Designation: D 5921 – 96$^{\epsilon 1}$

Standard Practice for
Subsurface Site Characterization of Test Pits for On-Site Septic Systems[1]

This standard is issued under the fixed designation D 5921; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

ϵ[1] NOTE—Paragraph 1.9 was added editorially October 1998.

INTRODUCTION

Many State and local jurisdictions have requirements for evaluating sites for approval of on-site septic systems. This practice provides a method to describe and interpret subsurface characteristics to evaluate sites for septic systems. All characteristics used in this practice influence the ability of a site to provide treatment and disposal of septic tank effluent. However, this practice is not meant to be an inflexible description of investigation requirements. State and local jurisdictions may require fewer or greater numbers of subsurface features to evaluate a site.

This practice primarily follows the U.S. Department of Agriculture, Soil Conservation Service (SCS) soil classification system, which encompasses a systematic framework for soil morphological characterization. The SCS classification the most prevalent system in use for on-site septic systems. This practice can be complemented by application of other soil description techniques as appropriate, such as the Unified Soil Classification System (D 2485).

1. Scope

1.1 This practice covers procedures for the characterization of subsurface soil conditions at a site as part of the process for evaluating suitability for an on-site septic system. This practice provides a method for determining the usable unsaturated soil depth for septic tank effluent to infiltrate for treatment and disposal.

1.2 This practice describes a procedure for classifying soil by field observable characteristics within the United States Department of Agriculture, Soil Conservation Service (SCS) classification system.[2] The SCS classification system is defined in Refs **(1–4)**,[3] not in this practice. This practice is based on visual examination and manual tests that can be performed in the field. This practice is intended to provide information about soil characteristics in terms that are in common use by soil scientists, public health sanitarians, geologists, and engineers currently involved in the evaluation of soil conditions for septic systems.

1.3 This procedure can be augmented by Test Method D 422, when verification or comparison of field techniques is required. Other standard test methods that may be used to augment this practice include: Test Methods D 2325, D 3152, D 5093, D 3385, and D 2434.

1.4 This practice is not intended to replace Practice D 2488 which can be used in conjunction with this practice if construction engineering interpretations of soil properties are required.

1.5 This practice should be used in conjunction with D5879 to determine a recommended field area for an on-site septic system. Where applicable regulations define loading rates-based soil characteristics, this practice, in conjunction with D5925, can be used to determine septic tank effluent application rates to the soil.

1.6 This practice should be used to complement standard practices developed at state and local levels to characterize soil for on-site septic systems.

1.7 The values stated in SI units are to be regarded as the standard.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.9 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction*

[1] This practice is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.01 on Surface and Subsurface Characterization.

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[2] In 1995, the name of the SCS was changed to Natural Resource Conservation Service. This guide uses SCS rather than NRCS because referenced documents were published before the name change.

[3] The boldface numbers given in parentheses refer to a list of references at the end of the text.

with professional judgment. Nat all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.

2. Referenced Documents

2.1 *ASTM Standards:*

D 422 Standard Test Method for Particle-Size Analysis of Soils[4]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[4]

D 2325 Test Method for Capillary-Moisture Relationships for Coarse- and Medium-Textured Soils by Porous-Plate Apparatus[4]

D 2434 Test Method for Permeability of Granular Soils (Constant Head)[4]

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[4]

D 3152 Test Method for Capillary-Moisture Relationships for Fine-Textured Soils by Pressure-Membrane Apparatus[4]

D 3385 Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer[4]

D 5093 Test Method for Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed-Inner Ring[4]

D 5879 Practice for Surface Site Characterization for On-Site Septic Systems[5]

D 5925 Practice for Preliminary Sizing and Delineation of Soil Absorption Field Areas for On-Site Septic Systems[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *limiting depth*—for the purpose of determining suitability for on-site septic systems, the depth at which the flow of water, air, or the downward growth of plant roots is restricted.

3.1.2 *mottle*—spots or blotches of different colors or shades of color interspersed with the dominant color **(5)**. In SCS **(3)** practice mottles associated with wetness in the soil are called redox concentrations or redox depletions.

3.1.3 *pocket penetrometer*—a hand operated calibrated spring instrument used to measure resistance of the soil to compressive force.

3.1.4 *potentially suitable field area*—the portions of a site that remain after observing limiting surface features such as excessive slope, unsuitable landscape position, proximity to water supplies, and applicable setbacks have been excluded.

3.1.5 *recommended field area*—the portion of the potentially suitable field area at a site that has been determined to be most suitable as a septic tank soil absorption field or filter bed based on surface and subsurface observations.

3.1.6 *unsaturated*—soil water condition at which the void spaces that are able to be filled are less than full.

3.1.7 *vertical separation*—the depth of unsaturated, native, undisturbed soil between the bottom of the disposal component of the septic system and the limiting depth.

4. Summary of Practice

4.1 This practice describes a field technique using visual examination and simple manual tests for characterizing and evaluating soils and identifying any limiting depth.

5. Significance and Use

5.1 This practice should be used as part of the evaluation of a site for its potential to support an on-site septic system in conjunction with Practice D 5879 and Practice D 5925.

5.2 This practice should be used after applicable steps in Practice D 5879 have been performed to document and identify potentially suitable field areas.

5.3 This practice should be used by those who are involved with the evaluation of properties for the use of on-site septic systems. They may be required to be licensed, certified, meet minimum educational requirements by the area governing agencies, or all of these.

5.4 This practice requires exposing the soil to an appropriate depth (typically 1.5 to 1.8 m, or greater as site conditions or project objectives require) for examining the soil morphologic characteristics related to the performance of on-site septic systems.

6. Limitations

6.1 The water content of the soil will affect its properties. The soil should be evaluated in the moist condition because the normal operating state of the septic system is a moist condition. If the soil is dry, moisten it.

6.2 This practice is not applicable to frozen soil.

6.3 Optimum lighting conditions for determining soil color are full sunlight from mid-morning to mid-afternoon. Less favorable lighting conditions exist when sun is low or skies are cloudy or smoky. If artificial light is used, it should be as near the light of mid-day as possible.

7. Apparatus

7.1 Tools typically used are a soil knife or a flat blade screw driver, tape measure, pencil and paper, Munsell soil color charts **(6)**, water bottle, wash rag, and a sack to carry samples if required. A pocket penetrometer may also be useful. When the presence of carbonate may be significant in soils, dilute hydrochloric acid (10 % HCl) should be used.

