TECHNICAL GUIDE NO. 5

GUIDELINES FOR SOIL DESCRIPTION

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MINISTRY OF AGRICULTURE
RURAL PHYSICAL PLANNING DIVISION
SOIL SURVEY UNIT

PREFACE

This technical guide presents a standardized format for the field description of soil profiles in Jamaica.
For soil profile pit descriptions and regular auger observations new comprehensive forms have been designed. Accompanying these forms a set of guidelines is given in this bulletin.

The testing of previous versions of these forms and guidelines in the field, discussions with RPPD/SSU staff members and comments on these drafts from N.H. Batjes, V.A. Campbell, L.L.T. Dawkins, P.A.M. van Gent, G.R. Hennemann, P. White and R.L. Wilks assisted in the writing of the present version of these guidelines.

This technical bulletin is issued by the Jamaica Soil Survey Project (JM/89/001), a bi-lateral undertaking of the Governments of Jamaica and The Netherlands. This report has been written by P.H. Oldeman, Associate Expert/Soil Survey Coordinator, Western Region, Montego Bay.

1. INTRODUCTION

A accurate and complete soil profile description is of great importance for soil survey, soil classification, soil correlation and land evaluation.

To facilitate the description, field forms are developed which can be used as a general check-list for observation and recording. The Profile Description Form is intended for regular pits (1 by 2 meters wide and 150 cm deep). For routine observations (auger borings and road cuts) a simpler form is derived from the Profile Description Form: the Auger Hole Observation Form. The Guidelines are an aid in the process of recording the field data on these forms and present a standard terminology to be used in all observations. The terminology and classes (including their numbers) are compatible with the one in use for the computerized land evaluation system (JAMPLES). Also, the new forms and guidelines can easily assist in the setting up of a computerized soil data base for Jamaica.

For easy reference, the headings on the form are numbered in the same sequence as in the guidelines. For the purpose of readability, the number of references has been kept to a minimum. Extensive use, however, has been made of: FAO (1977), Working Group Tuscany 77 (1978), USDA (1984), Van Waveren (1987) and SSU (1988).

Regarding the use of the profile description form: when a column (on the back side) provides insufficient space for a horizon description, one may use the next column. If even more space is needed, one can continue the description on a new form.

Another suggestion for recording the soil characteristics is to indicate the number of the respective classes; e.g. -d- for slope class 8-16 %, -3- for well drained and -3- for friable consistence.

2. GUIDELINES FOR THE PROFILE DESCRIPTION FORM

The headings are numbered in the same sequence as on the profile description form.

A. GENERAL INFORMATION

1. **Observation no.**: to be indicated in the following way:
   year/no. 1 : 12,500 toposheet/pit no.

2. **Date**: self explanatory

3. **Survey area**: self explanatory

4. **Location**: be as precise as possible

5. **Parish**: self explanatory

6. **Coordinates**: specify the state plane coordinates in the following way: 654321 N - 123456 E; the first 6 figures refer to the northern, the second figures to the eastern coordinates.

7. **Elevation**: self explanatory

8. **Described by**: self explanatory

9. **Aerial photo no.**: give numbers (flight no., run no.) and year of aerial photo on which the observation is located.

10. **A.P.I unit**: give map unit on Aerial Photo Interpretation map.

11. **Preliminary map unit**: give map unit on preliminary (field) soil map.

12. **Final map unit** (after final map correlation): indicate the map unit on final soil map.

13. **Classification**: FIRST CLASSIFICATION TO BE DONE IN THE FIELD
    Classify the soil according to the USDA Soil Taxonomy (and the FAO/Unesco legend). Once laboratory data become available the preliminary classification has to be revised. Give also the original Green

Book mapping unit (and number). In view of updating the "Green Book series" concepts, extra space is provided for a new series classification. Figure 1 can be used for determination of particle size classes for classification according to Soil Taxonomy (USDA, 1975).

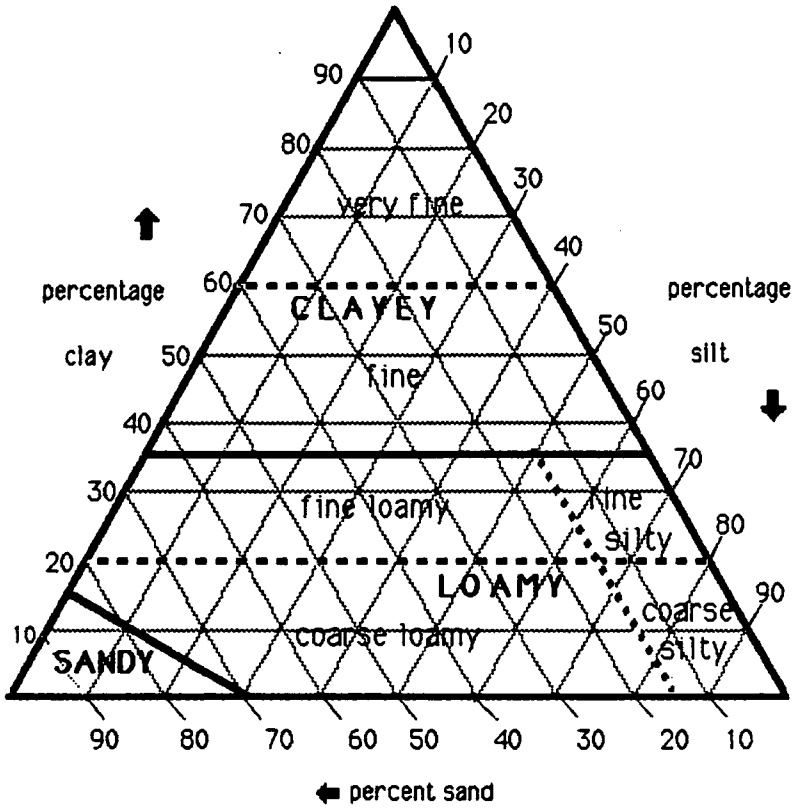


Figure 1. Particle size classes used in Soil Taxonomy classification

B. SITE INFORMATION

14. **Landform of surrounding country**: indicate one of the following landforms, according to the Soil Legend Framework for Jamaica (SSU,1988): Mountains (M); Hills and Foothills (H); Plateau (U), Inland Basin (B); Alluvial Fan (A); Coastal Plain (P); River Plain (R); Tidal Flats and Swamps (T).

15. **Physiographic position of site**: indicate the exact position of the profile site within the landform (given at 14) with one of the following terms: summit; crest (escarpment); terrace; slope; upper slope; midslope; lower slope; colluvial slope; colluvio-alluvial slope; valley bottom; depression.

