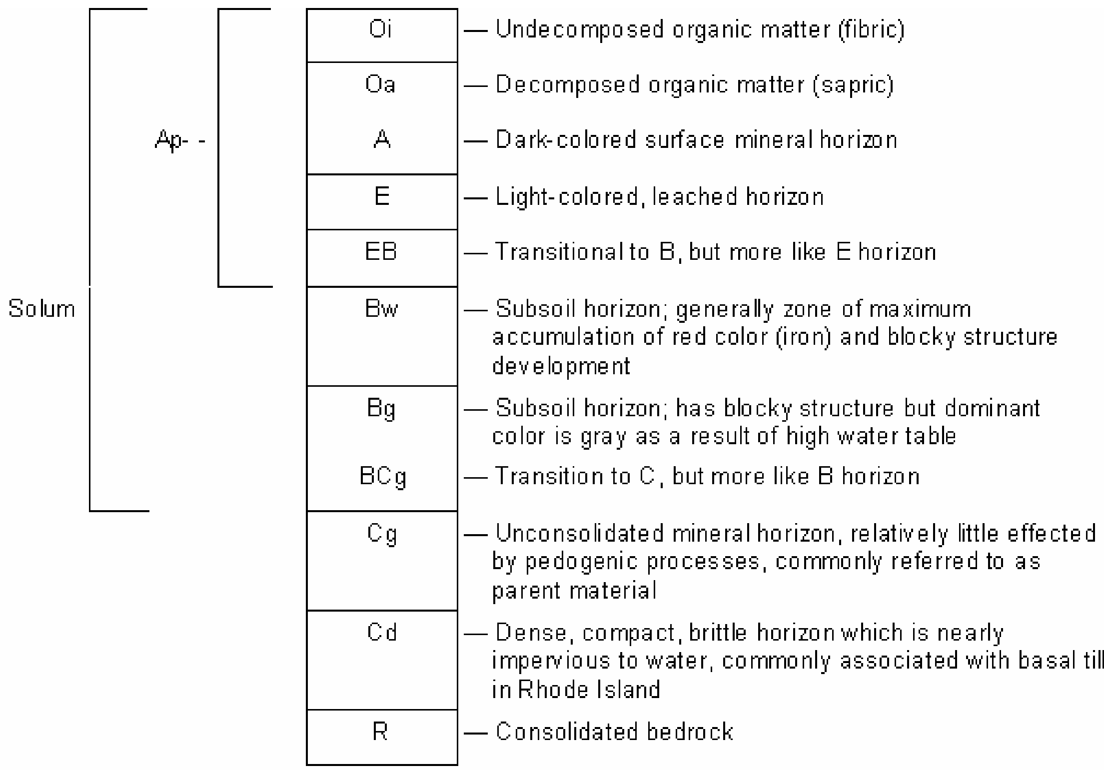

Figure 1. Hypothetical soil profile illustrating principal horizons

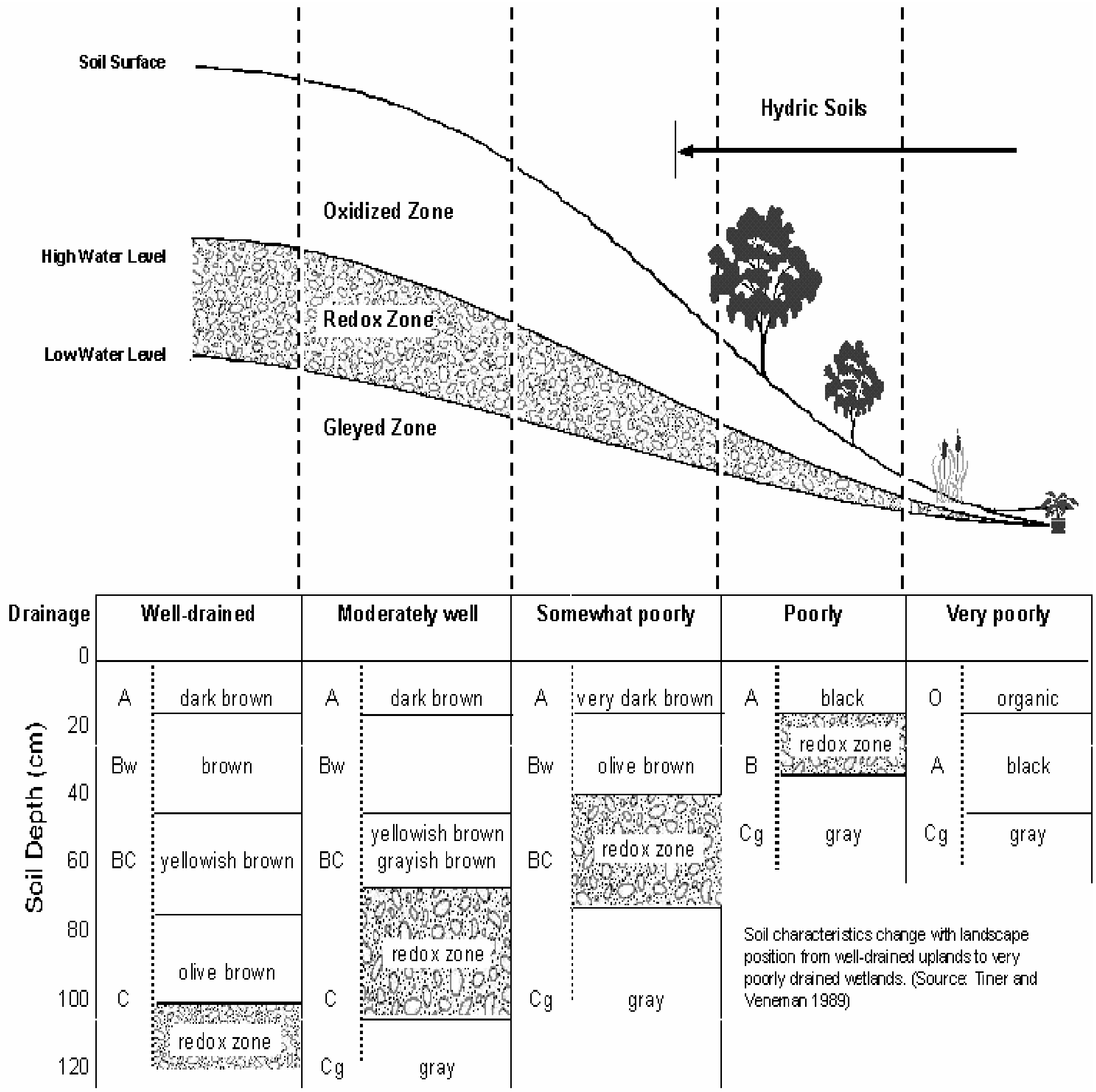

Figure 2. Soil Toposequence

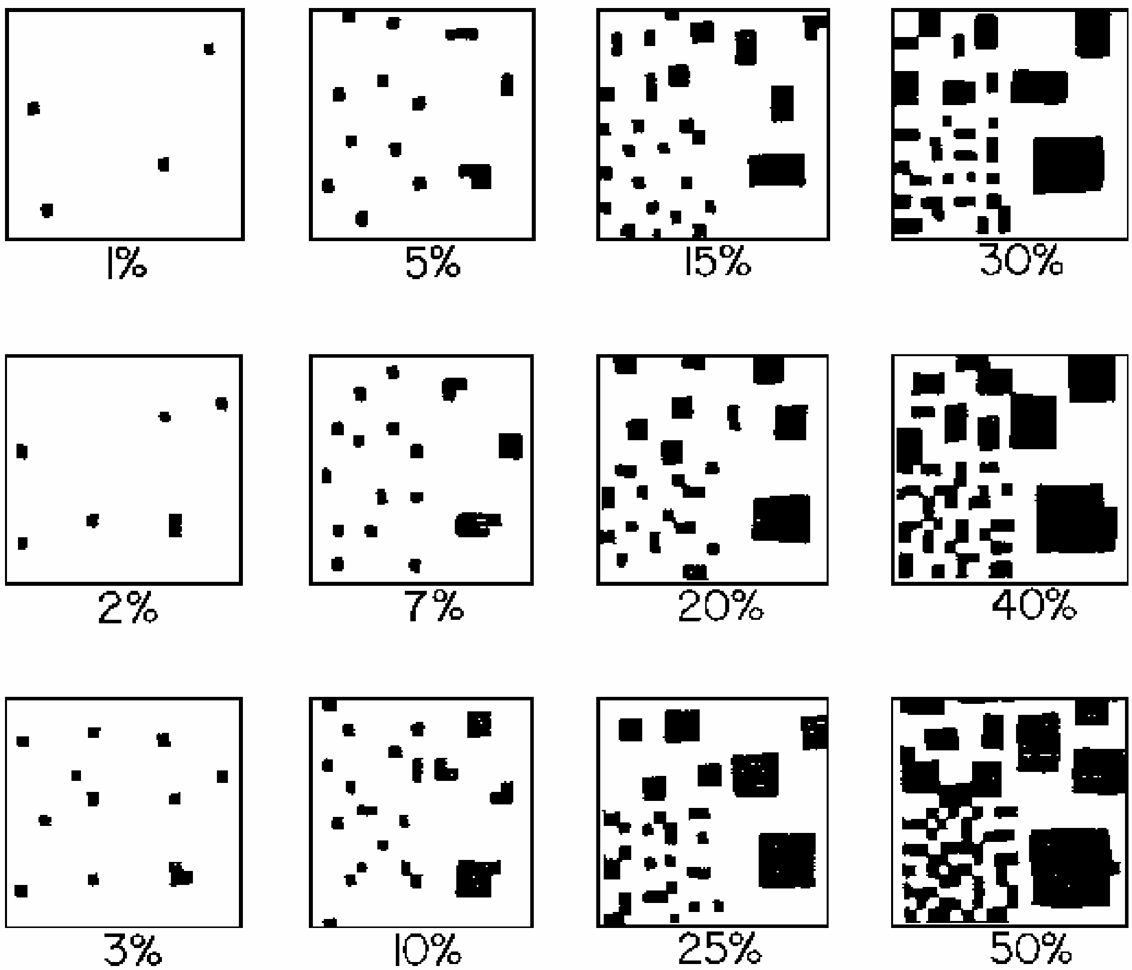

Figure 3. Chart for estimating proportions of re-dox features and coarse fragments.

Soil texture must be determined using soil material less than 2.0 mm. in size. If approximately 20% or more of the soil material is larger than 2.0 mm., the texture term includes a modifier. Example: gravelly sandy loam.

Example of use:
A soil material with 10% clay, 20% silt, and 70% sand is a sandy loam.