7.2 A backhoe will facilitate excavation of the test pits for examination. However, if the site is inaccessible or funds are limited, one may excavate by hand with a shovel. Depending on site conditions, power driven or hand held soil augers may also be suitable. Tube samplers allow description of soil morphologic features providing the size of the feature does not exceed the diameter of the core. Augers generally destroy such morphologic features as soil structure and porosity. The advantage of augers and tube samplers is that they are generally faster and less expensive than excavated pits. Their disadvantage is that they sample a smaller area of soil, preventing characterization of lateral changes in horizon boundaries and description of larger-scale morphologic features. Use of probes

[4] *Annual Book of ASTM Standards*, Vol 04.08.

[5] *Annual Book of ASTM Standards*, Vol 04.09.

or augers as an alternative to excavated pits requires a higher degree of experience and knowledge about soils in an area.

7.3 For preliminary examination of a site, one may probe vertically into the soil to get a feel for the presence and depth to a compacted layer, or a water table. Tools that might be used include a digging bar, tile probe, post hole digger, or hand soil auger.

8. Location of Sampling Points

8.1 Test pits or other subsurface sampling points should be located in the potentially suitable field area as determined using Practice D 5879, taking into consideration proximity of source of waste water and down slope of source, if possible. Locating down slope gives most flexibility in system design by allowing either gravity flow or pressure distribution. A preliminary sizing of the field should be performed in accordance with Practice D 5925 to determine placement of the sample points. Generally, sample points should be located on diagonal corners of the preliminary drainfield area so as to avoid disturbing the soil within the recommended field area. Depending on site conditions, additional sample points may be required to identify a recommended field area.

9. Procedure

9.1 Orient the excavation to expose the vertical face to the best light.

9.2 Excavate the test pit to a depth sufficient to satisfy the vertical separation required by the governing agency. If the limiting depth is too shallow to meet the vertical separation requirement, it may be desirable to excavate deeper to determine if the layer is underlain by permeable material.

9.3 Enter the test pit using all applicable safety requirements and examine the soil layers, or horizons. Select a representative area to examine in detail.[6]

9.4 Using a soil knife or other tool, expose the natural soil structure in an area approximately 0.5 m in width the full height of the test pit.

9.5 Describe master soil horizons following the criteria in Table 1. Horizons are separated by boundaries. Locate these boundaries by changes in color, texture, or structure.

9.6 For each layer describe and test as follows:

9.6.1 Measure the depth of the layer from the soil-air interface. Positive numerical values indicate increasing depth.

9.6.2 Describe color of soil with soil in the moist state. Use Munsell color chart **(6)** designation for hue, value, and chroma. Include the color name. Indicate lighting conditions, if other than direct sunlight.

9.6.3 Estimate the volumetric percentage of rock fragments (see Fig. 1).

9.6.4 Describe size, shape, and percentage of rock fragments (see Table 2).

9.6.5 Describe the texture of the $<$ 2 mm fraction of the layer using the flow chart in Fig. 2 as a guide. See Table 3 for abbreviations. For sandy soils, (that is, less than 20 % clay and greater than 50 % sand by weight), a field sieve analysis allows more precise texture classification using Table 4.

9.6.6 Note the presence or absence of mottles. Describe color **(6)**; proportion (see Fig. 1); and abundance, size, and contrast of mottles (see Table 5).

9.6.7 Describe soil structure by grade using Table 6 and shape and size using Fig. 3 and Fig. 4.

9.6.8 Describe soil-rupture resistance using criteria in Table 5.

9.6.9 If cementation is suspected, bring an intact soil clod from the site for further testing. Air dry the clod. Submerge the clod in water for at least 1 h. Perform the same tests for rupture resistance as shown in Table 7. The sample is cemented if it meets the very hard classification test. Describe the degree of cementation using classes given in Table 7.

9.6.10 Measure soil penetration resistance with a pocket penetrometer and describe the condition of the soil following the criteria in Table 8.

9.6.11 Describe abundance, size, and distribution of roots using modifier criteria given in Table 9 and Fig. 5.

9.6.12 Describe abundance, size, distribution and type of soil pores using criteria in Table 10 and Fig. 5.

9.6.13 If presence or absence of carbonates is a diagnostic soil property, use hydrochloric acid to determine depth to free carbonate. Describe effervescence as follows: (0) very slightly effervescent (few bubbles), (1) slightly effervescent (bubbles readily), (2) strongly effervescent (bubbles form low foam), (3) violently effervescent (thick foam forms quickly), and (4) noneffervescent.

9.6.14 Describe layer boundaries according to its distinctness and topography as shown in Table 11.

9.6.15 Estimate moisture conditions of the soil as dry, moist, or wet using the guidelines in Table 12. Measure the depth to zone of saturation, if encountered, immediately and remeasure periodically during evaluation of the site.

9.7 Evaluate changes in soil profile laterally within each pit and between the test pits, augmented by hand auger borings, as necessary, to determine if more test pits are needed to fully characterize the site.

10. Interpretation of Results

10.1 Identify limiting depth at each sampling point based on applicable regulatory criteria or definitions. Major types of limiting depths include depth to saturation, depth to a very slowly permeable layer that restricts downward movement of water, depth to an excessively permeable layer, and depth to a layer of strongly contrasting texture that impedes downward movement of water. Interpretation of limiting depth is a matter of judgement involving consideration of various observable soil features.

10.2 Depth to saturation. Soil morphologic indicators of depth to saturation include gleyed horizons, redox related mottles (redox concentrations and depletions, that is, zones indicative of oxidizing and reducing conditions), and iron and manganese concentrations (coatings, concretions and nodules).

10.2.1 Gleyed horizons (hues of 5GY, 5G, 5BG, 5B, and N **(6)**) and depleted matrices (generally two chroma or less **(6)**) indicate permanent saturation.

10.2.2 Mottled horizons characterized by areas of redox

[6] Test pits should comply with applicable Federal, State and Local safety regulations. Generally, test pits 1.5 meters or less in depth do not require special protection if the soil is cohesive.

concentrations and redox depletions generally indicate seasonal saturation. A common rule of thumb is the depth to two chroma mottles (redox depletions) represents the seasonal high water table. In some geographic areas and soil types, three chroma mottles may also indicate seasonal saturation. Generally, the percentage of the soil that is gray serves as an indicator of length of saturation, with more gray indicating longer periods of saturation. Soil morphologic features do not always correlate well with seasonal fluctuations in saturation, and the confidence in interpretations can be increased by studies that demonstrate a correlation for soils in an area. When evaluating soil mottling, consideration should be given to the possibility that they are relict features, especially when agricultural tile drainage is a common practice in the area. Also, the absence of redox depletions does not necessarily prove lack of saturation. Redox depletions may not be evident where ground water is well oxygenated, soils are very low in dissolved organic carbon, and low in iron oxides. Also, redoximorphic features do not develop where soils or ground water is less than 5°C and in soils with high pH (generally >8).