16. **Slope gradient**: indicate slope gradient in %, as measured on the site.
(slope angle in % = tan (slope angle in degrees)

17. **Slope class**: indicate the overall slope class (modified after SSU, 1988):

a	flat or almost flat	- slopes not steeper than 2 %
b	slightly undulating	- slopes between 2 % and 5 %
c	undulating	- slopes between 5 % and 8 %
d	rolling	- slopes between 8 % and 16 %
e	hilly	- slopes between 16 % and 30 %
f	steeply dissected	- slopes between 30 % and 50 %
g	highly dissected	- slopes over 50 %

18. **Slope form**: indicate one of the following:

convex:  straight: 

concave:  or complex: 

19. **Micro-topography**: small scale differences (natural or artificial) in relief within the immediate vicinity of the site.
Some examples: level, knobs, gilgai, termite mounds, dimples or craddle-knoll (depressions left by uprooted trees), animal tracks, artificial or natural levees, terracettes, holes due to burrowing animals, artificial terracing.

20. **Effective soil depth**: the depth to which roots can easily penetrate.
Indicate the depth in cm or use one of the following classes:

1 - **very shallow**	< 25 cm
2 - **shallow**	25-50 cm
3 - **moderately deep**	50-100 cm
4 - **deep**	> 100 cm

21. **Parent rock/material**: include information on the origin of the parent material and on the nature of the parent rock from which it is derived;
for example: slightly stony slopewash from hard white limestone (Troy Formation).

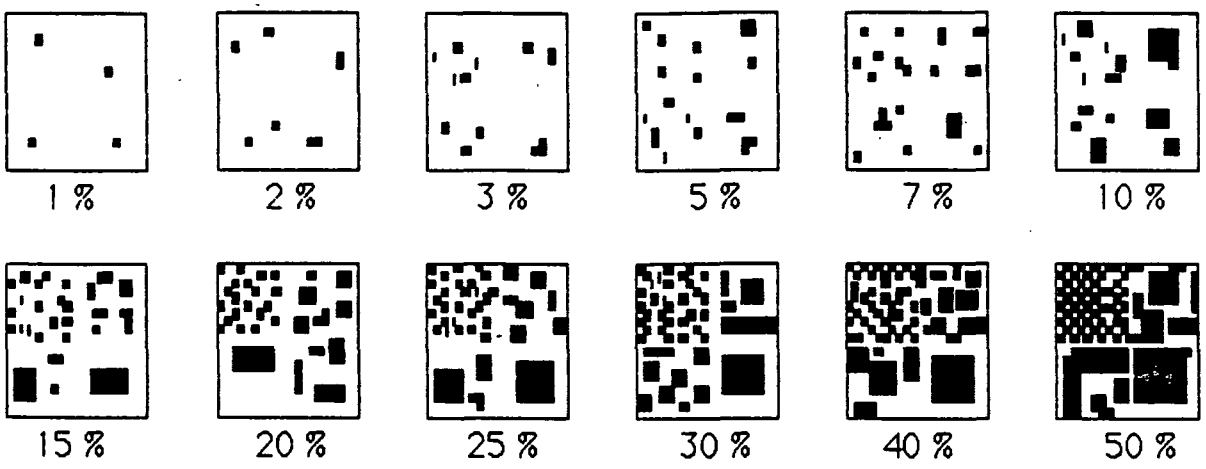


Figure 2. Charts for estimating proportions.
(Each quarter of a square has the same amount of black.)

22. **Rock outcrop**: indicate a percentage using figure 2 or use the following classes:

1 - **non rocky**: no bedrock exposure or too few to interfere with tillage; less than 2 % bedrock exposed;

2 - **fairly rocky**: sufficient bedrock exposure to interfere with tillage but not to make inter-tilled crops impracticable; rock exposure 35-100 metres apart, coverage 2-10 % of the surface;

3 - **rocky**: sufficient bedrock exposure to make tillage or inter-tilled crops impracticable, but soil can be worked for hay crops or improved pasture if other soil characteristics are favourable; rock exposures 10-35 metres apart, coverage 10-25 % of the surface;

4 - **very rocky**: sufficient rock exposure to make all use of machinery impracticable, except for light machinery where the other soil characteristics are especially favourable for improved pasture; rock exposures roughly 3.5-10 metres apart and coverage 25-50 % of the surface;

5 - **exceedingly rocky**: sufficient rock outcrop (or very shallow over rock) to make all use of machinery impractical; rock outcrops 3.5 metres apart or less, coverage 50-75 % of the area;

6 - **rock outcrop**: over 75 % of the land is covered by rock outcrops.

23. **Surface stoniness**: give a percentage (use figure 2) or indicate a class according to the following table:
    1 - **non stony**: too few stones to interfere with tillage; stones cover less than 0.01 % of the area;
    2 - **fairly stony**: sufficient stones to interfere with tillage but not to make inter-tilled crops impractical; stones cover 0.01-0.1 % of the area (stones 15 to 30 cm in diameter 10 to 30 meters apart);
    3 - **stony**: sufficient stones to make tillage or inter-tilled crops impractical, but the soil can be worked for hay crops or improved pasture if other soil characteristics are favourable; stones cover 0.1-3.0 % of the area (stones 15 to 30 cm in diameter 1.60 to 10 meters apart);
    4 - **very stony**: sufficient stones to make all use of machinery impracticable, except for very light machinery or hand tools where other soil characteristics are especially favourable; stones cover 3.0-15 % of the area (stones 15 to 30 cm in diameter 0.75-1.60 meters apart);
    5 - **exceedingly stony**: sufficient stones to make all use of machinery impractical; stones cover 15-75 % of the area (stones 15 to 30 cm in diameter < 75 centimeters apart);
    6 - **rubble land**: land essentially paved with stones which occupy more than 75 % of the surface area.

24. **Surface gravelliness**: indicate a percentage (use figure 2) or use one of the following classes:

1 - **non gravelly**	- gravels cover less than 0.01 % of the surface;
2 - **fairly gravelly**	- gravel covers 0.01-0.1 % of the surface;
3 - **gravelly**	- gravel covers 0.1-2.0 % of the surface;
4 - **very gravelly**	- coverage 2.0-25 % of the surface;
5 - **extremely gravelly**	- gravels cover 25-75 % of the surface;
6 - **gravel land**	- gravel covers more than 75 % of the surface.

25. **Drainage**: indicate one of the following drainage classes:
    1 - **excessivelly drained**: water is removed from the soil very rapidly; no mottles, very rapid percolation;
    excessively drained soils are commonly lithic subgroups and may be very steep and/or very porous.
    2 - **somewhat excessivelly drained**: water is removed from the soil rapidly; no mottles, rapid percolation;
    many of these soils have little horizon differentiation and are sandy and/or very porous.
    3 - **well drained**: water is removed from the soil readily but not rapidly;
    well drained soils commonly retain optimum amounts of moisture for plant growth after rains or additions of irrigation water.

4 - **moderately well drained**: water is removed from the soil somewhat slowly, so that the profile is wet for a small but significant part of the time; mottles start below 75 cm;
moderately well drained soils have a slowly permeable layer within or immediately beneath the solum, a relatively high water table, additions of water through seepage, or some combination of these conditions.

