LAND JUDGING AND SOIL EVALUATION

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INTRODUCTION, WHY ARE SOILS IMPORTANT, and WHAT WILL WE LEARN

Soil is one of Virginia's basic natural resources. We are dependent upon the soil as a primary source of food and fiber. Soils are necessary as a base for buildings and roads, and are being used more and more for waste disposal and treatment.

Land appreciation provides students an opportunity to better understand this important resource. You will first learn to identify soil and landscape properties that influence soil use. These properties will be used to evaluate the soil's suitability for production of food and fiber. Your understanding of soil properties will also be used to rate the soil for non-agricultural land uses such as foundations, septic tank drainfield systems, and shrubs. The basic and applied knowledge in this manual will provide a base for understanding and proper use of soils.

PART I - SOIL FEATURES

Soil Profile

A soil profile (Figure 1) is vertical cross-section cutting down through different soil layers. A soil profile can be observed in a freshly dug pit, road bank, ditch bank, or gully. The soil profile can be divided into layers with different appearances and properties. These layers are called soil horizons.

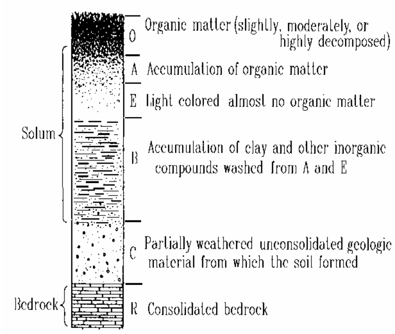

Figure 1. A sample soil profile with major layers or horizons identfied.

Parent material of different geologic origins in Virginia has been altered by weathering and biological processes to form soil. The uppermost soil horizons which comprise the solum of a soil profile have different colors, textures, structures, and other properties that are the result of these soil-forming processes.

Soil Texture

Soil texture will be discussed in detail later, but a basic understanding is necessary before we discuss the soil profile. Soil texture is the grouping of soil particles into different size classes. The basic classes, ranging from coarse to very fine, are sand, silt and clay. You will learn how to estimate amounts of these soil particles later.

Soil Horizons

O horizon.--The O horizon is composed of leaf litter and moderately decomposed and highly decomposed organic matter.

A horizon.--The A horizon is the surface soil and is a layer of accumulation of organic matter. It has lost clay and other inorganic compounds that have been carried by water deeper into the profile. The organic matter usually causes this horizon to be dark brown to black in color unless the soil has been severely eroded. If the surface soil has been plowed, it is identified by the symbol "Ap".

E horizon.--Soils that have not been eroded usually have a subsurface horizon that is lighter-colored, has almost no organic matter, and is about the same texture as the overlying A horizon. This subsurface horizon is defined as the E horizon. Most uneroded Virginia soils have an E horizon but, on agricultural soils with some erosion, the E horizon may have been mixed with the A horizon to form an Ap horizon during tillage.

B horizon.--The B horizon, or subsoil, is the zone of accumulation of clay and other inorganic compounds washed from the A and/or E horizons. It is usually the brightest colored (brown to red) horizon and has a higher clay content than overlying and underlying horizons.

C horizon.--The C horizon, or substratum, is partially weathered, unconsolidated geologic parent material from which soil formed. It is usually lower in clay and frequently shows rock structure in soils weathered directly from rock or stratification in soils developed from alluvial materials.

Thickness of the Surface Layer

The surface layer thickness is measured from the top of the mineral soil. If the soil is in agricultural use, the thickness of the plow layer, or Ap horizon, is measured. In forest soils, the thickness of the A and E horizons is measured if the E is present.

Surface Layer and Subsoil Texture

Soils are composed of mineral matter, organic matter, and spaces holding air and water (pores). The solid mineral particles are separated into the particle-size groups (Table 1).

The proportion of each particle-size group in any given soil sample is termed soil texture (Figure 2). Soil texture can be measured in the lab and can be estimated in the field by feeling the soil in a moist state. Since only estimates can be made in the field, soils with similar amounts of sand, silt, and clay are placed in groups termed textural classes.

Table 1. Particle-size groups.

Group	Particle Diameter
Sand	2.0 to 0.05 mm
Silt	0.05 to 0.002 mm
Clay	<0.002 mm

Textural classes are named according to the particle-size group that is dominant. These names were assigned based on the way the soil acts, or, in other words, which of the three particle-size groups it most closely resembles. The names are assigned according to the actual percentages of sand, silt, and clay in the soil. Most names are not single words but are a combination of two or three names; the dominant textural component is represented by the noun, and the adjectives mention the other components of importance. Thus we may have silty clay, sandy clay, silty clay loam, or loamy sand. The term "loam" is used when the soil-particle-size groups are "evenly-acting" -- that is, the proportions of sand, silt, and are nearly equal in their effect on the properties of the soil. Such a distribution will be approximately 40% sand, 40% silt, and 20% clay. Because clay has a stronger control over the properties of soils than does either sand or silt, it takes less clay for its properties to be expressed than it does for sand and silt.

Soil-textural classes and their relationships according to the actual percentages of sand, silt, and clay are given in the textural triangle (Figure 2). A soil may be placed in the "clay" textural class with only 40% clay whereas a minimum of 85% sand is required to place a soil in the "sand" textural class. A "sandy clay loam" is close to and "even-acting mix" or loam but has more influence from sand and clay than from silt.

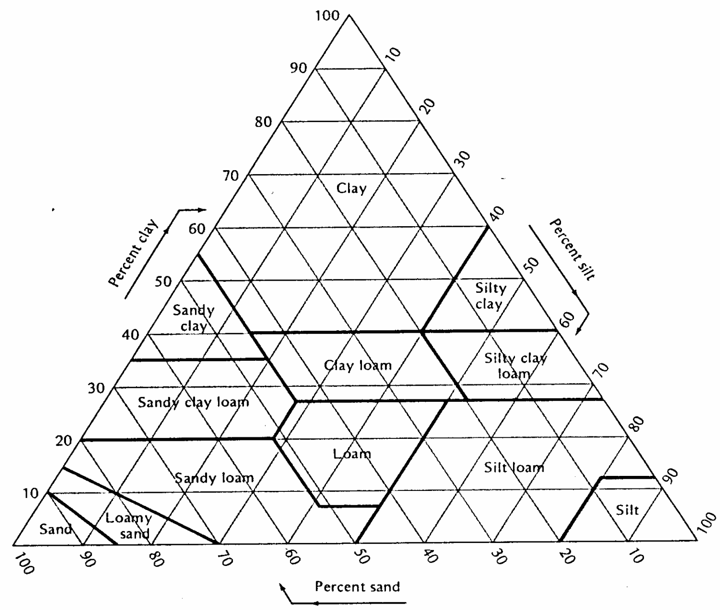

Figure 2. Guide for textural classification.

Understanding the Textural Triangle

In Figure 2, isolines along each side represent lines of equal content for that particle-size class. Isolines for sand run right to left across the bottom; isolines for silt run top to bottom along the right side; and isolines for clay run from bottom to top along the left side.