10.2.3 Horizons with iron and manganese concretions may indicate seasonal saturation or capillary fringe. Depth to iron and manganese concentrations will generally provide the most conservative estimate to depth to seasonal high water table.

10.2.4 Where the capillary fringe is also considered as part of the saturated zone for defining the limiting depth, soil texture can be used to estimate the thickness of the capillary fringe as shown in Table 13.

10.3 *Depth to Impermeable Layers*—Observable soil features that indicate layers that limit downward movement of water include slowly permeable soil genetic horizons, such as fragipans, duripans, and caliche, soil horizons with very weak, platy or massive structure, very firm or very hard rupture resistance, layers that are moderately cemented, strongly cemented or indurated, and high penetration resistance.

10.4 *Depth to Excessively Permeable Layers*—Coarse sand, very gravelly, extremely gravelly or soils with greater than 15 % rock fragments larger than gravel generally do not provide adequate treatment of wastewater effluent. Such layers are identified based on the size class and amount of sand in the < 2 mm fraction, and the percentage of rock fragments in the >2 mm fraction.

10.5 Strong textural contrasts between soil layers (fine-grained over coarse grained, or coarse-grained over fine-grained) impede both unsaturated and saturated flow. Where excess soil water percolates through the soil, such contrasts will also be indicated by mottling, whereas mottling may not be evident in areas where evapotranspiration exceeds precipitation.

11. Report

11.1 Reporting of results of the subsurface investigation should be integrated with the results of the surface investigation. The local or state regulatory authority may have developed forms or formulas for investigation reports, in which case, these should be used.

11.2 The report on the results of the subsurface soils examination should include the following:

11.2.1 Site map prepared for the surface site characterization investigation (see D5879) with locations of the test pits or soil borings located and identified.

11.2.2 Completed field data from each test pit on a standard form. A sample form and its headings is shown in Fig. 6. An example of a completed form for a site is shown in Fig. 7. A summary of abbreviations is shown in Fig. 8.

11.2.3 A narrative of each soil profile describing the major features and interpreting the limiting depths. Fig. 9

12. Precision and Bias

12.1 This practice provides qualitative information only, therefore, a precision and bias statement is not applicable.

12.2 Because the analysis is based on visual and manual tests, the observer should maintain proficiency of visual and manual testing ability by periodic review of standards and standard materials and by collecting random samples for laboratory analysis for comparison with visual and manual analysis.

13. Keywords

13.1 septic system; site characterization; soil classification; soil description; visual classification

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TABLE 1 Definitions and Designations for Soil Horizons (1), (3)

Master Horizons and Layers:

O Horizons—Layers dominated by organic material, except limnic layers that are organic.

A Horizons—Mineral horizons that form at the surface or below an O horizon and (1) are characterized by an accumulation of humified organic matter intimately mixed with the mineral fraction and not dominated by properties characteristic of E or B horizons; or (2) have properties resulting from cultivation, pasturing, or similar kinds of disturbance.

E Horizons—Mineral horizons in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these, leaving a concentration of sand and silt particles of quartz or other resistant materials.

B Horizons—Horizons that formed below an A, E, or O horizon and are dominated by (1) carbonates, gypsum, or silica, alone or in combination; (2) evidence of removal of carbonates; (3) concentrations of sesquioxides; (4) alterations that form silicate clay; (5) formation of granular, blocky, or prismatic structure; or (6) a combination of these.

C Horizons—Horizons or layers, excluding hard bedrock, that are little affected by pedogenic processes and lack properties of O, A, E, or B horizons. Most are mineral layers, but limnic layers, whether organic or inorganic are included.

R Layers—Hard bedrock including granite, basalt, quartzite, and indurated limestone or sandstone that is sufficiently coherent to make hand digging impractical.

Transitional Horizons:

Two kinds of transitional horizons occur. In one, the properties of an overlying or underlying horizon are superimposed on properties of the other horizon throughout the transition zone (that is, AB, BC, etc.). In the other, distinct parts that are characteristic of one master horizon are recognizable and enclose parts characteristic of a second recognizable master horizon (that is, E/B, B/E, and B/C).

Alphabetical Designation of Horizons:

Capital letters designate master horizons (see definitions above).

Lowercase letters are used as suffixes to indicate specific characteristics of the master horizons (see definitions below). The lowercase letter immediately follows the capital letter designation.

Numeric Designation of Horizons:

Arabic numerals are used as (1) suffixes to indicate vertical subdivisions within a horizon and (2) prefixes to indicate discontinuities.

Prime Symbol:

The prime symbol (′) is used to identify the lower of two horizons having identical letter designations that are separated by a horizon of a different kind. If three horizons have identical designations, a double prime (″) is used to indicate the lowest.

Subordinate Distinctions within Horizons and Layers:

a— Highly decomposed organic material where rubbed fiber content averages $<\frac{1}{6}$ of the volume.

b— Identifiable buried genetic horizons in a mineral soil.

c— Concretions or hard nonconcretionary nodules of iron, aluminum, manganese, or titanium cement.

d— Physical root restriction, such as dense basal till, plow pans, and other mechanically compacted zones.

e— Organic material of intermediate decomposition in which rubbed fiber content is $\frac{1}{6}$ to $\frac{2}{5}$ of the volume.

f— Frozen soil in which the horizon or layer contains permanent ice.

g— Strong gleying in which iron has been reduced and removed during soil formation or in which iron has been preserved in a reduced state because of saturation with stagnant water.

h— Illuvial accumulation of organic matter in the form of amorphous, dispersible organic matter-sesquioxide complexes, where sesquioxides are in very small quantities and the value and chroma of the horizons are < 3.

i— Slightly decomposed organic material in which rubbed fiber content is more than about $\frac{2}{5}$ of the volume.

k— Accumulation of pedogenic carbonates, commonly calcium carbonate.

m— Continuous or nearly continuous cementation or induration of the soil matrix by carbonates (km), silica (qm), iron (sm), gypsum (ym), carbonates and silica (kqm), or salts more soluble than gypsum (zm).

n— Accumulation of sodium on the exchange complex sufficient to yield a morphological appearance of a natric horizon.

o— Residual accumulation of sesquioxides.

p— Plowing or other disturbance of the surface layers for cultivation, pasturing, or similar uses.

q— Accumulation of secondary silica.

r— Weathered or soft bedrock including saprolite; partly consolidated soft sandstone, siltstone, or shale; or dense till that roots penetrate only along joint planes and which is sufficiently incoherent to permit hand digging with a spade.

s— Illuvial accumulation of sesquioxides and organic matter in the form of illuvial, amorphous dispersible organic matter-sesquioxide complexes, if both organic matter and sesquioxide components are significant and the value and chroma of the horizon are > 3.

ss— Presence of slickensides.

t— Accumulation of silicate clay that either has formed in the horizon and is subsequently translocated or has been moved into it by illuviation.

v— Plinthite which is composed of iron-rich, humus-poor, reddish material that is firm or very firm when moist and that hardens irreversibly when exposed to the atmosphere under repeated wetting and drying.

w— Development of color or structure in a horizon with little or no apparent illuvial accumulation of materials.

x— Fragic or fragipan characteristics that result in genetically developed firmness, brittleness, or high bulk density.

y— Accumulation of gypsum.

z— Accumulation of salts more soluble than gypsum.