5 - **imperfectly drained**: water is removed from the soil slowly enough to keep it wet for significant periods but not all the time; mottles present start to appear below 25 cm;
imperfectly drained soils commonly have a slowly permeable layer within the profile, additions of water through seepage, or a combination of these conditions.

6 - **poorly drained**: water is removed so slowly that the soil remains wet for a large part of the time; mottles as from the surface, grey matrix colours below 30-40 cm;
poorly drained conditions are due to a high water table, temporarily flooded conditions, a slowly permeable layer within the profile, seepage, or to some combination of these conditions.

7 - **very poorly drained**: water is removed from the soil so slowly that the water table remains at or on the surface the greater part of the time;
soils of this drainage class are often peaty or very humic; they usually occupy level or depressed sites and are flooded or ponded for most of the year.

26. **Runoff**: water that flows away from the soil over the surface without infiltrating. Six classes are recognized:

1 - **ponded**: little of the precipitation and run-on escapes as runoff, and free water stands on the surface for significant periods;
ponding normally occurs on level or nearly level soils in depressions, and water depth may fluctuate greatly.

2 - **very slow**: surface water flows away slowly, and free water stands on the surface for long periods and/or immediately enters the soil;
the soils are commonly level or nearly level and/or very open and porous.

3 - **slow**: surface water flows are slowly enough that free water stands on the surface for moderate periods or enters the soil rapidly;
the soils are nearly level or very gently sloping, or they are steeper but absorb precipitation very rapidly.

4 - **medium**: surface water flows away fast enough that free water stands on the surface for only short periods;
the soils are nearly level or gently sloping and absorb precipitation at a moderate rate, or they are steeper but absorb water rapidly.

5 - **rapid**: surface water flows away fast enough that the period of concentration on the surface is brief and free water does not stand on the surface;.
the soils are mainly steep and have moderate to slow rates of absorption.

6 - **very rapid**: surface water flows away so fast that the period of concentration is very brief and free water does not stand on the surface;
the soils are mainly steep or very steep and absorb precipitation slowly.

27. **Depth to watertable**: self explanatory

28. **Dry to .... cm; moist to .... cm**: self explanatory (to indicate moisture condition of soil).

29. **Flooding**: use one of the following classes (after Kenya Soil Survey Manual)

1 - **none**	no flooding
2 - **very low**	flooding once every 10 years
3 - **low**	flooding once every 6 - 10 years
4 - **moderate**	flooding once every 3 - 5 years
5 - **frequent**	flooding once every 1 - 2 years
6 - **very frequent**	flooding once or more every year

30. **Slowly permeable layers**: give depth of layers which form an obstruction for the flow of water, gasses and/or the penetration of roots in the soil.

31. **Presence salt/alkali**: exact classification of saline, alkali and saline-alkali soil conditions must be based on laboratory data, but the following classes can usually be distinguished in the field:

1 - **free** of salt or alkali	practically no crops are inhibited by, or show evidence of injury from excess salts or alkali;
2 - **slightly affected**	the growth of sensitive crops is inhibited but that of salt tolerant crops may not be;
3 - **moderately affected**	crop growth is inhibited and few crops produce well;
4 - **strongly affected**	only a few plants survive (mainly natural, salt tolerant, vegetation).

32. **Erosion**: give type and intensity of the erosion processes, as observed on the site.

Types of erosion:

s - **sheet erosion**	more or less uniform removal of soil from an area without development of conspicious water channels;
r - **rill erosion**	removal of soil through cutting of many small, but conspicious water channels (depth less than 30 cm); rills can be smoothed completely by normal tillage;
g - **gully erosion**	formation of channels (depth more than 30 cm) through cutting down into the soil along the line of water flow;
w - **wind erosion**	detachment and transport of soil particles by wind.

Note: moderate gully erosion will usually represent a more active erosion process than severe rill erosion.

For intensity one of the following descriptive terms can be used:
(1) **slight**, (2) **moderate** or (3) **severe**.

33. **Mass movement**: indicate type and intensity of mass movements.

The following types of mass movements can be distinguished:

f	- **fall**	mass in motion travels most of the distance through the air
s	- **slide**	movement along one or several surfaces
r	- **slump**	rotational movement along one surface
w	- **flow**	movement of a usually wet mass

The intensity can be indicated by using:
1 - **stable**: no evidence of recent mass movements,
2 - **locally unstable**: local and mostly shallow mass movements,
3 - **highly unstable**: major part of slope is affected by shallow and deep mass movements.

34. **Sedimentation**: any deposition of material due to erosion or mass movement processes can be indicated here.

35. **Surface sealing/crusting**: indicate one of the following classes:
    1 - no surface sealing/crusting,
    2 - slightly or partly sealed surface/crust formation,
    3 - thin continuous crust formed,
    4 - continuous hard crust formed.

36. **Sketch of physiographic setting**: sketches of physiography, cross-sections, catenas, etc. are very useful as these give a better understanding of the area.

37. **Natural vegetation**: give dominant species and the percentage of the surface covered by these species; if applicable, indicate also the percentage of bare soil.

38. **Land use**: give present land use and if there have been recent changes also the past use.

39. **Crop performance**: these observations make it possible to relate soil characteristics (and the derived land qualities) with crop performance; this is required for the validation of the Jamaic Physical Land Evaluation System (JAMPLES). The observations ideally include: general crop appearance, nutrient deficiency symptoms, response to soil improvements (e.g. fertilizer or lime applications) and yield information.

40. **Human influence**: indicate those activities which likely have affected chemical or physical characteristics of the soil, like ploughing, irrigation, drainage, terracing, burning, application of organic materials, manure, inorganic fertilizers or lime.

41. **Remarks**: anything relevant not indicated on this form.

42. **Diagnostic horizons/other diagnostic characteristics**: indicate the diagnostic horizons and characteristics of the profile to facilitate classification according to Soil Taxonomy.

43. **Short description pedogenesis/geogenesis**: describe in short the possible genesis of the soil and the site on which it is developed.

C. PROFILE CHARACTERISTICS (back page of Profile Description form)

44. **Horizon symbol**: according to the FAO Guidelines (FAO, 1978) and Soil Survey Manual (USDA,1984) as follows:

Master horizons:

H an organic horizon formed or forming from accumulations of organic material deposited on the surface, that is saturated with water for prolonged periods (unless artificially drained) and contains ≥ 30 % organic matter if the mineral fraction contains ≥ 60 % clay, ≥ 20 % organic matter if the mineral fraction contains no clay, or intermediate proportions of organic matter for intermediate contents of clay.

O an organic horizon formed or forming from accumulations of organic material deposited on the surface, that is not saturated with water for more than a few days a year and contains ≥ 35 % organic matter.

A a mineral horizon formed or forming at or adjacent to the surface that either: a) shows an accumulation of humified organic matter intimately associated with the mineral fraction, or b) has a morphology acquired by soil formation but lacks the properties of E and B horizons.

E a mineral horizon showing a concentration of sand and silt fractions high in resistant minerals, resulting from a loss of silicate clay, iron or aluminium or some combination of them.