Estimating the textural class of soil samples

Precise measurement of particle-size distribution requires a lengthy laboratory procedure. Field estimates can be made based on the "feel" of moist soil. Sand, silt, and clay each have a distinctive feel that allows estimation of the amounts of each component. Sand, the coarsest group, feels harsh and gritty when rubbed between the thumb and forefinger. Silt particles feel like talcum. They feel smooth because they are flat and about the same size as talcum powder. Clay particles stick to each other and to other particles, making the soil moldable (plastic). The more clay a soil contains the more plastic it is. We estimate the elasticity by pressing moist (putty-like) soil between thumb and forefinger and determining how long a "ribbon" of soil, capable of supporting its own weight, can be made. A flow chart can be used to estimate textural classes using moist to wet soil. Flow chart, such as "Instructions for estimating soil texture by feel 1 or 2," are good guides to estimating textural classes, but each individual will learn, with experience, to adjust these guidelines to best fit his or her technique.

Instructions for estimating soil texture by feel

Two keys are presented for estimating soil texture by feel. Use the key that is most comfortable for you.

Key 1:

Taken from : Portland Cement Association. 1962. PCA Soil Primer. Portland Cement Association, 33 West Grand Avenue, Chicago, Illinois, p. 10-11)

The feel and appearance of the textural groups illustrate factors used in determining the texture of a soil in the field and also assist in field classification work. Note that forming a cast of soil in the hand and pressing a moist ball of soil between the thumb and finger constitute two major field tests to judge soil texture.

Sand.--Individual grains can be seen and felt readily. Squeezed in the hand when dry, this soil will fall apart when the pressure is released. Squeezed when moist, it will form a cast that will hold its shape when the pressure is released but will crumble when touched.

Sandy loam.--Consists largely of sand, but has enough silt and clay present to give it a small amount of stability. Individual sand grains can be seen and felt readily. Squeezed in the hand when dry, this soil will fall apart when the pressure is released. Squeezed when moist, it forms a cast that will not only hold its shape when the pressure is released but will withstand careful handling without breaking. The stability of the moist cast differentiates this soil from sand.

Loam.--Consists of an even mixture of the different sizes of sand and of silt and clay. It is easily crumbled when dry and has a slightly gritty, yet fairly smooth feel. It is slightly plastic. Squeezed in the hand when dry, it will form a cast that will withstand careful handling. The cast formed of moist soil can be handled freely without breaking.

Silt loam.--Consists of a moderate amount of fine grades of sand, a small amount of clay, and a large quantity of silt particles. Lumps in a dry, undisturbed state appear quite cloddy but they can be pulverized readily; the soil then feels soft and floury. When wet, silt loam runs together and puddles. Either dry or moist casts can be handled freely without breaking. When a ball of moist soil is pressed between thumb and finger, it will not press out into a smooth, unbroken ribbon but will have a broken appearance.

Clay loam.--A fine-textured soil which breaks into clods or lumps that are hard when dry. When a ball of moist soil is pressed between the thumb and finger, it will form a thin ribbon that will break readily, barely sustaining its own weight. The moist soil is plastic and will form a cast that will withstand considerable handling.

Clay.--A fine-textured soil that breaks into very hard clods or lumps when dry, and is plastic and unusually sticky when wet. When a ball of moist soil is pressed between the thumb and finger, it will form a long ribbon.

Key 2:

Place approximately 25 grams of soil in the palm. Add water drop by drop and knead to break down structure. Soil is at the proper consistency when plastic and moldable like moist putty. Then ask yourself:
Does soil remain in a ball when squeezed?

No - the texture is ***SAND***
Yes - place ball between the thumb and forefinger and push the soil with the thumb to form a ribbon. Allow the ribbon to extend over the forefinger until it breaks from its own weight.

Does the soil form a ribbon?

No - the texture is ***LOAMY SAND***
Yes - thoroughly wet a small sample in the palm and rub with the forefinger

If the ribbon was <1 inch long when it broke and the thoroughly-wetted sample feels:

gritty, the texture is ***SANDY LOAM***
smooth, the texture is ***SILT LOAM***
neither gritty nor smooth, the texture is ***LOAM***

If the ribbon was between 1 and 2 inches long when it broke and the thoroughly-wetted sample feels:

gritty, the texture is ***SANDY CLAY LOAM***
smooth, the texture is ***SILTY CLAY LOAM***
neither gritty nor smooth, the texture is ***CLAY LOAM***

If the ribbon was >2 inches long when it broke and the thoroughly-wetted sample feels:

gritty, the texture is ***SANDY CLAY***
smooth, the texture is ***SILTY CLAY***
neither gritty nor smooth, the texture is ***CLAY***

Subsoil Color

Table 2 Field guide to subsoil color.	
Color Guide	Common Standard
red	clay drain tile, common red brick
yellowish red	tomato soup, red pencil eraser
strong brown	natural tanned leather, rust iron
yellowish brown	natural finished oak wood
light yellowish brown	new khaki, paper bag, cardboard
olive brown	worn army fatigues
gray	wood ashes, overcast sky

Dominant subsoil colors can be shades of red, brown, yellow, or gray (Table 2). Subsoils can have either a dominant color or can be mottled. The term mottled means a splotchy color pattern that contrasts against the dominant subsoil color. Mottles can also be shades of red, brown, yellow, or gray.

Red, brown, and yellow subsoil colors are produced by oxides and hydroxides of iron-coated soil particles. Subsoil colors can be used to identify soils with wetness problems. Under aerated conditions, the iron compounds remain red, brown, or yellow. Under wet (saturated) conditions, the iron compounds are chemically altered from the red oxidized form to a more easily dissolved form. When the soil is wet for extended periods in most years, the iron coatings dissolve so much that the gray colors of most sand, silt and clay particles can be seen. Thus, the occurrence of gray subsoil mottles or colors indicates that a soil is saturated (or has a seasonal water table) at the depth at which gray colors start appearing. This information is used widely to determine need for agricultural drainage systems and to determine soil suitability for many non-agricultural uses.

Subsoils with red, brown, or yellow colors indicate soils weathered under well drained conditions. Well- drained soils of the Northern Piedmont and the Valley and Ridge physiographic provinces generally have red or brown subsoil colors. Well-drained soils of the Coastal Plain generally have yellow-brown or yellow subsoil colors. Dark red subsoils also indicate either a very old soil or a soil weathered from rocks high in iron compounds.

Subsoils with solid gray or gray mottles indicate soils under wet conditions. Solid gray subsoil colors indicate a poorly drained soil that is saturated with water for periods of 3 months or longer in most years. Subsoils with gray mottles indicate moderately well or somewhat poorly drained soils that are saturated with water for 1 month or longer in most years. The depth to the seasonal water table is estimated by measuring the depth to gray colors or mottles.

Another soil property that can be inferred from soil color is permeability. Clayey red, brown, or yellow subsoils generally indicate slow or moderate permeability unless there is strong blocky subsoil structure. Sandy and loamy subsoils with red, brown, or yellow colors generally indicate moderate to rapid permeability.

PART II - LANDSCAPE FACTORS

Slope Gradient

The steepness of slope is important in estimating the rate of runoff and predicting the hazard of erosion. Slope is estimated in percent or as the rise (or fall) per 100 feet of distance. Many instruments and techniques can be used to estimate slope gradient, but we will not using any instruments in this contest. Your scorecard, clipboard, or hand may be used as a level to estimate change in elevation. Two stakes placed 100 feet apart will be used as sighting stakes for slope measurements. The slope between the two stakes is the slope to be measured. Since no instruments will be used, it is important that the slope stakes be 100 feet apart. Care must be taken not to be confused by short distance changes in slope in the areas between the stakes. If there is much slope, the evaluation should always be made from the lower stake. Judges should be careful not to put stakes on slopes that are very close to breaks in slope classes. Slope classes are usually designated by letters, with class A being the flattest and class F being the steepest. The slope classes used in Virginia land-judging contests are given in Table 3.