TABLE 2 Abbreviations and Designations for Rock Fragment Classes (1), (3), and (7)

Modifier (Volume%)[A]		Adjective/Noun	Shape/Size Rounded, Subrounded, Angular, or Irregular (diameter, mm)
<15 %	none	GR—gravelly/pebbles	2 to 75
>15 to 35 %	dominant rock		
35 to 60 %	dominant rock + very (v)		
> 60 %	(>10 % fines) dominant rock + extremely (x)	CB—cobbly/cobbles	75 to 250
> 60 %	(<10 % fines) dominant rock noun	ST—stony/stones	250 to 600
		B—bouldery/boulders	>600 flat (long, mm)
		CN—channery/channers	2 to 150
		FL—flaggy/flagstones	150 to 380
		ST—stony/stones	380 to 600
		B—bouldery/boulders	> 600

[A]Classes for application of rock fragment modifiers (that is, gravelly loam would have >15 to 35 % pebbles by volume).

TABLE 3 Abbreviations and Designations for USDA Soil Texture Classes (1), (3), and (7)

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

TABLE 4 Percentage of Sand Sizes in Subclasses of Sand, Loamy Sand, and Sandy Loam Basic Classes (12). (Weight %)

		Soil Separates				
Basic soil class	Subclass (abbrevia- tion)	Very coarse sand, 2.0-1.0 mm	Coarse sand, 1.0-0.5 mm	Medium sand, 0.5-0.25 mm	Fine sand, 0.25-0.1 mm	Very fine sand, 0.1-0.05 mm
Sands	Coarse sand (COS)	25 % or more		Less than 50 %	Less than 50 %	Less than 50 %
	Sand (S)	25 % or more			Less than 50 %	Less than 50 %
	Fine sand (FS)				50 % or more	
				—or—		
		Less than 25 %				Less than 50 %
	Very fine sand (VFS)					50 % or more
Loamy Sands	Loamy coarse sand (LCOS)	25 % or more		Less than 50 %	Less than 50 %	Less than 50 %
	Loamy sand (LS)	25 % or more			Less than 50 %	Less than 50 %
	Loamy fine sand (LFS)				50 % or more	
				—or—		
		Less than 25 %				Less than 50 %
	Loamy very fine sand (LVFS)					50 % or more
Sandy Loams	Coarse sandy loam (COSL)	25 % or more		Less than 50 %	Less than 50 %	Less than 50 %
	Sandy loam (SL)	30 % or more				
				—and—		
		Less than 25 %			Less than 30 %	Less than 30 %
	Fine sandy loam (FSL)				30 % or more	Less than 30 %
			—or—			
		Between 15 and 30 %				
	Very fine sandy loam					30 % or more
				—or—		
	(VFSL)	Less than 15 %			More than 40 %	

* Half of fine sand and very fine sand must be very fine sand.

Abundance	
Few (f)	<2% of exposed surface.
Common (c)	2-20% of exposed surface.
Many (m)	>20% of exposed surface.
Size	
Fine (1)	Diam. <5 mm.
Medium (2)	Diam. 5-15 mm.
Coarse (3)	Diam >15 mm.
Contrast	
Faint (f)	Barely visible.
Distinct (d)	Readily seen but not striking.
Prominent (p)	Outstanding visible feature of horizon.

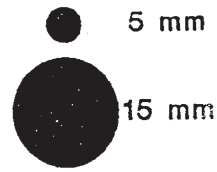


TABLE 5 Modifiers for Mottles (3, 6, and 7)

TABLE 6 Grades of Soil Structure (3)

Grade
1—Weak (poorly defined individual peds)
2—Moderate (well formed individual peds)
3—Strong (durable peds, quite evident in place; will stand displacement)

TABLE 7 Rupture Resistance Classes (3)

NOTE 1—Specimens should be block-like and 25 to 30 mm on edge. If specimens smaller than the standard size must be used, corrections should be made for class estimates (that is, a 10-cm block will require about one-third the force to rupture as will a 30-cm block. Both force, newton (N) and energy, joule (J), are employed. The number of newtons is ten times the kilograms of force. One joule is the energy delivered by dropping a 1 kg weight 10 cm.

Classes			Test Description		Classes			Test Description	
Rupture Resistance		Cementation			Rupture Resistance		Cementation		
Moderately Dry and Very Dry	Slightly Dry and Wetter	Air Dried, Submerged	Operation	Stress Applied a/	Moderately Dry and Very Dry	Slightly Dry and Wetter	Air Dried, Submerged	Operation	Stress Applied a/
Loose (L)	Loose (L)	Not applicable	Specimen not obtainable		Very hard (VH)	Extremely firm (EFI)	Moderately cemented (MC)	Cannot be failed between thumb and forefinger but can be between both hands or by placing on a nonresilent surface and applyin gentle force underfoot.	80 to 160*N*
Soft (S)	Very friable (VFR)	Noncemented (CO)	Fails under very slight force applied slowly between thumb and forefinger	<8*N*					
Slightly hard (SH)	Friable (FR)	Extremely weakly cemented (XWC)	Fails under slight force applied slowly between thumb and forefinger	8 to 20 *N*	Extremely hard (EH)	Slightly rigid (SR)	Strongly cemented (SC)	Cannot be failed in hands but can be underfoot by full body weight (ca 800*N*) applied slowly.	160 to 800*N*
Moderately hard (MH)	Firm (FI)	Very weakly cemented (VWC)	Fails under moderate force applied slowly between thumb and forefinger	20 to 40 *N*	Rigid (R)	Rigid (R)	Very strongly cemented (VSC)	Cannot be failed underfoot by full body weight but can be by < 3*J* blow.	800*N* to 3*J*
Hard (H)	Very firm (VFI)	Weakly cemented (WC)	Fails under strong force applied slowly between thumb and forefinger (80*N* about maximum force can be applied)	40 to 80 *N*	Very rigid (VR)	Very rigid (VR)	Indurated (I)	Cannot be failed by blow of < 3*J*.	≥3*J*