B a mineral horizon in which rock structure is obliterated or is but faintly evident, characterized by one or more of the following features:

a) an illuvial concentration of silicate clay, iron, aluminium, or humus, alone or in combinations;

b) a residual concentration of sesquioxides relative to source materials;

c) an alteration of material from its original condition to the extent that silicate clays are formed, oxides are liberated, or both, or granular, blocky or prismatic structure is formed.

C a mineral horizon (or layer) of unconsolidated material from which the solum is presumed to have formed and which does not show properties diagnostic of any other master horizons.

R a layer of continuous indurated rock. The rock of R layers is sufficiently coherent when moist to make hand digging with a spade impracticable. The rock may contain cracks but these are too few and too small for significant root development. Gravelly and stony material which allows root development is considered as C horizon.

Transitional horizons

Soil horizons in which the properties of two master horizons merge are indicated by the combination of two capital letters (for instance AE, EB, BE, BC, CB, AB, BA, AC and CR), The first letter marks the master horizon to which the transitional horizon is most similar.

Mixed horizons that consist of intermingled parts, each of which associated with different master horizons, are designated by two capital letters separated by a slash (for instance: E/B, B/C). The first letter marks the master horizon that dominates.

Letter suffixes

A small letter may be added to the capital letter to qualify the master horizon designation. Suffix letters can be combined to indicate properties which occur concurrently in the same master horizon (for example Ahz, Btg, Cck). Normally no more than two suffixes should be used in combination. In transitional horizons no use is made of suffixes which qualify only one of the capital letters. A suffix may be used, however, when it applies to the transitional horizon as a whole (for example BCk, ABg).

The suffix letters used to qualify the master horizons are as follows:

a highly decomposed organic material (sapric organic material: rubbed fiber content less than 1/6 of volume).
b buried horizon (for example Btb).
c accumulation of concretions; this suffix is commonly used in combination with another which indicates the nature of the concretionary material (for example Bck, Ccs).

e organic material of intermediate decomposition (hemic organic material: rubbed fiber content 1/6 to 2/5 of volume).
g mottling reflecting variations in oxidation and reduction (for example Bg, Btg, Cg).
h accumulation of organic matter in mineral horizons (for example Ah, Bh); for the A horizon, the h suffix is applied only where there has been no disturbance or mixing from ploughing, pasturing or other activities of man (h and p suffixes are thus mutually exclusive).
i slightly decomposed organic material (fibric organic material: rubbed fiber content more than 2/5 of volume).
k accumulation of calcium carbonate.
m strongly cemented, consolidated, indurated; this suffix is commonly used in combination with another indicating the cementing material (for example Cmk marking a petrocalcic horizon within a C horizon, Bms marking an iron pan within a B horizon).
n accumulation of sodium (for example Btn).
p disturbed by ploughing or other tillage practices (for example Ap).
q accumulation of silica (for example Cmq marking a silcrete layer in a C horizon).
r strong reduction as a result of groundwater influence (for example Cr).
s accumulation of sesquioxides (for example Bs).
t illuvial accumulation of clay (for example Bt).
u unspecified; this suffix is used in connexion with A and B horizons which are not qualified by another suffix but have to be subdivided vertically by figure suffixes (for example Au1, Au2, Bu1, Bu2). The addition of u to the capital letter is provided to avoid confusion with the former notations A1, A2, A3, B1, B2, B3 in which the figures had a genetic connotation.
w alteration in situ as reflected by clay content, colour, structure (for example Bw).
x occurrence of a fragipan (for example Btx).
y accumulation of gypsum (for example Cy).
z accumulation of salts more soluble than gypsum (for example Az or Ahz).

Letter suffixes can be used to describe diagnostic horizons and features in a profile (for example argillic B horizon: Bt; natric B horizon: Btn; cambic B horizon: Bw; oxic B horizon: Bws; mottled layers: g).

Figure suffixes

Horizons designated by a single combination of letter symbols can be vertically subdivided by numbering each subhorizon consecutively, starting at the top of the horizon (for example Bt1-Bt2-Bt3-Bt4). The suffix number always follows all of the letter symbols. The number sequence applies to one symbol only so that the sequence is resumed in case of change of the symbol (for example Bt1-Bt2-Btr1-Btr2). A sequence is not interrupted, however, by a lithological discontinuity (for example Bt1-Bt2-2Bt3).

Numbered subdivisions can also be applied to transitional horizons (for example AB1-AB2), in which case it is understood that the suffix applies to the entire horizon and not only to the last capital letter.

Figure prefixes

When it is necessary to distinguish lithological discontinuities Arabic (replacing former Roman) numerals are prefixed to the horizon designations concerned (for instance, when the C horizon is different from the material in which the soil is presumed to have formed the following soil sequence could be given: A, B, 2C. Strongly contrating layers within the C material could be shown as an A, B, C, 2C, 3C, etc. sequence).

45. **Depth (cm)**: indicate depth of top and bottom of each horizon. When the boundaries have a wavy or irregular topography, give the average depth, not two depths (e.g. 0-15 cm instead of 0-10/20 cm).

46. **Colour**: colours are described using the notations given in the Munsell Soil Color charts (Munsell, 1975); for topsoil both dry and moist colours, for the subsoil only moist colours are required.
Colours are always determined of a fresh ped surface under standard conditions of (sun-)light intensity and quality.

47. **Mottles**:

A. **Colour**: moist colour according to Munsell Soil Color charts.

B. **Abundance** of mottles:

few - mottles occupy less than about 2 % of the exposed surface
common - mottles occupy about 2 % to 20 % of the exposed surface
many - mottles occupy more than 20 % of the exposed surface

Figure 2 (page 6) can be used for estimating the percentages

C. **Size** of mottles:

fine - mottles less than 5 mm along greatest dimension
medium - mottles between 5 and 15 mm along greatest dimension
coarse - mottles are greater than 15 mm along greatest dimension

D. **Contrast** between mottles:

faint - indistinct mottles are evident and recognizable only with close examination;
soil colours in both the matrix and mottles have closely related hues and chromas.

distinct - although not striking, the mottles are readily seen;
the hue, value and chroma of the matrix are easily distinguished from those of the mottles; they may vary as much as one or two hues or several units in chroma or value; the pattern may be one or one of mixtures of two or more colours.

prominent - the conspicious mottles are obvious and mottling is one of the outstanding features of the horizon;
hue, chroma and value may be several units apart; the pattern may be one of a continuous matrix with contrasting mottles or one of mixtures of two or more colours.