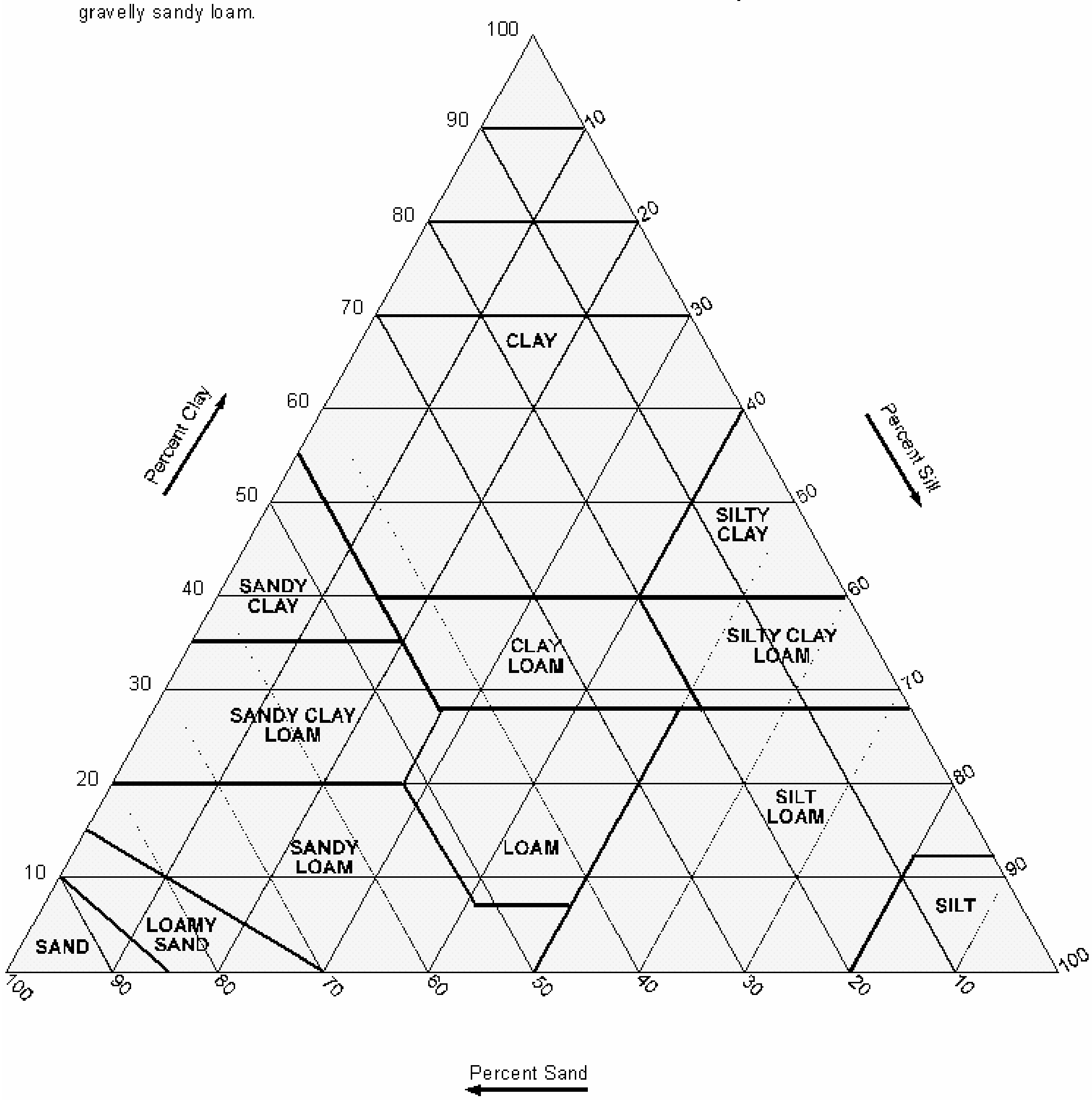

Figure 4. Soil Textural Triangle

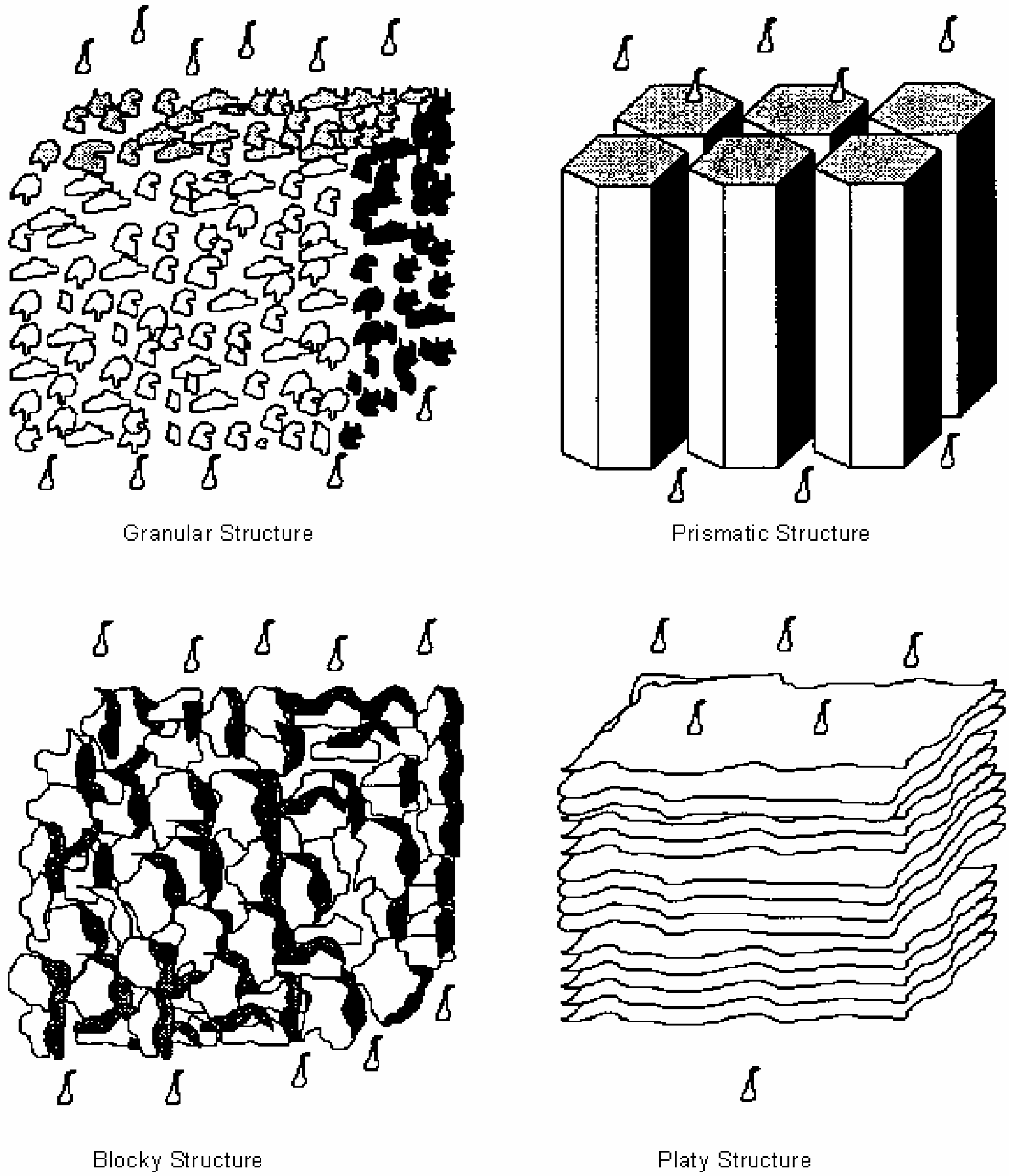

Figure 5. Water and wastewater movement in structured soils

Rate and volume of water/wastewater movement in structured soils.
Granular > prismatic = columnar > blocky > platy > massive.