TABLE 8 Soil Penetration Resistance Classes (3), (8), and (9), (MPa, Megapascal)

Classes	Penetration Resistance (MPa)	
Small	< 0.1	
Extremely low (EL)		< 0.01
Very low (VL)		0.01 to 0.1
Intermediate	0.1 to 2	
Low (L)		0.1 to 1
Moderate (M)		1 to 2
Large	>2	
High (H)		2 to 4
Very high (VH)		4 to 8
Extremely high (EH)		> 8

TABLE 9 Modifiers for Roots (3), (8)

Abundance Classes	Number per Unit Area	
v1—very few	<0.2	
1—few	<1	
2—moderately few	0.2 to 1	
3—common	1 to 5	
4—many	≥5	
Size Classes	**Diameter**	**Unit Area**
v1—very fine	<1 mm	1 cm^2
1—fine	1 to 2 mm	1 cm^2
2—medium	2 to 5 mm	100 cm^2
3—coarse	5 to 10 mm	100 cm^2
4—very coarse	≥10 mm	1 m^2

Distribution Within Horizons:
P—Between peds
C—In cracks
M—In mat at top of horizon
S—Matted around stones
T—Throughout

TABLE 10 Modifiers for Soil Pores (3) (8)

Abundance Classes		Number/Unit Area
1—few		<1
2—common		1 to 5
3—many		> 5
Size Classes	**Diameter**	**Unit Area**
V1—very fine	<1 mm	1 cm^2
1—fine	1 to 2 mm	1 cm^2
2—medium	2 to 5 mm	100 cm^2
3—coarse	5 to 10 mm	100 cm^2
4—very coarse	>10 mm	1 m^2
Distribution Within Horizons		
in—inped (most pores are within peds)		
ex—exped (most pores follow interfaces between peds)		
Types of Pores		
v—vesicular (approximately spherical or elliptical)		
t—tubular (approximately cylindrical and elongated)		
i—irregular		

TABLE 11 Classes of Soil Water (3), (8), (9)

Dry (D)—Very little visual or tactile change between field observation and after air-dried samples.
Moist (M)—Visual or tactile change between field observation and after air drying.
Wet (W)—Water films evident, or free water.

TABLE 12 Guide for Estimation of Capillary Fringe (10)

USDA Texture Class	Est. Capillary Fringe, cm
Coarse sand	1 to 7
Sand	1 to 9
Fine sand	3 to 10
Very fine sand	4 to 12
Loamy coarse sand	5 to 14
Loamy sand	6 to 14
Loamy fine sand	8 to 18
Coarse sandy loam	8 to 18
Loamy very fine sand	10 to 20
Sandy loam	10 to 20
Fine sandy loam	14 to 24
Very fine sandy loam	16 to 26
Loam	20 to 30
Silt loam	25 to 40
Silt	35 to 50
Sandy clay loam	20 to 30
Clay loam	25 to 35
Silty clay loam	35 to 55
Sandy clay	20 to 30
Silty clay	40 to 60
Clay	25 to 40

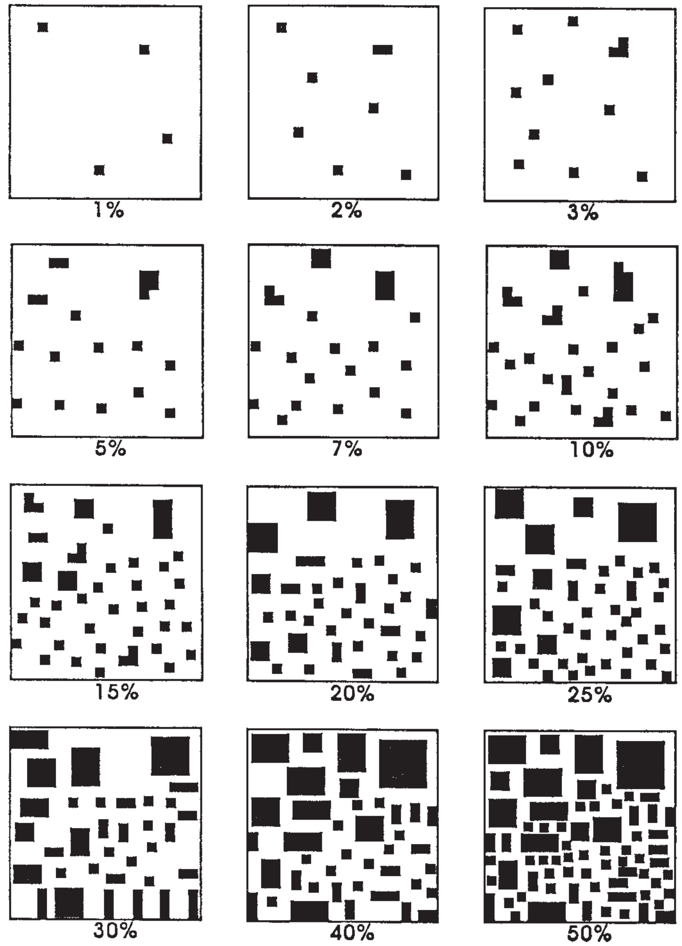
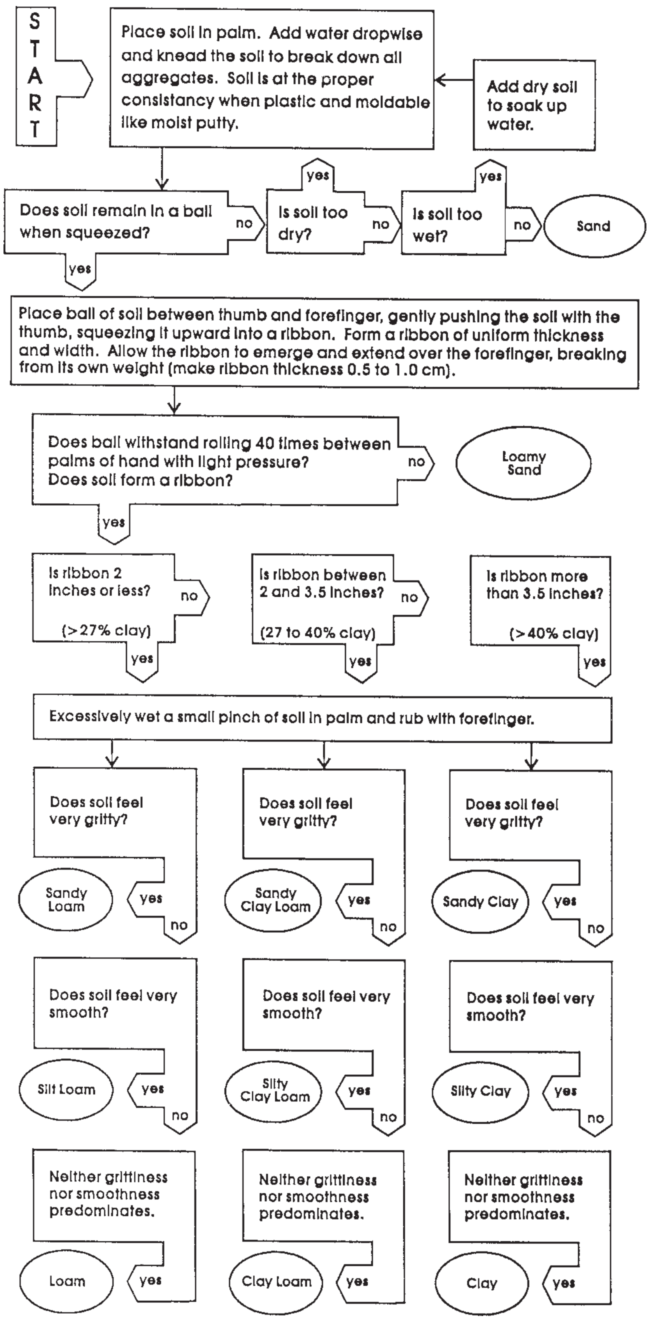
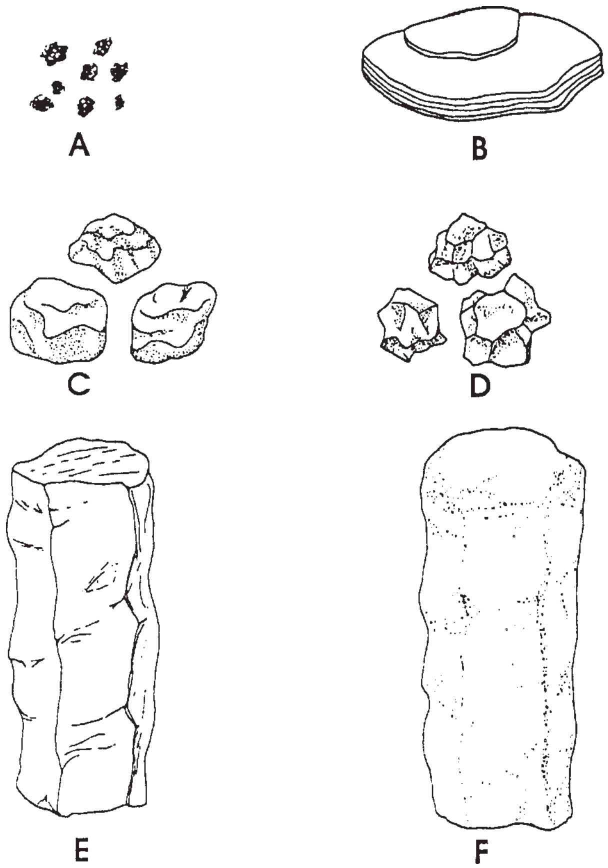