E. Sharpness of mottle **boundaries**:

sharp - knife-edge boundaries between colours
clear - colour transition less than 2 mm wide
diffuse - colour transition extends over more than 2 mm

48. **Texture**: see texture triangle (figure 3) below:

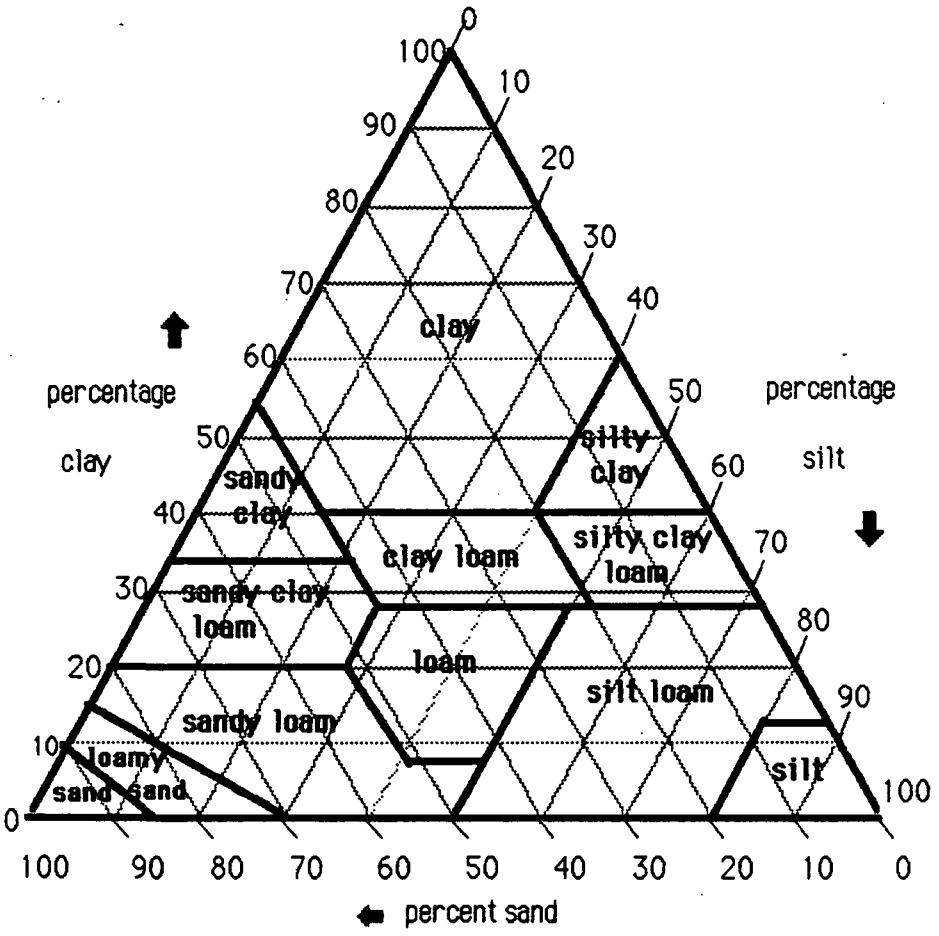


Figure 3. Textural classes (texture triangle)

The following guidelines are given for the estimation of texture in the field (after Kenya Soil Survey Guidelines):

A. Squeeze the soil in the hand

1. soil does not cohere	**sand**
2. soil just coheres	**sand**
3. soil coheres well or very well, but does not form a "worm" when rolled between the fingers	**loamy sand**

B. Roll between the fingers

I. soil tends to form a worm, but breaks during rolling

1. soil feels gritty	**sandy loam**
2. soil feels smooth, mat surface	**loam**
3. soil feels smooth, shiny surface	**silt loam**

II. soil rolls out into thin worm and if bend into a circle:

a. worm bends, but tends to break

1. gritty feel	**sandy clay loam**
2. not gritty, mat surface	**clay loam**
3. not gritty, shiny surface	**silty clay loam**

b. worm does not break

1. gritty feel	**sandy clay**
2. not gritty, mat surface	**light clay**
3. not gritty, shiny surface	**silty clay**

c. worm bends easily **clay**

49. **Gravel, Stones, Boulders**: Abundance, shape and nature of gravel, stones and boulders can be described according to the following:

A. **Abundance**: apart from indicating a volume percentage (with the use of figure 2, page 6), the following classes can be used. (These terms can be used in the final description with additional textural qualification, e.g. gravelly loam, stony clay.)

class	percentage of large particles	size of particles (largest dimension)		
		0.2 - 7.5 cm	7.5 - 25 cm	> 25 cm
1	2-15 %	slightly gravelly	slightly stony	bouldery
2	15-50 %	gravelly	stony	
3	50-90 %	very gravelly	very stony	very bouldery
4	> 90 %	gravel	stones	boulders

Table 1. Classes for gravel, stones and boulders.

B. **Shape**: can be indicated with terms like angular, rounded or flat.

C. **Nature**: the nature of the rock fragments can be described, e.g. white limestone, non calcareous shale;

also the degree of weathering can be indicated by one of the following terms:

unweathered - fragments show little or no signs of weathering

slightly weathered - partial weathering is indicated by discoloration and loss of crystal form in the outer part of the fragments, but the centers remain relatively fresh and the fragments have lost little of their original strength

strongly weathered - all but the most resistant minerals are strongly discoloured and altered throughout the fragments which tend to desintegrate under only moderate pressure

50. **Structure**:

A. **Grade**: the degree of aggregration; it expresses the difference between cohesion within the aggregrates and adhesion between aggregrates. These properties vary with the moisture status of the soil and, where possible, grade should be determined when the moisture content of the soil is "normal".

Terms for grade of structure are:

1 - **structureless** - that condition in which there is no observable aggregration or no definite orderly arangement of natural lines of weakness;
massive if coherent; **single grain** if non coherent.

2 - **weak** - that degree of aggregration characterized by poorly formed indistinct peds that are barely observable in place;
when disturbed, soil material thathas this grade of structure breaks into a mixture of few entire peds, many broken peds, and much unaggregrated material; if necessary for comparison this grade may be subdivided in **very weak** and **moderately weak**.

3 - **moderate** - that grade of structure characterized by well formed distinct peds that are moderately durable and evident but not distinct in undisturbed soil;
soil material of this structure grade, when disturbed, breaks down into a mixture of many distinct entire peds, some broken peds, and little unaggregrated material.

4 - **strong** - that grade of stucture characterized by durable peds that are quite evident in undisplaced soil, that adhere weakly to one another, and that withstand and become separated when the soil is disturbed;
when removed from the profile, soil material of this grade of structure consists very largely of entire peds and includes few broken peds and little or no unaggregrated material; if necessary for comparison this grade may be subdivided in **moderately strong** and **very strong**.

B and C. **Types and classes**: use figure 4 and table 2 (on next page).