For purposes of land judging, the soil pit is located on one simple slope segment. Two stakes are placed 100 feet apart in this area, and percent slope is determined between the stakes.

Most landscapes have a variety of slope shapes and gradients. Before you can understand this complexity, you need to look at small segments of the landscape and the representative soils associated with each.

Table 3. USDA soil survey slope classes.

Slope (%)	Letter Designation	Descriptive Term
0 to 2	A	nearly level
3 to 7	B	gently sloping
8 to 15	C	sloping
16 to 25	D	moderately steep
>26	E, F	steep

Erosion

Erosion is the detachment and transport of soil particles by wind or water. It results in the loss of millions of tons of valuable topsoil from Virginia soils each year. Raindrop splash and running water cause most erosion in Virginia. Cleared fields in the Coastal Plain with sand, loamy sand, or sandy loam surface textures may also be subject to wind erosion. In order to estimate how much erosion has occurred, the following items are evaluated:

- Original surface layer thickness (information given at each site to be judged)
- Original sequence and thickness of subsurface and subsoil layers
- Incorporation of subsurface and subsoil layers in the present plow layer

Erosion classes based on these criteria are defined below.

Erosion Classes

None to Slight.--The plow layer consists mostly of the original surface layer. 25 percent or less of the original surface layer eroded for the soil to be placed in this class.

Moderate.--The plow layer consists of the original subsurface layer plus some of the subsoil. The base of the plow layer rests on or in the subsoil. Moderately eroded soils have lost 25-75 percent of the original surface layer.

Severe.--The plow layer consists mostly of subsoil material. It has color and texture similar to those of the subsoil. More than 75 percent of the original topsoil has been lost.

Landscape Analysis

The position of a soil in the landscape can influence its properties and its potential use. Detailed landscape and geologic analyses are beyond the scope of this program; however, a basic understanding of soil-landscape relations is necessary to study soil at any level. The major landscape positions are illustrated in Figures 3 and 4.

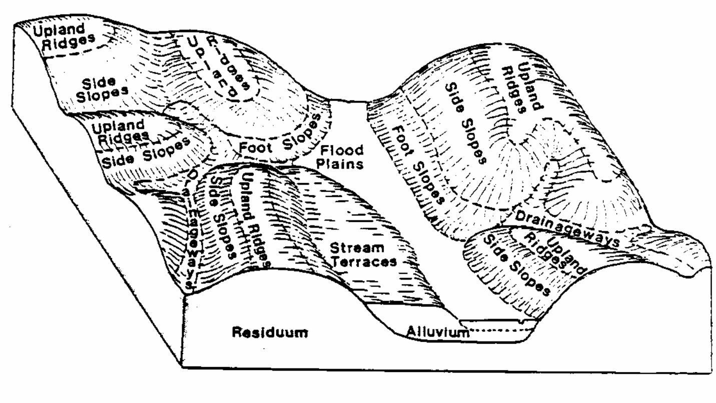

Figure 3. Block diagram showing major landscape positions.

Upland landscapes

Upland ridge summits.--Upland ridge summits are landforms that form the upper part of the local landscape setting. They may be somewhat rolling but are flatter than surrounding side slopes. Soils on upland ridges are usually developed from the dominant underlying geologic material (bedrock or deep Coastal Plain sediments).

Side slopes.--Side slopes are slopes leading off the ridges towards some lower, flatter landforms. Side slopes usually are the steepest sloping landscapes in the local setting. Soils on side slopes are usually developed from the dominant underlying geologic material (bedrock or deep Coastal Plain sediment).

Foot slopes.--Foot slopes are slopes at the base of side slopes that are usually more gently sloping than side slopes but are sloping toward some flatter landform at a lower elevation. Soils on foot slopes are usually developed in materials carried primarily by gravity (with some washing) from upland ridges and side slopes that have been deposited at the base of side slopes. To illustrate the relationship between upland ridges, side slopes, and foot slopes, sit in a chair and extend your foot, flat on the floor, as far as you can. The portion above your knee is the upland ridge, from your knee to your ankle is the side slope, and your foot (aha!, wonder where the term came from?) is the foot slope.

Alluvial landscapes

Alluvial landscapes is the general term used for landscapes (flood plains, terraces, and drainageways) formed from sediments deposited by flowing water. These landscapes tend to occupy the lower positions of the local setting and are usually the flattest areas in the immediate setting.

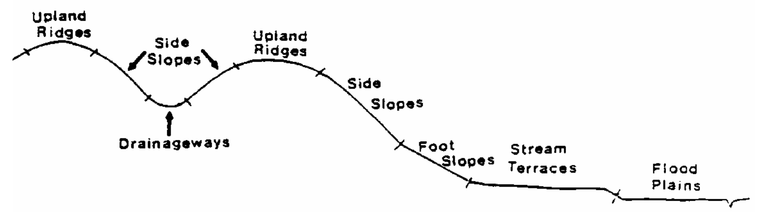

Figure 4. Cross-section showing relative location on the landscape of the major landscape positions.

Flood plains (or bottomlands).--Flood plains are the lowest landscapes immediately along streams. On the flood plain, new material is being deposited frequently so the soils are relatively young and not well developed. Many flood plain soils are so young that no subsoil horizon has developed.

Stream terraces.--Once the stream has cut deeper into the landscape, creating a new flood plain, it leaves an old flood plain above the new flood level. Since the old flood plain is no longer covered by water and sediment, soil formation can occur in the same material for a long time without being buried. These former flood plains that are now above flood level are called stream terraces.

Drainageways.--Before runoff reaches major streams, it collects in small natural drains that cut through other landscapes. These drains may carry water only after major rains, but the upper several feet of soil in the area surrounding the drains is topsoil washed from nearby uplands or side slopes. The landscapes associated with these drains or intermittent streams are like miniature flood plains and are termed drainageways.

PART III - INFERRED SOIL CHARACTERISTICS

Inferred soil properties are those that cannot be easily measured or are combination or interaction of slope, texture, structure, vegetative cover, and time - all affect what is being measured.

Soil structure

Soil structure is very important in inferring soil characteristics. Soil structure is the manner in which individual soil particles (sand, silt, and clay) form compound soil units or peds. Certain types of soil structure can greatly influence the rate of water movement in soil. For example, a clay subsoil with strong blocky structure can have medium rates of water flow (permeability) through it whereas the same clay soil without structure would have virtually no water flowing through it.

Several basic shapes of structural units are recognized in soils. Figure 5 and the following terms describe the basic shapes.

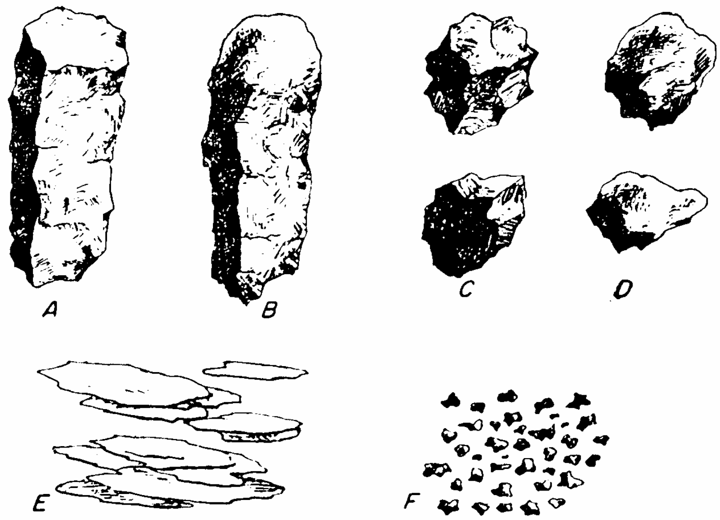

Figure 5 Structural shapes: A, prismatic; B, columnar; C, angular blocky; D, subangular blocky; E, platy; and F, granular.