FIG. 1 Chart for Estimating Proportions of Mottles or Rock Fragments (6), (7), (8), (9)



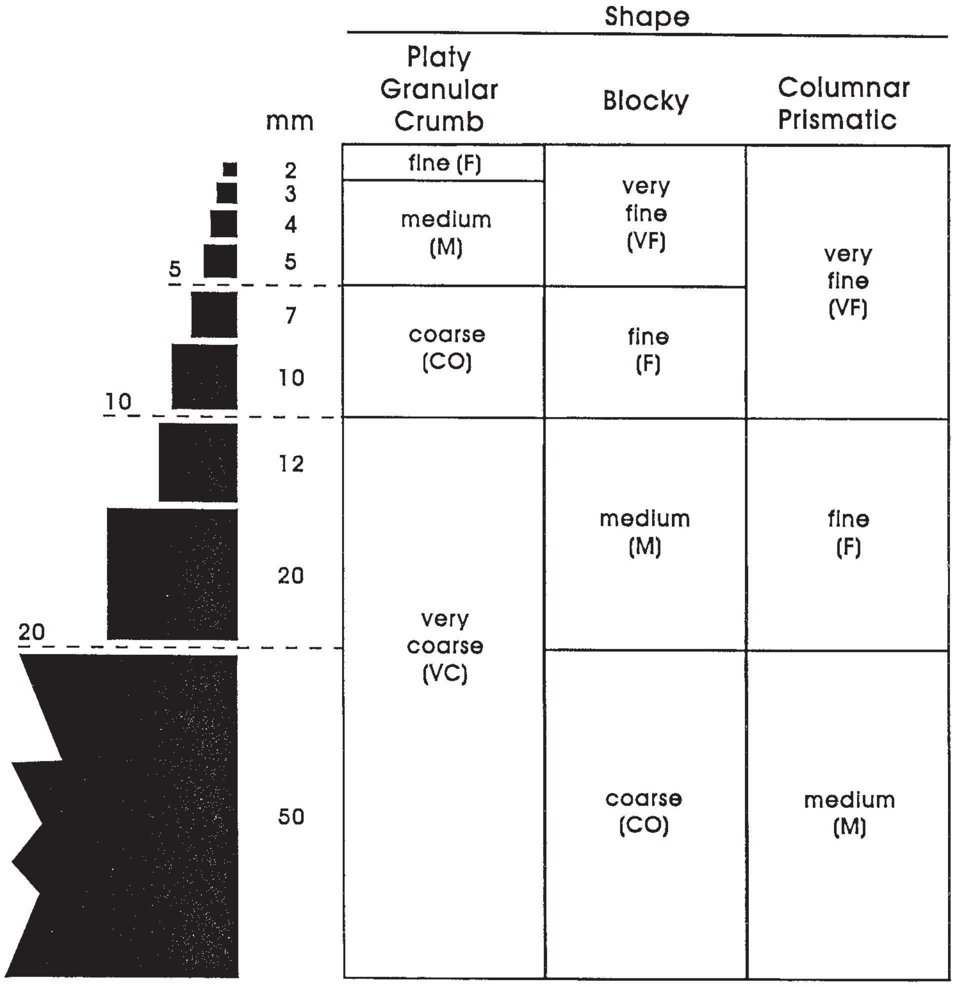
NOTE 1—Local clay mineralogy may require modifications in the above procedure. Field texture determinations should be periodically corroborated by laboratory analyses (weight %).