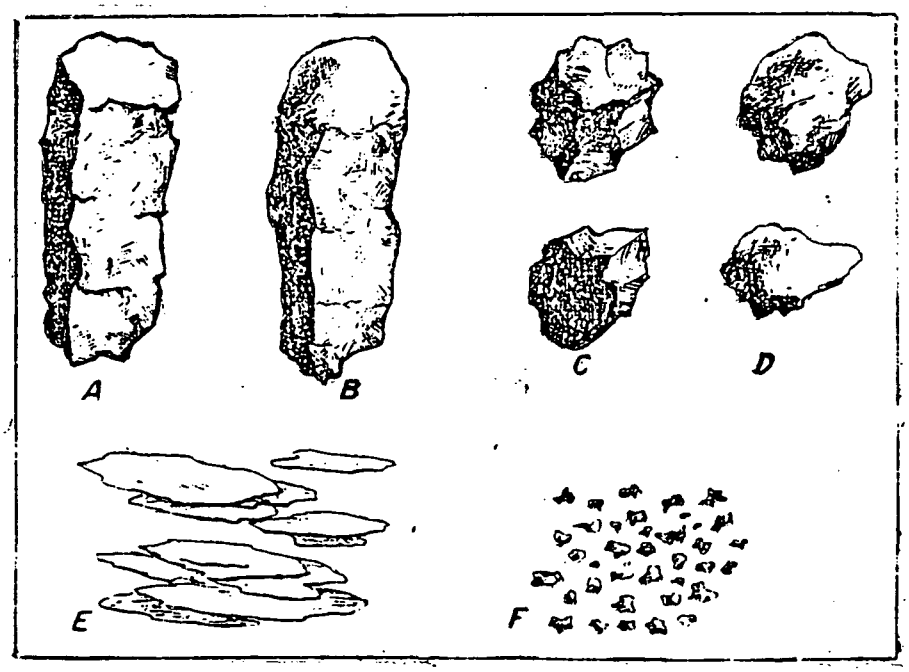


Figure 4. Drawings illustrating some of the types of soil structure: A. Prismatic; B. Columnar; C. Angular Blocky; D. Subangular Blocky; E. Platy and F. Granular.

Table 2 **Type (shape and arrangement of peds)**

Class	Plate-like with one dimension (the vertical) limited and greatly less than the other two; arranged around a horizontal plane; faces mostly horizontal	Prism-like with two dimensions (the horizontal) limited and considerably less than the vertical; arranged around a vertical line; vertical faces well defined; vertices angular		Block-like; polyhedron-like or spheroidal, with three dimensions of the same order of magnitude, arranged around a point			
				Block-like; blocks or polyhedrons having plane or curved surfaces that are casts of the moulds formed by the faces of the surrounding peds		Spheroids or polyhedrons having plane or curved surfaces which have slight or no accomodation to the faces of the surrounding peds	
		without rounded shape	with rounded shape	faces flattened; most vertices sharply angular	mixed rounded and flattened faces with many rounded vertices	relatively non-porous peds	porous peds
	Platy	**Prismatic**	**Columnar**	**Angular blocky**	**Sub-angular blocky**	**Granular**	**Crumb**
very fine or very thin	very thin platy, < 1 mm	very fine prismatic, < 10 mm	very fine columnar, < 10 mm	very fine angular blocky, < 5 mm	very fine subangular blocky, < 5 mm	very fine granular, < 1 mm	very fine crumb, < 1 mm
fine or thin	thin platy, 1-2 mm	fine prismatic, 10-20 mm	fine columnar, 10-20 mm	fine angular blocky, 5-10 mm	fine subangular blocky, 5-10 mm	fine granular 1-2 mm	fine crumb 1-2 mm
medium	medium platy, 2-10 mm	medium prismatic, 20-50 mm	medium columnar, 20-50 mm	medium angular blocky, 10-20 mm	medium subangular blocky, 10-20 mm	medium granular, 2-5 mm	medium crumb, 2-5 mm
coarse or thick	thick platy, 5-10 mm	coarse prismatic, 50-100 mm	coarse columnar, 50-100mm	coarse angular blocky, 20-50 mm	coarse subangular blocky, 20-50 mm	coarse granular, 5-10 mm	
very coarse or very thick	very thick platy, > 10 mm	very coarse prismatic, > 100 mm	very coarse columnar, > 100 mm	very coarse angular blocky, > 50 mm	very coarse subangular blocky, > 50 mm	very coarse granular, > 10 mm	

51. **Consistence**:

A. Consistence when **wet**:
Determined when the soil is at, or slightly above, field capacity

a) **Stickiness** - the quality of adhesion of the soil material to other objects; determined by noting the adherence of soil material when it is pressed between thumb and finger.

1	**non sticky**	after release of pressure, practical no soil material adheres to thumb or finger;
2	**slightly sticky**	after pressure, soil material adheres to both thumb and finger but comes off one or the other rather cleanly; it is not appreciably stretched when the digits are separated;
3	**sticky**	after pressure, soil material adheres to both thumb and finger and tends to stretch somewhat and pull apart rather than pulling free from either digit;
4	**very sticky**	after pressure, soil material adheres strongly to both thumb and forefinger and is decidedly stretched when they are separated.

b) **Plasticity** - the ability of soil material to change shape continuously under the influence of an applied stress and to retain the impressed shape on removal of the stress; determined by rolling the soil material between thumb and forefinger.

1	**non plastic**	no wire is formable;
2	**slightly plastic**	wire is formable, but soil mass easily deformable and it breaks:
3	**plastic**	wire formable and much pressure required for deformation of the soil mass, which (hardly) breaks;
4	**very plastic**	wire formable and much pressure required for deformation of the soil mass.

B. Consistence when **moist**:
Determined at a moisture content approximately midway between air-dry and field capacity, by attempting to crush in the hand a mass of soil material that appears slightly moist.

1	**loose**	non coherent;
2	**very friable**	soil material crushes under very gentle pressure but coheres when pressed together;
3	**friable**	soil material crushes easily under gentle to moderate pressure between thumb and forefinger;
4	**firm**	soil material crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable;
5	**very firm**	soil material crushes under strong pressure; barely crushable between thumb and forefinger;
6	**extremely firm**	soil material crushes only under very strong pressure; cannot be crushed between thumb and forefinger and must be broken apart bit by bit;

C. Consistence when **dry**:
Determined by attempting to break an air-dry mass between thumb and forefinger or in the hand.

1	**loose**	non coherent;
2	**soft**	soil mass is very weakly coherent and friable; breaks to powder or individual grains under very slight pressure;
3	**slightly hard**	weakly resistant to pressure; easily broken between thumb and forefinger;
4	**hard**	moderately resistant to pressure; can be broken in the hands without difficulty, but is barely breakable between thumb and forefinger;
5	**very hard**	very resistant to pressure; can be broken in the hands only with difficulty; not breakable between thumb and forefinger;
6	**extremely hard**	extremely resistant to pressure; cannot be broken in the hands.

52. **Cutans**:

A. **Quantity**:

patchy	small scattered patches of cutan on ped faces or as linings in pores, etc.;
broken	cutans which cover much but not all of ped faces or line most but not all pores, etc.;
continuous	cutans that cover peds entirely or completely line pores, channels, etc.;

B. **Thickness**:

thin	fine sand grains are readily apparent in the cutan, bridges between grains are weak, thickness microscopic;
moderately thick	fine sand grains are enveloped in the cutan and their outlines are indistinct;
thick	surface of cutan is smooth showing no outlines of fine sand grains, strong bridges between larger grains.