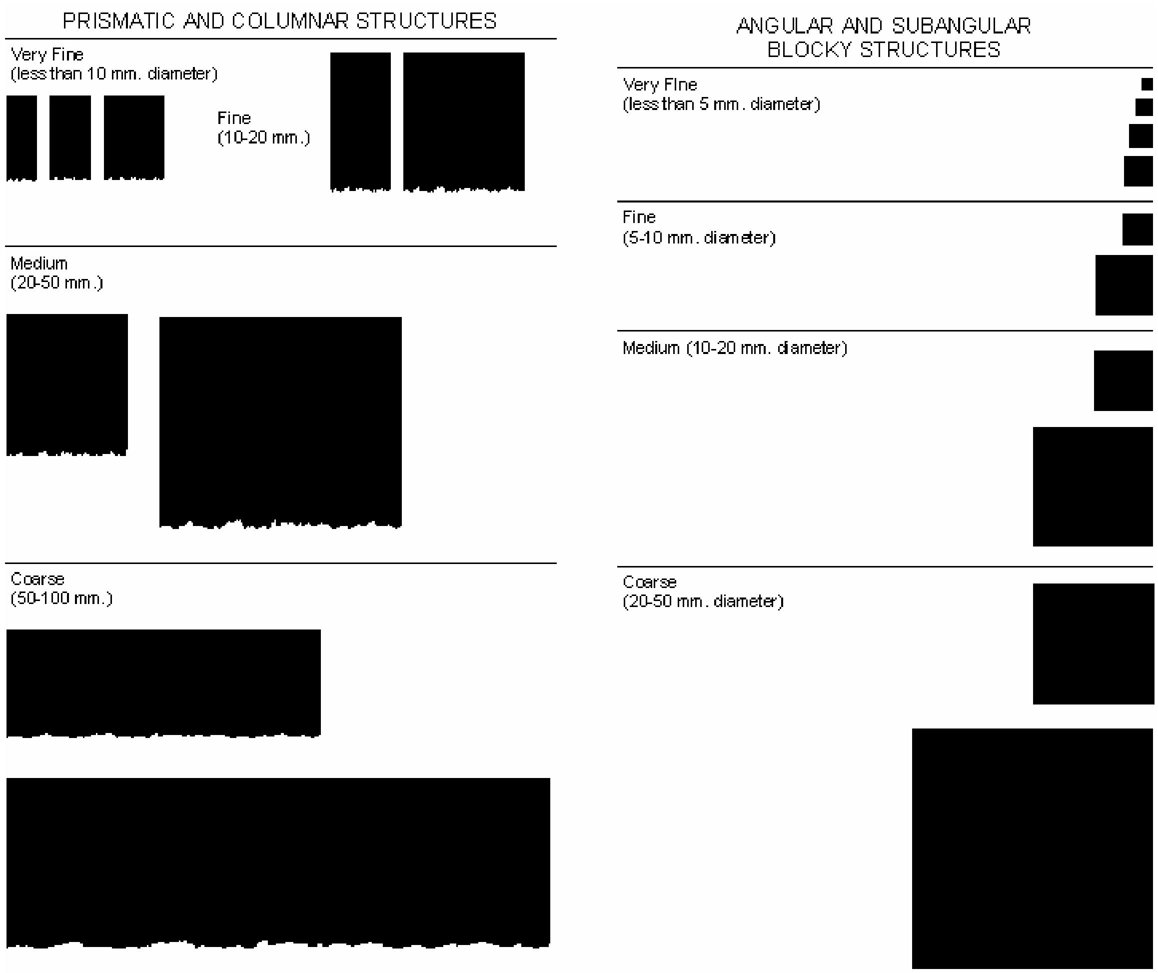

Figure 6. Size classification of prismatic and blocky structures.