FIG. 2 Flow Chart for Estimating Soil Texture (6), (7), (11)



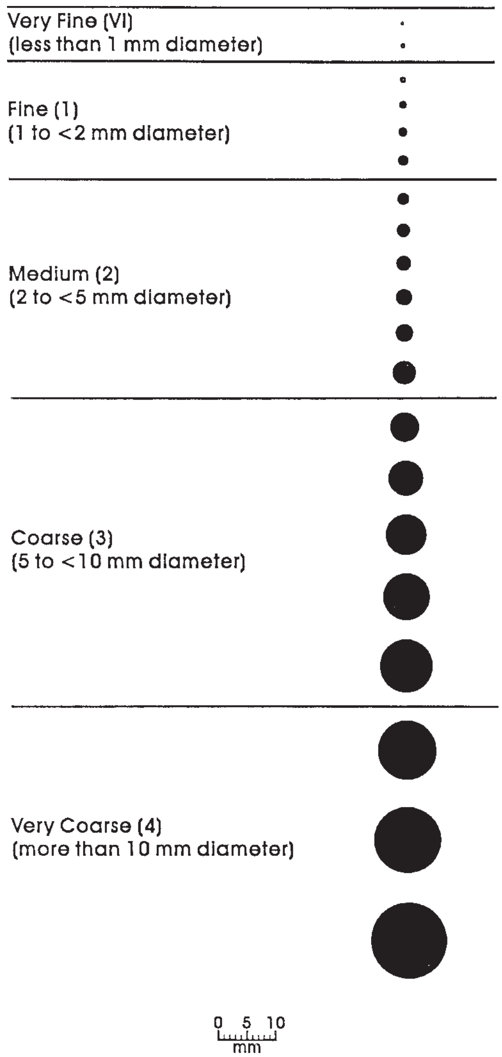
NOTE 1—Not shown, massive (MA), single grain (SGR).

FIG. 3 Drawings Illustrating Some of the Types of Soil Structure: A, Granular; B, Platy; C, Subangular Blocky; D, Angular Blocky; E, Columnar; F, Prismatic (3)



NOTE 1—Based on classes defined in Ref **(3)**.

FIG. 4 Charts for Estimating Size Class of Different Structural Units (8)



NOTE 1—Modified from Ref **(9)**.

FIG. 5 Charts for Estimating Pore and Root Size

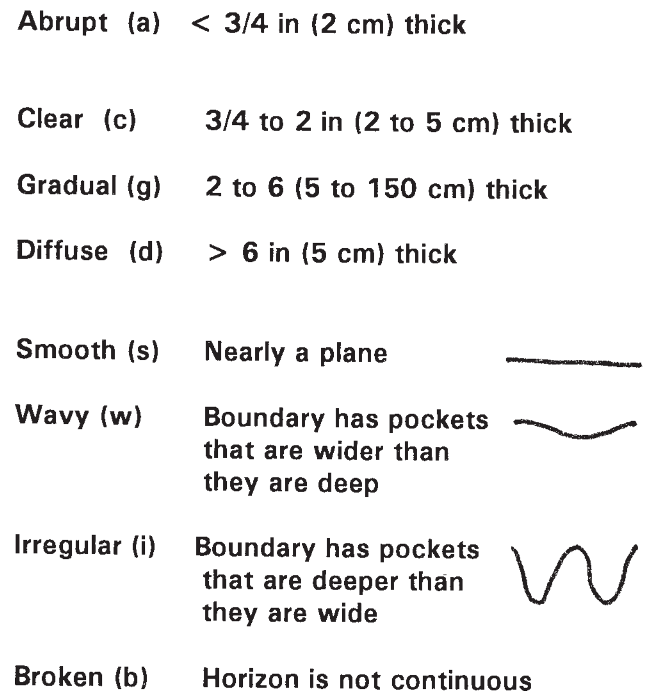


FIG. 6 Horizon Boundary Distinctness and Topography (3), (6), (7)

SOILS EVALUATION FORM PER ASTM D 5921

PROPERTY OWNER: ______________________________
LOCATION: ______________________________
DATE: ______________________________
INVESTIGATORS: ______________________________
EXCAVATION METHOD: ______________________________
WEATHER, LIGHTING: ______________________________

Test Pit #	Horizon		Depth	Color	Rock Fragments		Texture		Rock	Mottles				Structure			RUPTURE RESISTANCE		Cementation	Penetration Resistance	Roots			Pores				Carbonates	Boundary		Water	Limiting Depth
							SAND SIZE			ABUNDANCE	SIZE	CONTRAST		GRADE	SIZE	SHAPE	DRY	MOIST			ABUNDANCE	SIZE	LOCATION	ABUNDANCE	SIZE	LOCATION	SHAPE		DISTINCTNESS	TOPOGRAPHY		
	O A E B C R	a o b p c q d r e s f ss g t h v i w k x m y n z		H, V/C **C ≤ 2** H = N,5	V X	GR CB CN FL ST B	CO F VF	C SIC **SC** SICL CL SIL SI L SL LS S	**UWB** **WB**	f c m	1 2 3	F D P	Color H V/C	1 2 3	VF F M CO VC	PR COL ABK SBK GR **PL** **MA** **SGR**	L S SH MH H **VH** EH R VR	L VFR FR FI **VFI** EFI SR R VR	**CO** XWC VWC WC **MC** SC VSC I	**EL** **VL** L M H VH EH	VI 1 2 3 4	VI 1 2 3 4	P C M S T	1 2 3	VI 1 2 3 4	IN EX	VS TU	4 0 1 2 3	A C G D	S W I B	D M W	

*Bold print indicates soil features that may limit depth.

FIG. 7 Soil Evaluation for On-Site Septic System

SOILS EVALUATION FORM PER ASTM D 5921

PROPERTY OWNER: SARAH & ROCKY SHALE, 37 STONE ROAD, MOUNTAIN VIEW, AR 72000 501-234-5678
LOCATION: GREEN MEADOWS ROAD, PORT ANGELES, CLALLAM COUNTY, WA, PARCEL # 03-30-29-41'0030
DATE: 3/25/95 10:00 AM – 11:30 A.M.
INVESTIGATORS: SAM S. SPADE CPSS PE, SOILS-R-US, INC, 111 EAST 3RD ST, SEATTLE WA, 98000 206 555 1234
EXCAVATION METHOD: CASE 580C BACKHOE J & C EXCAVATING, INC.
WEATHER, LIGHTING: CLEAR, 60°F, FULL SUNLIGHT