C. **Nature**: indicate one of the following:

humus	clay with iron oxides and hydroxides
pure clay	clay with organic matter (humus)
sesquioxides	manganese oxides or hydroxides
silica	soluble salts (carbonates, sulphates, chlorides)

D. **Location** of cutans: The location of the cutans on ped faces should be described, paying particular attention to the orientation of the peds. Thus cutan development may be much better developed on horizontal ped faces than on vertical ones. The cutans may form bridges between peds or mineral grains, or they may be confined to pores or root channels.

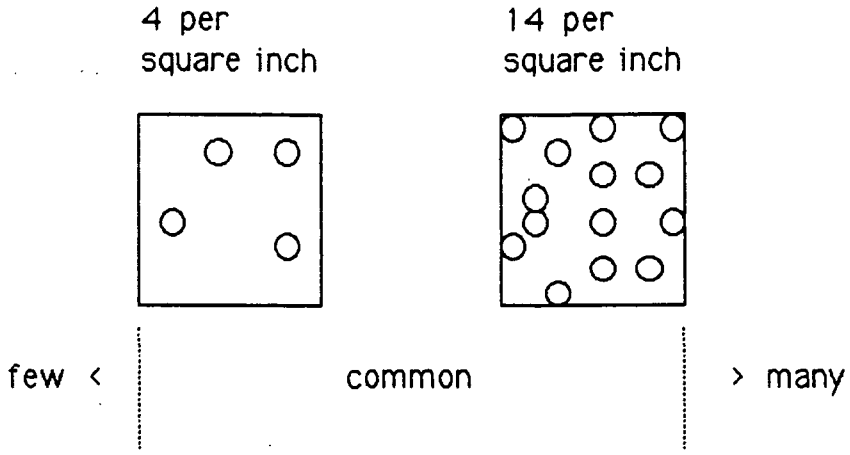
53. **Slickensides/Pressure faces**: if present, give quantity of slickensides or pressurefaces.

Slickensides: indicate size, general angle and if they are close enough to intersect.

Pressure faces: mention if they are patchy, broken or continuous (use definitions of Cutans: A. Quantity).

54. **Pores**:

A. **Abundance**:



few	1 to 50 per square decimeter (1 to 4 per square inch)
common	50 to 200 per square decimeter (4 to 14 per square inch)
many	> 200 per square decimeter (> 14 per square inch)

B. **Size**:

micro *	less than 0,075 mm
very fine	0.075 to 1 mm
fine	1 to 2 mm
medium	2 to 5 mm
coarse	5 to 10 mm
very coarse	more than 10 mm

* micro pores are present in all soils, but are difficult to observe without a microscope. Normally, therefore, they will not be mentioned in the field description.

N.B. the same size limits as for granular peds.

55. **Roots**:

A. **Abundance**: quantitative terms are difficult to define; expressions like very few, few, common, frequent, very frequent and abundant are usually adequate.

B. **Size**:

very fine	less than 1 mm diameter
fine	1 - 2 mm diameter
medium	2 - 5 mm diameter
coarse	more than 5 mm diameter

56. **Nodules**:

A. **Abundance**:

very few	less than 5 % by volume
few	5-15 % by volume
common	15-50 % by volume
many	more than 50 % by volume

The percentages can be estimated by using figure 2 (page 6).

B. **Size**:

very small	less than 0.5 cm diameter (largest dimension)
small	0.5 - 1 cm diameter (largest dimension)
large	1 - 2 cm diameter (largest dimension)
very large	more than 2 cm diameter (largest dimension)

C. **Hardness**:

soft	nodule can be broken between forefinger and thumb nail
hard	nodule cannot be broken between the fingers

D. **Shape**:

rounded	approximately equi-dimensional
cylindrical	one dimension is much greater than the other two
platelike	shaped crudely like a plate
irregular	irregular shaped

E. **Colour**: simple terms (e.g. black, white, red) are adequate.

F. **Nature**: the presumed nature of the material from which the nodule is mainly formed should be given, e.g. iron, iron-manganese, manganese, calcium carbonate.

57. **Pans/Cementation**: describe nature and hardness of pan; some examples of pans: plough pan, petrocalcic, petrogypsic, ironstone (indurated plinthite), ironpan (other than indurated plinthite), duripan, fragipan, salt pan.

For hardness the following classes can be used:

1	weakly cemented	- brittle and hard, but can be broken in hands
2	strongly cemented	- easily broken with a hammer
3	very strongly cemented	- for breakage a sharp blow with a hammer is required, hammer generally rings as a result of the blow.

58. **Biological activity**: some types of biological activity: mounds, worm channels, shells, termite channels. Indicate also the abundance of the features using: few, common, many.

59. **pH (field)**: as recorded with Hellige-pH field kit.

60. **Reaction HCl**: as measured with "cold" 10 % HCl; indicate

0	non calcareous (no visible reaction)
+	slightly calcareous (slight reaction, barely visible, but detectable with ears)
++	calcareous (bubbles in simple layer)
+++	strongly calcareous (violent reaction, foamy, bubbles in many layers)

61. **Boundary**: the boundary to the horizon below can be described with:

A. **Width**:

abrupt	boundary less than 2 cm
clear	boundary 2 - 5 cm wide
gradual	boundary 5 - 12 cm wide
diffuse	boundary more than 12 cm wide

B. **Topography**:

smooth	boundary is nearly a plane surface
wavy	pockets are wider than their depths
irregular	pockets are deeper than their width
broken	horizon boundary is not continuous (occurs when horizons are developed in separated cracks or pockets)

62. **Sample type and no.**: give number and type of sample taken for analysis.

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APPENDICES

1. Profile description form

2. Auger hole observation form

3. Example of the use of the profile description form

4. Example of the use of the Auger hole observation form

SOIL SURVEY UNIT
MINISTRY OF AGRICULTURE

PROFILE DESCRIPTION FORM

1. Observation no.: ..... / ..... / .....
2. Date: .....
3. Survey area: .....
4. Location: .....
.....
5. Parish: .....
6. Coordinates: ..... N - ..... E
7. Elevation: ..... m (..... ft.)
8. Described by: .....
.....

9. Aerial photo no.: .....
10. A.P.I. unit: .....
11. Preliminary map unit: .....
12. Final map unit: .....
13. CLASSIFICATION.
Soil Taxonomy: .....
.....
FAO/Unesco: .....
Local soil name: .....
Proposed new series: .....

14. Landform of surrounding country: .....
15. Physiographic position of site: .....
16. Slope gradient: .....% 17. Slope class: ..... 18. Slope form: .....
19. Microtopography: ..... 20. Effective soil depth: .....cm
21. Parent rock/material: .....
22. Rock outcrop: ..... % 23. Surface stoniness: ..... % 24. Surface gravelliness: ..... %

25. Drainage: .....
26. Runoff: .....
27. Depth of watertable: ..... cm
28. Dry to: ..... cm; Moist to: ..... cm
29. Flooding: .....
30. Slowly permeable layers: ..... cm; ..... cm
31. Presence salt/alkali: .....