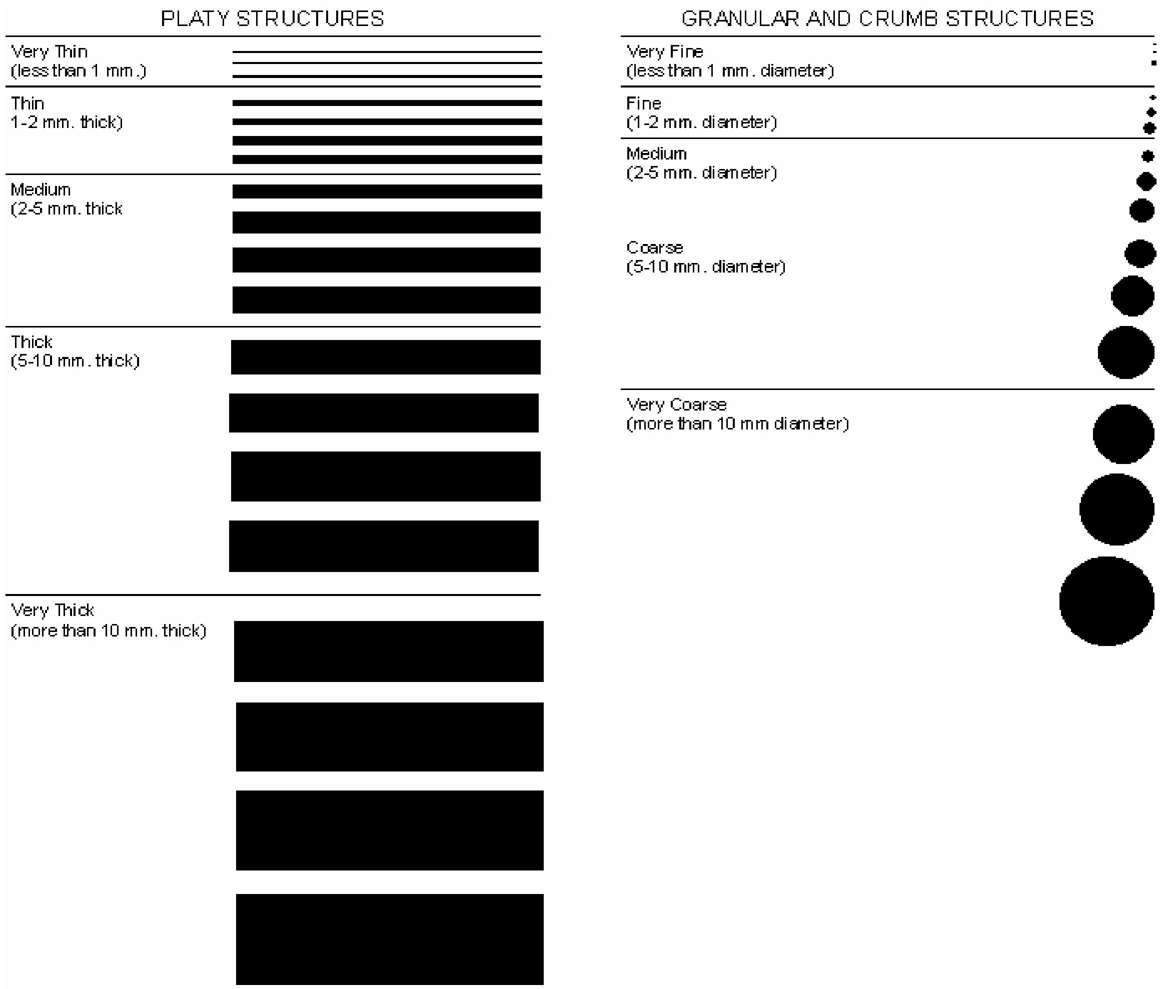

Figure 7. Size classification of platy and granular structures.

VI. SOIL CHARACTERISTICS, ASSOCIATED LAND FORMS, AND ON-SITE CONSIDERATIONS

1. GLACIAL TILL

Definition: Dominantly unsorted and unstratified (not layered) sediment deposited by a glacier. Soil particle sizes associated with this type of soil are clay, silt, sand, gravel, stones and boulders. In Rhode Island, however, clay is rarely found. Glacial till can be further subdivided into two (2) categories: **LODGEMENT and ABLATION**.

LODGEMENT (OR COMPACT) TILL: (Class A)
Characteristics:

1) Wide particle size distribution - clay, silt, sand, gravel, cobbles, stones and boulders. Most common textures found in Rhode Island, however, are sandy loam, fine sandy loam and silt loam.
2) Unsorted and unstratified - heterogeneous mixture of all particle sizes showing no layering.
3) Angular shaped rock fragments.
4) Substratum is typically below 1.5 - 2.5 feet and is usually compact. Often referred to as hardpan.
5) Very dense, cannot be easily dug into by hand or backhoe.
6) Less commonly exists in western Rhode Island. Crystalline derived (lighter color) rounded/sub-rounded coarse frags.