Massive.--Individual soil particles do not bind together to form secondary particles bounded by surfaces.

Prismatic.--The individual units are bounded by flat or slightly rounded vertical faces. Units are distinctly longer vertically, and the faces are typically casts or molds of adjoining units. Vertices are angular or subrounded; the tops of the prisms are somewhat indistinct and normally flat (Figure 5A).

Columnar.--The units are similar to prisms and are bounded by flat or slightly rounded vertical faces. The tops of columns, in contrast to those of prisms, are very distinct and normally rounded (Figure 5B).

Blocky,--The units are blocklike or polyhedral. They are bounded by flat or slightly rounded surfaces that are casts of the faces of surrounding peds. Blocky structural units are nearly equidimensional but grade to prisms and plates. The structure is described as angular blocky if the faces intersect at relatively sharp angles; as subangular blocky if the faces are a mixture of rounded and plane faces and the angles are mostly rounded (Figure 5C and 5D).

Platy.--The units are flat and platelike. They are generally oriented horizontally and are usually overlapping (Figure 5E).

Granular: The units are approximately spherical or polyhedral and are bounded by curved or very irregular faces that are not casts of adjoining peds (Figure 5F).

Infiltration rate

Infiltration rate is the rate at which rainfall enters the soil surface. Mostly surface layer texture and structure affect this rate. Infiltration rates are given in relation to soil texture and soil structure in Table 4.

Table 4. Infiltration rate.

Soil Texture	Soil Structure	Infiltration Rate
sand, loamy sand	all	rapid
sandy loam, loam	all	medium
silt loam	granular, blocky	medium
	massive	slow
silty clay loam, clay loam, sandy clay loam	granular, blocky	medium
	massive	slow
silty clay		
silty clay, sandy clay, clay	all	slow

Surface runoff

Surface runoff is affected by slope, slope length, surface texture, vegetative cover, infiltration rate, and the intensity and duration of rainfall. Slope and infiltration rate are the major variables used to estimate surface runoff. Surface-runoff classes are given in relation to slope and infiltration rate in Table 5.

For the purpose of this program, we will evaluate runoff as "runoff potential from bare soil" so that vegetative effects will not have to be considered. However, if the soil surface is vegetated, the rate of surface runoff can be greatly decreased. For example, a stable forest growing on a loamy soil will have slow runoff even on 20 to 30 percent slopes, but the same soil with a grass cover will have a high rate of surface runoff. However, even the steep forested soil runoff rate will become high if the rain lasts long enough to saturate the soil. Once a soil becomes saturated or the rate of rainfall exceeds the infiltration rate, regardless of texture, slope, or vegetative cover, the surface runoff rate will be high.

Table 5. Surface-runoff classes.

Slope %	Rapid Infiltration	Medium Infiltration	Slow Infiltration
0 to 1	very slow	very slow	very slow
1 to 2	very slow	slow	slow
3 to 7	slow	medium	rapid
8 to 15	medium	rapid	rapid
>16	rapid	rapid	rapid

Permeability

Permeability is the rate that water moves or percolates downward through the soil. Soil properties such as texture, structure, bulk density, pore size and quantity, root channels, and animal or insect burrows affect permeability. Since pores are hard to see and evaluate, texture and structure are used to estimate soil permeability. In a land-judging contest, the subsoil or substratum layer with the slowest permeability below the surface to the bottom of the pit is used. Permeability rates in relation to soil texture and soil structure are given in Table 6.

Table 6. Permeability.

Texture	Structure	Permeability rate
sand, loamy sand	single grain	rapid
sandy loam, loam, silt loam*	all	moderately rapid
clay loam, sandy clay loam clay, sandy clay, silty clay	blocky	moderate
clay loam, sandy clay loam clay, sandy clay, silty clay	prismatic, platy, massive	slow

*A dense, brittle, platy layer known as a hardpan or fragipan may occur in some subsoils with these textures. The occurrence of a fragipan indicates slow permeability, regardless of soil texture.

Natural Soil Drainage Classes

Soil drainage is the result of the interaction of several soil properties. The interpretation of drainage depends on the intended use. The drainage classes in Table 7 group soils by soil water characteristics that influence agricultural production. Excessively drained soils do not hold enough water for optimum plant growth. Poorly drained soils are opposite in that they are so wet that crops can only be grown if the soils are artificially drained. Somewhat poorly drained soils may require drainage and will likely be wet late in the spring if not drained. Moderately well drained soils may be wet late in the spring but are not wet enough to warrant drainage. Well drained soils do not have water tables at depths shallow enough to hinder agricultural use. Depth to water table, as indicated by gray mottles or colors, and texture are evaluated in determining the following drainage classes:

Although excess water is a problem in moderately well, somewhat poorly, and poorly drained soils, retaining sufficient water within the rooting depth to supply plant needs is equally important. Water, held by the soil for plant growth, does not cause mottling and is called "plant-available water". Excessively drained soils usually cannot hold adequate available water for good plant growth. The plant available water in all other drainage classes varies depending on soil texture and structure. In most poorly and somewhat poorly drained soils, the presence of a shallow water table during the growing season may provide adequate water regardless of structure or texture. However, this usually occurs in soils where productivity is restricted due to wetness.

Table 7. Natural soil drainage classes.

Drainage Class	Subsoil Texture	Depth to Water or Gray Mottles (inches)
excessive	sand, loamy sand	>36
well	all except sand and loamy sand	>36
moderately well	all	18 to 36
somewhat poorly	all	10 to 18
poorly	all	0 to 10

PART IV - AGRICULTURAL MANAGEMENT

Land Capability Classification

The land-capability-classification system groups soils with similar potential for agricultural production. The broadest grouping is the *land capability class*. There are eight such classes. Classes I through IV are capable of producing cultivated crops. Soils in classes V, VI, and VII are not suited to cultivated crops but are suitable for pasture and forestry. Soils in class VIII are suitable only for wildlife and forestry. Table 8 provides a general guide to land-capability classification. Complete definitions of the eight land-capability classes are given below.

With the exception of soils in class I lands, soils in each of the other seven land capability class are separated into subclasses on the basis of one or more minor problems. The subclasses and their symbols are:

- erosion hazard - e
- wetness - w
- unfavorable soil properties in the root zone - s
- climate - c

No Virginia soils fall into the climate limitation subclass.

Definitions of the eight land capability classes are:

Class I land. --Class I land has few or no conditions that limit its use for most common agricultural crops; it can be safely cultivated without special conservation treatment. There are no subclasses in class I land.

Soils in Class I land are suited to a wide range of plants and may be used safely for cultivated crops, pasture, range, woodland, and wildlife. Because they are nearly level, the erosion hazard (wind or water) is low. They are deep, generally well drained, and easily worked. They hold water well and are either fairly well supplied with plant nutrients or highly responsive to fertilizer. These soils are not subject to damaging overflow. Class I land is productive and suited to intensive cropping. The local climate is favorable for growing most common field crops. Class I land that is used for crops needs only ordinary management practices to maintain it.