Test Pit #	Horizon		Depth (CM)	Color	Rock Fragments		Texture		Rock	Mottles				Structure			RUPTURE RESISTANCE		Cementation	Penetration Resistance	Roots			Pores				Carbonates	Boundary		Water	Limiting Depth
							SAND SIZE			ABUNDANCE	SIZE	CONTRAST		GRADE	SIZE	SHAPE	DRY	MOIST			ABUNDANCE	SIZE	LOCATION	ABUNDANCE	SIZE	LOCATION	SHAPE		DISTINCTNESS	TOPOGRAPHY		
	O A E B C R	a b c d e f g h i k m n / o p q r s ss t v w x y z		H, V/C C ≤ 2 H = N,5	V X	GR CB CN FL ST B	CO F VF	C SIC SC SICL CL SIL SI L SL LS S	UWB WB	f c m	1 2 3	F D P	Color HV/C	1 2 3	VF F M CO VC	PR COL ABK SBK GR PL MA SGR	L S SH MH H VH EH R VR	L VFR FR FI VFI EFI SR R VR	CO XWC VWC WC MC SC VSC I	EL VL L M H VH EH	VI 1 2 3 4	VI 1 2 3 4	P C M S T	1 2 3	VI 1 2 3 4	IN EX	VS TU	4 0 1 2 3	A C G D	S W I B	D M W	
1	A	P	0-20	GR BRN 10YR 5/2	–	–	F	SL	–	–	–	–	–	1	W	GR	–	VFR	CO	VL	4	12	T	2	VI	IN	VS	–	A	S	M	–
	B	–	20-75	DK YELBRN 10YR 4/4	–	GR	–	SL	–	–	–	–	–	2	M	SBK	–	FR	CO	L	3	12	P	2	1	IN	VS	–	C	W	M	–
	C	–	75-120	GRAY 10YR 5/1	V	GR	–	LS	–	C	1	P	DK BRN 7.5YR 4/4	–	–	SGR	–	EFI	WC	H	3	12	M	–	–	–	–	–	–	–	W	YES
																													–			
2	A	P	0-18	GR BRN 10YR 5/2	–	–	F	SL	–	–	–	–	–	1	W	GR	–	VFR	CO	VL	3	12	T	2	VI	IN	VS	–	A	S	M	–
	B	–	18-80	DK YELBRN 10YR 4/4	–	GR	–	SL	–	–	–	–	–	2	M	SBK	–	FR	CO	L	3	12	P	2	1	IN	–	–	C	W	M	–
	C	–	80-95	GRAY 10YR 5/1	V	GR	–	LS	–	C	2	P	REDBRN 5YR 4/3	–	–	SGR	–	EFI	WC	H	4	12	M	–	–	–	–	–	–	–	W	YES
3	A	–	0-10	DK BRN 10YR 4/2	–	–	–	SIL	–	–	–	–	–	1	M	GR	–	VFR	CO	VL	3	1	T	2	VI	IN	VS	–	C	S	M	–
	B	–	10-70	DK GR BRN 10YR 4/2	–	–	–	SIL	–	f	2	F	YELBRN 2.5Y 4/4	2	M	PR	–	FR	CO	M	1	1	P	2	2	EX	TU	–	G	W	M	YES
	C	–	70-150	GR BRN 2.5YR 5/2	–	GR	–	SICL	–	f	2	D	STR BRN 7.5YR 5/6	–	–	MA	–	FI	CO	H	2	1	M	–	–	–	–	–	–	–	W	YES

*Bold print indicates soil features that may limit depth.

FIG. 8 Example Soil Evaluation Form for Typical Site

Horizon
a - organic <1/6
b - buried
c - concretions
d - root restriction
e - organic 1/6 -2/5
f - frozen
g - gleyed
h - fluvial organic, v, c<3
i - organic > 2/5
k - carbonates
m - cemented
n - sodium
o - sesquioxides
p - plowed
q - silica
r - rock
s - fluvial organic, v, c>3
ss - slickensides
t - clay
v - plinthite
w - color and structure
x - fragipan
y - gypsum
z - salts

Rock Fragments
V - very
X - extremely
GR - gravelly
CB - cobbly
ST - stony
B - bouldery
CN - channery
FL - flaggy

Texture
CO - Coarse
F - Fine
VF - Very Fine
C - Clay
SIC - Silty Clay
SC - Sandy Clay
SICL - Silty Clay Loam
SI - Silt
L - Loam
SL - Sandy Loam
LS - Loamy Sand
S - Sand

Rock
UWB - Unweathered Bedrock
WB - Weathered Bedrock

Mottles
f - Few
C - Common
M - Many
1 - Fine
2 - Medium
3 - Coarse
F - Faint
D - Distinct
P - Prominent

Structure
1 - Weak
2 - Moderate
3 - Strong
VF - Very Fine
F - Fine
M - Medium
CO - Coarse
VC - Very Coarse
PR - Prismatic
COL - Columnar
ABK - Angular Blocky
SBK - Subangular Blocky
GR - Granular
PL - Platy
MA - Massive
SGR - Single Grain

Rupture Resistance

DRY
L - Loose
S - Soft
SH - Slightly Hard
MH - Moderately Hard
VH - Very Hard
H - Hard
EH - Extremely Hard
R - Rigid
VR - Very Rigid

MOIST
L - Loose
VFR - Very Friable
FR - Friable
FI - Firm
VFI - Very Firm
EFI - Extremely Firm
SR - Slightly Rigid
R - Rigid
VR - Very Rigid

Cementation
CO - Non Cemented
XWC - Extremely Weakly Cemented
VWX - Very Weakly Cemented
WC - Weakly Cemented
MC - Moderately Cemented
SC - Strongly Cemented
VSC - Very Strongly Cemented
I - Indurated

Penetration Resistance
EL - Extremely Low
VL - Very Low
L - Low
M - Moderate
H - High
VH - Very High
EH - Extremely High

Roots
V1 - Very Few
1 - Few
2 - Moderately Few
3 - Common
4 - Many
V1 - Very Fine
1 - Fine
2 - Medium
3 - Coarse
4 - Very Coarse
P - Between Peds
C - In Cracks
M - Matted On Top
S - Matted On Stones
T - Throughout

Pores
1 - Few
2 - Common
3 - Many
V1 - Very Fine
1 - Fine
2 - Medium
3 - Coarse
4 - Very Coarse
IN - In Ped
EX - Ex Ped
VS - Vesicular
TU - Tubular

Carbonates
4 - Non Effervescent
0 - Very Slightly Effervescent
1 - Slightly Effervescent
2 - Strongly Effervescent
3 - Violently Effervescent

Boundary
a - Abrupt
c - Clear
g - Gradual
d - Diffuse
s - Smooth
w - Wavy
i - Irregular
b - Broken

Water
D - Dry
M - Moist
W - Wet

FIG. 9 Definitions for Abbreviations