Associated Landforms:

1) Till "mantle" ridge (e.g., URI main campus; Chopmist Hill, Scituate, most of Aquidneck Island).
2) East side of Narragansett Bay. Typically dark, coarse fraggy, monochromic carbon-based soils.
3) Drumlin

Site Identification and Septic System Considerations:

1) Identifying Lodgment Till
   a) Note the ease of excavation by the backhoe. The bucket will often chatter across the surface of lodgment till subsoil, making shallow cuts with each pass.
   b) Pick at the side of the test pit with a knife to feel for ease of penetration. Compact till will be difficult to penetrate or dig out.
   c) Squeeze a clod of soil between thumb and index finger. Compact till will initially resist crushing, but with increased pressure it will rupture suddenly.
   d) Surface stones common in many areas of till unless removed for past land uses. Stone walls may be a found on-site.
2) Check for presence of perched or apparent (true) water table. In cases of a perched water table which poses a depth to groundwater restriction, a curtain (subsurface) drain may be used to lower the groundwater table. Lowering the groundwater table may thereby ease the depth to groundwater restriction. Wet season (January 1 - April 1) monitoring may be required.
   Note: In some areas subsurface drains may not be permitted, for example in the Scituate watershed.

3) Avoid construction when the ground is very moist or wet. Construction in moist to wet soils will cause smearing and compaction, thereby reducing the infiltrative capacity of the soil.

DEBRIS FLOW/ABLATION (OR LOOSE) TILL: (Class B)

Characteristics:

1) Typically coarser than lodgement till with a particle size distribution of sand, gravel, cobbles and stones. Common soil textures in Rhode Island are fine sandy loam, sandy loam and loamy sand. Some areas may have silt loam texture.
2) Much less compact than lodgement till.
3) Unsorted and unstratified - heterogeneous mixture of all particle sizes showing no layering.
4) May contain lenses or pockets of finer material.
5) Small amounts of silt, almost no clay.
6) Most extensive soil parent material on the west side of Narragansett Bay.

Associated Landforms:

1) Moraines (Terminal and Recessional)
2) Ground Moraine

Site Identification and Septic System Considerations:

1) Identifying Ablation Till
   a) Note the ease of excavation by the backhoe. The bucket will be able to dig through ablation till easier than lodgement till making medium cuts with each pass.
   b) Pick at the side of the test pit with a knife to feel for ease of penetration. Ablation till will be moderately difficult to penetrate or dig out.
   c) Squeeze a clod of soil between thumb and index finger. Ablation till will crush easier than the lodgement till.
   d) Surface stones common in many areas of till unless removed for past land uses. Stone walls may be found on-site.
2) Check for presence of water table. Water tables in ablation till are most likely to be apparent (true) rather than perched.
3) Document any restrictive layers.
4) Avoid construction during wet periods. Doing so will prevent smearing and compaction thereby maintaining the infiltrative capacity of the soil.

2. **GLACIAL OUTWASH DEPOSITS**

Definition: Stratified deposits of sands and gravels deposited by melt-water streams that flowed from melting glaciers. Glacial outwash is further subdivided into Proglacial and Ice-contact outwash deposits. Proglacial outwash deposits are formed in front of or just beyond the outer limits of the glacier. Ice-contact outwash deposits are formed adjacent to stagnant glacial ice, possibly collapsing after the ice has melted and leaving an irregular and often hilly terrain.

PROGLACIAL OUTWASH: (Class C)

Characteristics:

1) Stratified (layered appearance) and well sorted.
2) Clean sands and gravel, typically with very little silt or clay.
3) If present, gravel and cobble size rock fragments are sub-rounded to rounded.
4) Sediment is very loose, walls of test pit may slough in.
5) Generally, there is a lack of stones and boulders.

Associated Landforms:

1) Outwash Plain (e.g., URI Turf Fields)

Site Identification and Septic System Considerations:

1) Proglacial outwash is characterized by stratified (layered) sands and gravel.
2) When digging test pits, close adherence to OSHA test pit safety methods is extremely important. Test pits can very easily slough in.
3) Percolation rates in these soils can be very rapid. Caution must be exercised in environmentally sensitive areas (such as coastal ponds) or in well head protection areas. Proglacial outwash ares are commonly recharge areas for aquifers.
4) Enhanced treatment septic systems may be necessary to reduce the nitrate and phosphate loading associated with on-site disposal of wastewater.
5) Galleys should not be considered in these areas because of high infiltration rates and the lack of treatment provided by this system which discharges at depths of 2+ feet.

GLACIAL ICE CONTACT OUTWASH: (Class D)

Characteristics:

1) Stratified (layered appearance) may be irregular or slumped.
2) Sediment may be well to poorly sorted.
3) Typically loose sandy material, but may contain pockets or lenses of silty material.
4) Contains significantly more silt size particles than proglacial outwash.
5) If present, gravel and cobble size rock fragments are sub-rounded to rounded.
6) May include areas of stones and boulders.
7) Sediment is very loose; walls of test pit may slough in.