Class I land is level and is not subject to accelerated erosion. It does not have a wetness problem or other unfavorable soil characteristics in the root zone.

Table 8. General guide to land-capability classification.

Soil Factor	Criteria	Best Land Class Possible
Texture:	sand, loamy sand	III
	all others	I
Depth to rock or fragipan:	<20 inches (shallow)	VI
	>20 inches (moderately deep)	I
Permeability:	rapid	III
	moderate	I
	slow	II
Slope:	nearly level (0 to 2%)	I
	gently sloping (3 to 7%)	II
	sloping (8 to 15%)	III
	moderately steep (16 to 25%)	IV
	steep (>26%)	VI
Erosion:	none to slight	I
	moderate	II
	severe	VI
Runoff:	rapid	II
	medium, slow	I
	very slow	II
Wetness:	water table at 0 to 18 inches	III
	water table >18 inches	I
Flooding:	none to common	I
	frequent	II

Class II land. –Class II land has some natural conditions that require some conservation practices when it is cultivated or that limit the kinds of plants it can produce. Soils in class II require more careful management than do those of class I land, including conservation practices, to prevent deterioration or to improve air and water relations when the soils are cultivated. The limitations are slight, however, and the practices are easy to apply. Although this land can be used for cultivated crops, pasture, range, wildlife food and cover, woodland, or outdoor recreation, the farm operator has less latitude in the choice of crops and management practices than with class I land.

Class III land. --Class III land has one or more moderate limitations on its use. These soils are more restricted in the crops that can be produced than are those in classes I and II. When cultivated, conservation practices are more difficult to implement, and/or maintenance is usually required. Class III lands may be used for cultivated crops, pastures, range, wildlife food and cover, woodland, or recreation.

Limitations of soils in class III restrict the amount of clean cultivation; time of planting, tillage or harvesting operations; choice or yield of crops; or a combination of these. The limitations may be natural ones, such as steep slopes or water, or the limitation may be the result of erosion brought on by the way the land has been used.

Class IV land. –Class IV land is suitable for only occasional or limited cultivation. It has one or more severe limitations that restrict its use.

Soils in class IV have very severe limitations that restrict the kinds of plants that can grow. When cultivated, they require very careful management, and conservation practices are more difficult to apply and maintain than on soils in classes II and III.

Class IV land includes soils in areas where flooding may preclude planting or harvesting crops during unfavorable years. Many sloping soils in class IV in humid areas are suited to occasional, but not regular, cultivation because of the severe erosion hazard. Some of the poorly drained, nearly level soils are not subject to erosion but are poorly suited to some crops because of wetness, frequency of flooding, or low productivity for cultivated crops. Some hilly soils in class IV are well suited to one or more special crops such as fruits or ornamental trees and shrubs.

Class V land. --Class V land is level but has some conditions that limit its use to pasture or range, woodland, recreation, watershed protection, or wildlife habitat.

The soils in class V land have limitations other than erosion that restrict the kinds of plants that can be grown and/or that prevent tillage of cultivated crops. Examples of limitations are: a) subject to frequent flooding, b) stony or rocky soils, and c) ponded areas where drainage is not feasible.

Class VI land. --Class VI land has soils with very severe limitations that make it generally unsuited for cultivation and restrict its use to pasture, range, woodland, recreation, watershed protection, or wildlife habitat. It may be well or poorly suited to woodland, depending on the characteristics of the soil.

The soils are such that it is practical to apply range or pasture improvement such as seeding, liming, fertilization, or water control by means of contour furrows, drainage ditches, diversions, or water spreaders.

Some soils in class VI are well adapted to long-term meadows and sodded orchards that do not require cultivation or to special crops such as blueberries that require soil conditions unlike those demanded by most cultivated crops.

Class VII land. --Class VII land has soils with very severe limitations that make it unsuited for cultivation and restrict its use to pasture, range, woodland, recreation, watershed protection, or wildlife habitat. Even in these the soils require careful management.

Soils in this class VII land have restrictions more severe than those in class VI because of one or more limitations that cannot be modified. These conditions make the land unsuited for common cultivated crops, although some special crops with unusual management practices can be grown. Physical conditions of the soils make it impractical to apply such pasture or range improvements as seeding, liming, or fertilization, and water control measures such as contour furrows, ditches, diversions, or water spreaders. Soils in this class range from well to poorly suited for woodland.

Class VIII land. --Class VIII land has soils with severe limitations that prevent its use for commercial plant production. Soils and landforms in class VIII cannot be expected to return significant on-site benefits from management for crops, grasses, or trees, although benefits from wildlife use, watershed protection, or recreation may be possible. Rock outcrops, sand beaches, river wash, mine tailings, and other nearly barren areas are included in class VIII. With major reclamation efforts, a few areas of nearly level class VIII land can be altered to make them suited to cropland use.

Major Factors that Keep Land Out of Class I

- Slope, more than 2%
- Erosion, moderate or severe
- Depth, less than 20 inches to rock or a fragipan
- Permeability, slow or rapid
- Runoff, very slow
- Wetness, poorly drained soils
- Flooding*, frequent (more than one year in five)
- Texture, sand textures in surface and subsoil

* flooding frequency will be given for each site in the land-judging contest. If no flooding frequency is given, assume no flooding occurs.

Soil Amendments

Lime ($CaCO_3$ and $MgCO_3$).--Lime is used to correct excess soil acidity and to supply calcium (Ca) and magnesium (Mg) as plant nutrients. Lime should be added for most agronomic crops if the pH is less than 6.0.

Nitrogen (N).--Nitrogen should be added to every crop except legumes, which associate with microbes that fix atmospheric nitrogen. As part of the information given for each site for the land-judging contest you will be told if a legume is to be grown.

Phosphorus (P).--Phosphorus is needed on crops except when the soil test is very high (starter P applied as a band may be beneficial when the soil test is high). The phosphorous content of a fertilizer is expressed as percent phosphate.

Potassium (K).--Potassium is needed on crops except when the soil test is very high. The potassium content of a fertilizer is expressed as percent potash.

None needed.--The soil has an adequate amount of lime and fertilizer to produce the highest yield that the soil is capable of producing (generally, water becomes a limiting factor in obtaining the maximum potential yield of a soil).

Note: The pH, P, and K levels are based on soil tests of the surface layer. It is assumed that all of the plant's nutritional needs can be supplied by fertilizer and lime applications to the surface layer.

Land Management Systems

Land management systems involve both crop rotation and tillage systems. It is assumed that the land will be used as intensively and as economically as possible. The tillage system involves no long-term soil modifications.

Continuous row crops. --Choose only for Class I land.

Sod or legume crop every 4th year. --Choose for Class II soils.

Sod or legume crop every 3rd year. --Choose for Class III soils that are not sandy.

Sod or legume crop every 2nd year. --Choose for sandy Class III soils and all Class IV soils.

Surface residue management and/or minimum tillage. --This is a management system using an off-set disk or similar implement to prepare a seedbed with as few passes as possible over the field. *Surface residue management* involves leaving as much crop residue exposed or only slightly mixed into the surface layer thus enhancing infiltration and reducing erosion. *Minimum tillage* should leave the soil surface quite rough, also enhancing infiltration and reducing erosion. Some type of minimum tillage and/or residue management system should be used in all row crop (corn, soybean, wheat, etc.) production.

Establish recommended grasses and legumes.--Choose for Class V and VI soils.

Plant recommended trees.--Choose when indicated on given information and on all Class VII soils.

Use only for wildlife or recreation.--Choose for Class VIII soils.

Note: No-till planting is not given as an option because it is almost always a good replacement for any tillage practice. No-till practices offer good erosion protection and increase water content in the soil. Since no-till is so widely applicable, it would allow for "continuous row crops" on Class II, III, and IV soils. No-till was not included as an option, to allow more emphasis on the need to manage by capability class.

Mechanical Practices

Mechanical practices serve to reduce a soil limitation within a given land capability class so that the soil can be utilized more intensively without degradation.

No treatment needed.--This would be checked on (a) Class I land where brush and trees are not a problem, (b) Class II land where erosion and drainage are not problems, (c) on sandy soils without an erosion problem, or (d) Class VII or VIII land where soils are so severely limited that no return on practices can be expected.

Farm on contour, or strip crop.--Farming on the contour or strip cropping is used on soils to reduce erosion hazard to an acceptable level for a given management system. Select for Class II, III, and IV soils.

Tile drainage or ditches.--Tile drainage is used to permanently lower the water table and/or increase the rate of runoff during the growing season. However, drainage is not always feasible. Choose for soils where seasonal water tables are at depths of 18 inches or less.

Control brush or trees.--Select this practice for soils that are capable of growing crops or improved pasture where brush or trees are too big to be removed by normal tillage operations.

Control gullies.--Control existing gullies by establishing grassed waterways and by filling and grading. Select for severely eroded soils with gullies.

PART V - SOIL AND LAND USE INTERPRETATIONS

Only a small percentage of our population is actually involved in food and fiber production. The tremendous productivity of the agricultural sector allows most of us to work in non-agricultural areas. It is critically important that we all understand the need to conserve our soils for agricultural use, but for many of us the impact of non-agricultural land use will directly affect us. For example, in purchasing a house, many critical soil properties which should be considered. This section provides an opportunity to learn how to evaluate soil for uses other than food and fiber production.

Scorecard Interpretations

When using soil for non-agricultural purposes, the emphasis shifts from surface to subsurface soil properties. In addition, infrequent catastrophic events, such as flooding, are much more important in most non-agricultural uses.

In this section, important soil properties are evaluated and identified; then the limitation of that soil property for a specific use is determined. On the land judging scorecard, it must be realized that box location for a soil property evaluation has no relationship with box location for use limitations. For example, rapid is the third box down for permeability but has slight limitations (first box) for Homesite Foundations (no basement). Again, any relationship between location of a box for a soil feature and the limitations of that feature is coincidental.

Use limitations categories for each soil feature are those used by the National Cooperative Soil Survey. They are defined as follows:

Slight limitations.--Those soils or locations that have properties favorable for the planned use and present few or no problems.

Moderate limitations.--Those soils or locations that have properties only moderately favorable for the planned use. Limitations can be overcome or modified with special planning, design, or maintenance. Special treatment of the site for the desired use may be necessary.

Severe limitations.--Those soils or locations that have one or more properties unfavorable for the planned use. Limitations are difficult and costly to modify or overcome for the use desired.

After limitations on each use for each soil feature have been determined, a final evaluation for each use is completed. This determines the overall limitation on the use of the site. The final limitation is based on the most restrictive soil-site property. For example, if a soil is rated slight for Homesite Foundations (no basement) for all features except is rated severe for frequent flooding, it receives a final evaluation of "severe" because the most limiting factor will control the use. Everything else may be suitable for a homesite, but if it floods frequently, it is not a desirable homesite.

Soil Properties to be Evaluated

Most of the properties evaluated in this section are similar to those evaluated in Parts 1, 2, and 3. Limits for classes may be somewhat different in this section since we are more concerned about internal water flow and soil properties at greater depths. Differences between this section and other sections are discussed below.

Texture: Four general textural classes are used for soil interpretations. Sands and loamy sands are combined into the general class of sands. Sandy loams, silt loams, loams, sandy clay loams, silty clay loams, and clay loams are combined into the general class of loams and clay loams. Sandy clays, silty clays, and clays are grouped in the clay class. Clays are separated into two types, those with low shrink-swell and those with high shrink-swell. Shrink-swell is the relative change in volume on wetting and drying. Shrink-swell is estimated indirectly in the field according to the plasticity of the soil. Clays with high shrink-swell are "tight" and hard to work, and have shiny pressure faces on peds due to repeated volume change. These clays will form ribbons greater than 3 to 4 inches in length. High shrink-swell clays are associated with claypan soils. Most clays in Virginia are not high shrink-swell, but where high shrink-swell soils occur they limit many land uses.

Permeability: The same classes are used, but for this section rates of flow are considered.

Depth to Rock: Class limits are based on impact on land use, but limitation breaks for a specific use do not necessarily correspond with class breaks. The importance of depth to rock depends on the use.

Slope: Slope breaks are the same as in Part 2, but more than one slope class may have the same limitation for a specific use.

Water Table: The three water classes used reflect relative impact on use, but class breaks do not correspond to limitation breaks for a specific use.

Flooding: Flooding classes are based on frequency of occurrence. Frequent flooding occurs at least one year in five. Occasional flooding occurs less than one year in five but at least one year in twenty five. No flooding (none), as defined for this contest, occurs less frequently than one year in twenty five. Flooding frequency is part of the given information for the land-judging contest. If nothing is given, assume no flooding.

Determination of Use Limitations

Foundation (no basement)

Soil properties evaluated are depth to rock, slope, landscape position, texture of the soil at a depth of two to seven feet and depth to a water table or gray mottles. It is assumed that footings will be placed thirty inches below the surface. Table 9 is used to determine the degree of limitation for foundations (no basement) based on these soil properties.

Table 9. Degree of limitation for foundations for dwellings without basements.

Soil Property	Slight	Moderate	Severe
subsoil texture	loams, clay loams	sands, low shrink-swell clays	high shrink-swell clays
permeability	rapid, moderate	---	slow
depth to rock	>3 feet	2 to 3 feet	<2 feet
slope	0 to 7%	8 to 15%	>15%
water table depth	>3 feet	2 to 3 feet	<2 feet
flooding	none	---	occasional, frequent

Soil Property Review for Foundations

Soil texture relates to bearing capacity, shrink-swell potential, and sidewall stability.

Slow permeability makes it likely that wetness will be a problem around the foundation.

Removing ***rock*** is expensive, but if part of the foundation is on hard rock and part on clay, the foundation may not be stable. Special designs can reduce this problem but the cost increases.

As the ***slope*** steepens, it becomes more difficult to prepare suitable footings. House sites on steeper slopes may require special designs and are usually more costly.

A ***water table*** at footing depth reduces the soil-bearing capacity and increases the chance for wetness problems in the house.

Houses should not be built on sites subject to ***flooding***.

Septic Tank Absorption Fields

Soils must dispose of a large amount of wastewater in addition to properly filtering it before it reaches the groundwater table. The assumed depth of drainfield trenches is 24 to 48 inches. Table 10 is used to determine the degree of limitation for septic tank absorption fields.

Table 10. Degree of limitations for septic tank absorption fields.

Soil Property	**Slight**	**Moderate**	**Severe**	
subsoil texture	loams, clay loams	low shrink-swell clays	sands and high shrink-swell clays	
permeability	moderately rapid		moderate	rapid and slow
depth to rock	>5 feet	3 to 5 feet	<3 feet	
slope	0 to 7%		8 to 15%	>16%
water table depth	>6 feet	4 to 6 feet	<4 feet	
flooding	none	occasional	frequent	

Disposal of human waste is a critical role that the soil must handle. The soil in a drainfield must be able to dispose of water equivalent to 200 inches of rainfall a year. Therefore, a good drainfield soil must be moderately permeable and deep to water and rock. Texture is important primarily in the control it places on permeability. A certain minimum thickness of soil, depending largely on permeability, is needed for filtering. One foot of soil between the drainfield trench bottom and either rock or water table is a *minimum* thickness.