Associated Landforms:

1) Kames
2) Kettles
3) Eskers
4) Kame Deltas and Terraces
5) End Moraines (e.g., Charlestown Moraine)

Site Identification and Septic System Considerations:

1) Ice-contact outwash may have variable stratification and sorting.
2) Test pits may show little consistency in their soil profiles, even on relatively small parcels. Care in ascertaining the extent of the soil conditions is necessary.
3) When digging test pits, close adherence to OSHA test pit safety methods is extremely important. Test pits can very easily slough in. Document any restrictive layers.
4) Percolation rates in these soils can vary greatly from one location to another. Caution must be exercised in environmentally sensitive areas (such as coastal ponds) or in well head protection areas. Proglacial outwash areas are commonly recharge areas for aquifers.
5) Enhanced treatment septic systems may be necessary to reduce the nitrate and phosphate loading associated with on-site disposal of wastewater.

3. **COASTAL DUNE DEPOSITS**: (Class E)

Definition: Natural mound on ridge of sand-sized sediment deposited, landward of a coastal beach, by wind action and storm overwash.

1) Fine to coarse sands.
2) Well sorted and often finely stratified.
3) May contain an eolian silt layer, but otherwise no silt or clay.
4) Typically no gravel size or coarser rock fragments.

Associated Landforms:

1) Ridges or mounds that often parallel the shoreline landward of the beach.
2) May be vegetated by dune grass or unvegetated loose sand. Commonly found in beach environments such as south shore of Rhode Island.

Site Identification and Septic System Considerations:

1) Ever-changing landscape that is susceptible to strong winds and wave action.
2) Typically found in Protected Resource Areas, careful evaluation of aerial extent is necessary. Other regulatory agencies may have jurisdiction (see: CRMC).

4. **ALLUVIAL (FLOODPLAIN) DEPOSITS**: (Class F)

Definition: Material transported and deposited by present day streams and rivers.

Characteristics:

1) Susceptible to seasonal flooding.
2) Nearly level areas adjacent to streams and rivers.
3) Sorted and often stratified.
4) Usually fine textured sediments (silts and fine sands). May be coarser depending on stream/river velocity.
5) May have dark buried layers in the substrata that once were surface layers.

Associated Landforms:

1) Floodplain
2) Stream Terrace
3) Oxbow
4) Meander Scar

Site Identification and Septic System Considerations:

1) Typical high seasonal groundwater table.
2) Fine textured sediments that are well sorted and stratified.
3) PROTECTED RESOURCE AREA - CAUTION: Careful evaluation of aerial extent is necessary. Other regulatory agencies may have jurisdiction (see: RIDEM Wetlands Division, CRMC).

5. **EOLIAN DEPOSITS**: (Class G)

Definition: Silt-sized sediment deposited by wind action.

Characteristics:

1) Typically silts ranging from six inches to several feet in Rhode Island.
2) Silt layer typically contains no rock fragments (i.e., gravel, cobble or stone).

Associated Landforms:

1) Eolian deposits are located across various landforms. Outwash plains and till ridges are the most extensive landforms with an eolian silt deposits drape.
2) Found in many places in Washington County and in some areas of Kent County.

Site Identification and Septic System Considerations:

1) Eolian deposits are typically silt textured soils which are powdery (like flour) when dry and smooth when wet.
2) Eolian deposits may retain a perched water table if underlying material is much coarser than silt.
3) Often overly glacial till and outwash soils.

Soil Class Listing for Rhode Island Soil Series:

Soil Class “A” **Lodgement Till**	**Soil Class “B”** **Ablation Till - Loose**	**Soil Class “C”** **Proglacial Outwash**	**Soil Class “D”** **Glacial Ice Contact**
• Birchwood	Canton	Agawam	Gloucester
• Leicester	Lippitt	• Deerfield	Hinckley
• Mansfield	Sutton	Hinckley	
Newport	**Ablation Till - Compact**	Merrimac	
Paxton	• Charlton	• Ninigret	
• Pittstown		Quonset	
Poquonock		• Sudbury	
• Ridgebury		Windsor	
• Stissing			
• Whitman			
• Woodbridge			
Soil Class “E”	**Soil Class “F”**	**Soil Class “G”**	**Other Soils** **(Not Previously Listed)**
Coastal Dunes	**Alluvial**	**Eolian Deposits**	**X** Adrian
Udipsamments	**X** Matunuck	Bridgehampton (C)	**X** Carlisle
	• Podunk	Broadbrook (A)	**X** Ipswich
	X Rumney	Enfield (C)	**X** Scarboro
		Narragansett (B)	**X** Walpole
		• **X** Rainbow (A)	
		•Raypol (C)	
		•Scio (B)	
		•Tisbury (C)	
		•Wapping (B)	

Legend:

•	Potentially problematic soils due to “perched” or “apparent” high groundwater tables
X	Groundwater table likely to be less than 2-feet below the soil surface.
( )	Letters within parentheses indicate the class of the substratum