Shrubs and Trees

Most of the soil around a newly built home has been highly disturbed during construction. Often the topsoil is put back on top of subsoil. Shrubs and trees include those normally used as ornamental plantings around homesites. Table 11 is used to determine the degree of limitation for trees and shrubs.

Table 11. Degree of limitations for shrubs and trees

Soil Property	Slight	Moderate	Severe
subsoil texture	loams, clay loams	sands, clays	---
permeability	moderate	rapid	slow
depth to rock	>3 feet	1.5 to 3 feet	<1.5 feet
slope	0 to 7%	8 to 25%	>25%
water table depth	>3 feet	1.5 to 3 feet	<1.5 feet
flooding	none, occasional	frequent	---

Clays may seal and cause "drowning of tree roots". Sands will hold water inadequately. Slowly permeable soils will slowly cause "drowning of tree roots". Rapidly permeable soils will not keep water in the root zone. Woody plants need adequate depth to rock or water tables for roots to get water and nutrients. Excessive slopes increase runoff and erosion and reduce water available for growth. Frequent flooding can damage shrubs and cause "drowning of tree roots".

Soils for Roadfill

Soil properties important for roadfill or fill of any kind related to soil texture and thickness of suitable material. The table below rates the suitability of a *source area* for materials, not for location of the road. Table 12 is used to determine the degree of limitation for roadfill.

Table 12. Degree of limitation for roadfill

Soil Property	Slight	Moderate	Severe
subsoil texture	loams, clay loams	sands	clays
permeability	moderate	rapid	slow
depth to rock	>5 feet	3 to 5 feet	<3 feet
slope	0 to 15%	16 to 25%	>25%
water table depth	>5 feet	3 to 5 feet	<3 feet
flooding	none, occasional	frequent	---

Soil materials that are too high in clay or sand are less desirable than soil materials with a good mixture of sand-, silt-, and clay-sized particles.

A sufficient depth of suitable material above rock or a water table is needed for economic operation. What is left must be capable of growing plants with appropriate additions of lime and fertilizer.

The source area slope relates to the erosion hazard while soil is being removed and during reclamation while vegetation is being established.

Waste Lagoons

Waste lagoons require a slowly permeable soil or one that can be made impermeable. Most are usually a combination of an excavation and a berm. In any case, it is most economical to use excavated soil material for a lining or to obtain nearby soil material for such uses. The floor and sidewalls of a lagoon must have slow permeability so that water will not leak. The following table lists those soil properties that must be evaluated for this kind of use. Table 13 is used to determine the degree of limitation for waste lagoons.

Table 13. Degree of limitation for waste lagoons

Soil Property	Slight	Moderate	Severe
subsoil texture	low shrink-swell clays	loams, clay loams,	sands, high shrink-swell clays
permeability	slow	moderate	rapid
depth to rock	>6 feet	3 to 6 feet	<3 feet
slope	0 to 2%	2 to 7%	>7%
water table depth	>6 feet	3 to 6 feet	<3 feet
flooding	none	---	frequent

The permeability of the sidewalls and bottom of a lagoon must be slow or the soil must be modified to make it impermeable. Rapidly permeable materials require more extensive and expensive modifications. In some cases, a plastic or rubber liner is needed. Often, local clayey soil material can be used to line ponds and lagoons.

Shallow depth to rock or water table reduces the depth of a lagoon pond, and exposed rock may be hard to seal. Slopes make construction difficult. Sandy and loamy textures are difficult to make impermeable. High shrink-swell clays may crack after the lagoon is emptied and may leak when the lagoon is refilled. Flooding could lead to a washout of lagoon contents unless the berm is above flood level.

PART VI - CONDUCTING A LAND JUDGING CONTEST

Selection of a Site

A site should have only one landscape and slope gradient. The area to be evaluated should be marked with flagging or stakes. Depending on the land form complexity, a site may be small or large in area. When a field that has complex slopes is being evaluated, the pit and slope stakes should be located in the least variable part.

Slope.--Slope stakes should be located 100 feet apart.

Soil Profile.--A pit should be 3 to 5 feet deep. Auger holes are not an acceptable way to expose a soil profile. A recent road cut can be used. The contestant can evaluate only what can be observed. So, if soil properties below the depth of the pit to 7 feet are important for interpretations, they must be listed on the information card.

The control area evaluated by the judges should be marked for the entire length of the profile. This area should be used for measurements and contestants should not dig in this area. The soil profile exposed in the pit wall is assumed to be representative of the soil in the area being evaluated.

Topsoil and subsoil layers must be put into boxes so that everyone has equal access to the surface soil and subsoil.

The surface layer thickness is measured from the soil surface to the base of the plow layer in agricultural soil. In forested soils, it is measured from the surface to the top of the subsoil (which has a different color and usually a clay content higher than the surface layer). An E horizon, if present, would be included in the thickness of a forest soil.

Depth to gray mottles, water table, or rock is measured from the surface mineral horizon. Do not include the O horizons.

An information card at each pit should contain:

- original soil thickness
- pH of surface soil (can be estimated)
- depth to rock and water between the pit and 7 feet
- P and K soil test levels (can be estimated)
- if a legume is to be grown - no nitrogen is needed
- flooding information (if appropriate)
- distance between slope stakes
- a reminder not to dig in the control area

Resource People

In many localities, Virginia Tech or NRCS soil scientists are available to assist with site selection and evaluation of soil profiles. Extension agents and NRCS conservationists should assist with agricultural and urban interpretations.

GLOSSARY OF TERMS

agronomy: A specialization of agriculture concerned with the theory and practice of field-crop production and soil management. The scientific management of land.

alluvial soil: A soil developing from recently deposited alluvium and exhibiting essentially no horizon development nor modification of the recently deposited materials.

alluvium: Sediment deposited by flowing water.

amendment, soil: Any substance added to the soil that alters soil properties. Examples are gypsum, lime, fertilizers, sawdust, etc.

available nutrient: That quantity of a nutrient element or compound in the soil that can be readily absorbed and assimilated by growing plants.

available water: The portion of water in a soil that can be absorbed by plant roots. Considered by most workers as the amount of water released by the soil when the equilibrium soil water matrix potential is decreased from field capacity to -15 bar.

bedrock: The solid rock underlying soils and the regolith in depths ranging from zero (where exposed by erosion) to several hundred feet.

clay: As a soil-separate, individual particles less than 0.002 mm in diameter. As a textural class: a soil that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

clayey: Containing large amounts of clay or having properties similar to those of clay.

clay mineral: A naturally occurring inorganic crystalline phyllosilicate material found in soil and other earthy deposits. Not limited by particle size.

claypan: A dense compact layer in the subsoil having a much higher clay content than the overlying material, from which it is separated by a sharply defined boundary: formed by downward movement of clay or by synthesis of clay in place during soil formation. Claypans are usually hard when dry and plastic and sticky when wet. Also, they usually impede the movement of water and air and the growth of plants.

coarse fragments: Rock or mineral particles > 2 mm in diameter.

coarse texture: The texture exhibited by sands, loamy sands, and sandy loams (except for very fine sandy loam). See sand, sandy.

colluvium: A deposit of rock fragments and soil material accumulated at the base of steep slopes as a result of gravitational action.

consistency: (1) The resistance of a material to deformation or rupture. (2) The degree of cohesion or adhesion of the soil mass.

crystalline rock: A rock consisting of various minerals that have crystallized in place from magma.

drain, to: (1) To provide channels, such as open ditches or drain tile, so that excess water can be removed by surface or by internal flow. (2) To lose water (from the soil) by percolation.

ecology: The science that deals with the interrelations of organisms and their environment.

eluvial horizon: A soil horizon that has been formed by the process of eluviation. See *illuvial* horizon.

eluviation: The removal of soil material in suspension (or in solution) from a layer or layers of a soil. (Usually, the loss of material in solution is described as "leaching"). See illuviation and leaching.

erode: To wear away or remove the land surface by wind, water, or other agents.
erosion: (1) The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. (2) Detachment and movement of soil or rock by water, wind, ice, or gravity.

evapotranspiration: The combined loss of water from a given area, and during a specified period of time, by evaporation from the soil surface and by transpiration from plants.

fertility, soil: The status of a soil with respect to its ability to supply the nutrients essential to plant growth.

fragipan: A natural subsurface horizon with high bulk density relative to solum above, seemingly cemented when dry, but when moist showing a moderate to weak brittleness. The layer is low in organic matter, mottled, slowly or very slowly permeable to water, and usually shows occasional or frequent bleached crack forming polygons. It may be found in profiles of either cultivated or virgin soils but not in calcareous material.

gully: A channel resulting from erosion and caused by the concentrated but intermittent flow of water usually during and immediately following heavy rain. Deep enough to interfere with, and not to be obliterated by, normal tillage operations.

hardpan: A hardened soil layer in the lower A horizon or in the B horizon.

illuvial horizon: A soil layer or horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension. The layer of accumulation. See *eluvial* horizon.

illuviation: The process of deposition of soil material from one horizon to another in the soil, usually from an upper to a lower horizon in the soil profile. See *eluviation.*

impeded drainage: A condition that hinders the movement of water through soil under the influence of gravity.

land classification: The arrangement of land units into various categories based upon the properties of the land or its suitability for some particular purpose.

landscape: All the natural features such as fields, hills, forests, water, etc., which distinguish one part of the earth's surface from another part. Usually that portion of land or territory that the eye can comprehend in a single view, including all its natural characteristics.

leaching: The removal of materials in solution from the soil. See *eluviation.*

mottled zone: A layer that is marked with spots or blotches of different color or shades of color. The pattern of mottling and the size, abundance, and color contrast of the mottles may vary considerably and should be specified in soil descriptions.

mottling: Spots or blotches of different color or shades of color interspersed with the dominant color.

organic soil: A soil which contains a high percentage (> 15% or 20%) of organic matter throughout the solum.

pans: Horizons or layers in soils that are strongly compacted, indurated, or very high in clay content. See *claypan*, *fragipan*, and *hardpan.*

parent material: The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of soils is developed by pedogenic processes.

particle size: The effective diameter of a particle measured by sedimentation, sieving, or micrometric methods.

particle-size analysis: Determination of the various amounts of the different separates in a soil sample, usually by sedimentation, sieving, micrometry, or combinations of these methods.

particle-size distribution: The amounts of the various soil separates in a soil sample, usually expressed as weight percentages.

ped: The unit of soil structure such as an aggregate, prism, block, or granule, formed by natural processes (in contrast with a clod, which is formed artificially).

pedogenic processes: Processes or factors that result in the formation soils: parent material, organisms, relief, climate, and time.

percolation, soil water: The downward movement of water through soil. Especially, the downward flow of water in saturated or nearly saturated soil.

permeability, soil: (1) The ease with which gases, liquids, or plant roots penetrate or pass through a bulk mass of soil or a layer of soil. Since different soil horizons vary in permeability, the particular horizon under question should be designated. (2) The property of a porous medium itself that relates to the ease with which gases, liquids, or other substances can pass through it.

pH, soil: (1) The negative logarithm of the hydrogen ion activity. (2) The degree of acidity (or alkalinity) of a soil as determined by means of a glass, quinhydrone, or other suitable electrode indicator at a specified moisture content or soil-water ratio, and expressed in terms of the pH scale.

physical weathering: The breakdown of rock and mineral particles into smaller particles by physical forces such as frost action.

plastic soil: A soil capable of being molded or deformed continuously and permanently, by relatively moderate pressure, into various shapes.

profile, soil: A vertical section of the soil through all its horizons and extending into the parent material.

regolith: The upper part of the earth's crust influenced by weathering causing the break down of rocks.

residual material: Unconsolidated and partly weathered mineral materials accumulated by disintegration of consolidated rock in place.

sand: As a soil-separate, particles from 0.05 mm to 2.0 mm in diameter. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

sandy: Containing large amounts of sand or having properties similar to those of sand.

second bottom: The first terrace above the normal flood plain of a stream.

sedimentary rock: A rock formed from materials deposited from suspension or precipitated from solution and usually more or less consolidated. The principal sedimentary rocks are sandstones, shales, limestones, and conglomerates.

silt: As a soil-separate, particles from 0.002 mm to 0.05 mm in diameter. As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

silty: Containing large amounts of silt or having properties similar to those of silt.

soil: (1) The unconsolidated mineral material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. (2) The unconsolidated mineral matter on the face of the earth that has been subjected to and influenced by genetic and environmental factors of parent material, climate (including moisture and temperature effects), macro- and microorganisms and topography, all acting over a period of time and producing a product (soil) that differs from the material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics.

soil conservation: (1) Protection of the soil against physical loss by erosion or against chemical deterioration; that is, excessive loss of fertility by either natural or artificial means. (2) A combination of all management and land use methods that safeguard the soil against depletion or deterioration by natural or by man-induced factors. (3) A division of soil science concerned with soil conservation as defined in (1) and (2).

soil genesis: (1) The mode of origin of the soil with special reference to the processes or soil-forming factors responsible for the development of the solum, or true soil, from the unconsolidated parent material. (2) A division of soil science concerned with soil genesis as defined in (1).

soil management: (1) The sum total of all tillage operations, cropping practices, fertilizer, lime, and other treatments conducted on or applied to soil for the production of plants. (2) A division of soil science concerned with the items listed under (1).

soil morphology: The physical constitution of a soil profile as exhibited by the kinds, thickness, and arrangement of the horizons in the profile, and by the texture, structure, consistency, and porosity of each horizon. (2) The structural characteristics of the soil or any of its parts.

solum: The A, or surface soil, and B, or subsoil, make up the solum.

soil science: That science dealing with soils as a natural resource on the surface of the earth including soil formation, classification, and mapping, and the physical, chemical, biological, and fertility properties in relation to their management for crop production.

tight soil: A compact, relatively impervious and tenacious soil (or subsoil) that may or may not be plastic.

tilth: The physical condition of soil as related to its ease of tillage, its fitness as a seedbed, and its impedance to seedling emergence and root penetration.

topsoil: (1) The layer of soil moved in cultivation. (2) The A horizon. (3) Presumably, fertile soil material used to topdress roadbanks, gardens, and lawns.

water table: The upper surface of groundwater or that level in the ground where the water is at atmospheric pressure.

weathering: All physical and chemical changes produced in rocks, at or near the earth's surface, by climatic or biologic agents.

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