32. Erosion: .....
33. Mass movement: .....
34. Sedimentation: .....
35. Surface sealing/crusting: .....

36. Sketch of physiographic setting:

37. Natural vegetation: .....
38. Land use: .....
.....
39. Crop performance: .....

40. Human influence: .....
41. Remarks: .....
.....
.....

42. Diagnostic horizons/other diagnostic characteristics: .....
.....

43. Short description pedogenesis/geogenesis: .....
.....
.....

44. Horizon symbol					
45. Depth (cm)					
46. Colour — dry					
46. Colour — moist					
47. Mottles — colour					
47. Mottles — abundance					
47. Mottles — size					
47. Mottles — contrast					
47. Mottles — boundaries					
48. Texture					
49. Gravel — Abundance					
Stones — Abundance					
Boulders — Abundance					
Shape					
Nature					
50. Structure — grade					
50. Structure — class					
50. Structure — type					
51. Consistence — wet					
51. Consistence — moist					
51. Consistence — dry					
52. Cutans — quantity					
52. Cutans — thickness					
52. Cutans — nature					
52. Cutans — location					
53. Slickensides/Pressurefaces					
54. Pores — abundance					
54. Pores — size					
55. Roots — abundance					
55. Roots — size					
56. Nodules — abundance					
56. Nodules — size					
56. Nodules — hardness					
56. Nodules — shape					
56. Nodules — colour					
56. Nodules — nature					
57. Pans/Cementation					
58. Biological activity					
59. pH (field)					
60. Reaction HCl					
61. Boundary — width					
61. Boundary — topography					
62. Sample type and no.					

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AUGER HOLE OBSERVATION FORM

Observation no.: ...../...../..... (year/1:12,500 toposheet/no.) Date: .....
Survey area: ..... Described by: .....
Location: ..... Parish: ..... Aerial photo no.: .....
A.P.I. Unit: ..... Preliminary map unit: ..... Final map unit: .....
Local soil name (Green Book): ..... no.: .....
Proposed (new) series: .....
USDA Soil Taxonomy: .....

Landform of surrounding country: .....
Physiographic position of site: .....

Slope form:.....	Drainage:	Erosion: .....
Slope gradient: .....%	Depth groundwater: .....cm	Mass movement: .....
Elevation: .....m.	Dry to: .....cm, Moist to: .....cm	Sedimentation: .....
Microtopography:	Flooding:	Presence salt/alkali:.....
.....	Effective soil depth: .....cm	Surface sealing: .....

Parent rock/material: .....
Rock outcrop: .....% Surface stoniness: .....% Surface gravelliness: .....%

Vegetation/land use: .....
Remarks: .....

Horizon	Depth (cm)	Colour dry	Colour moist	Mottling	Texture	Gravel Stones	Consistence dry	Consistence moist	Consistence wet	Nodules	pH	Reaction

SOIL SURVEY UNIT
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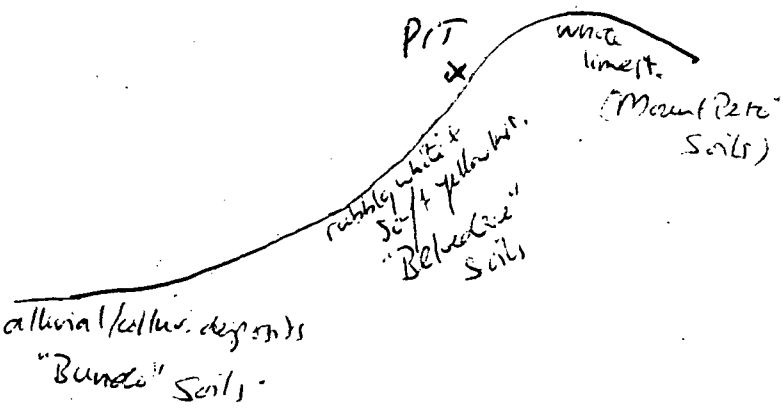
EXAMPLE

PROFILE DESCRIPTION FORM

1. Observation no.: PP / 3261 / 212
2. Date: May 26, 1982
3. Survey area: Montpelier
4. Location: Shuttlewood, near housing settlement
5. Parish: Hanover
6. Coordinates: 52498 N - 21657 E
7. Elevation: 165 m (550 ft.)
8. Described by: P. Cashman, P. Oldeman, R. Wilks
9. Aerial photo no.: 212 - 212 (1982)
10. A.P.I. unit: H.1.4
11. Preliminary map unit: H.1.2
12. Final map unit: H.1.1
13. CLASSIFICATION
Soil Taxonomy: Vertic Eutropept very fine, mixed, isohyperthermic
FAO/Unesco: Vertic Cambisol
Local soil name: Union Hill Stony Clay (75)
Proposed new series: "Belvedere"

14. Landform of surrounding country: foothills (H)
15. Physiographic position of site: toeslope of steep slope in rolling ridgelike area
16. Slope gradient: 17% 17. Slope class: e 18. Slope form: convex
19. Microtopography: animal tracks 20. Effective soil depth: 120 cm
21. Parent rock/material: mixed rubbly white and soft yellow limestones
22. Rock outcrop: 0 % 23. Surface stoniness: 1 % 24. Surface gravelliness: 2 %
25. Drainage: moderately well drained
26. Runoff: rapid
27. Depth of watertable: >120 cm
28. Dry to: — cm; Moist to: >120 cm
29. Flooding: No
30. Slowly permeable layers: >80 cm; — cm
31. Presence salt/alkali: No
32. Erosion: slight sheet erosion
33. Mass movement: No
34. Sedimentation: No
35. Surface sealing/crusting: No

36. Sketch of physiographic setting:



37. Natural vegetation: —
38. Land use: improved pasture, but hardly used
39. Crop performance: —
40. Human influence: —
41. Remarks: This soil shows many clay cracked cubic clay

42. Diagnostic horizons/other diagnostic characteristics: Vertic properties Cambic B horizon

43. Short description pedogenesis/geogenesis: Soil has developed on limestone. Penetration and some erosion (slope) inhibit much soil development

44. Horizon symbol		Ap.	AB	Bwg1	Bwg2	Bwg3
45. Depth (cm)		0 - 8	8 - 20	20 - 45	45 - 70	70 - 90
46. Colour	dry *	—	—	—	—	—
	moist	10YR 3/3	10YR 6/6	10 YR 6/6	10YR5/8	10YR5/6
47. Mottles	colour		10YR7/2	10YR7/2	10YR7/2 and 10YR5/6	
	abundance		few	few	few	v. few
	size		fine	fine	fine	fine
	contrast		faint	faint	faint	distinct
	boundaries		sharp	sharp	sharp	sharp
48. Texture		clay	heavy clay	heavy clay	heavy clay	heavy clay
49. Gravel	Abundance	very few (<1%)	v. few (<1%)	few (<2%	few (<2%	few (<2%
Stones	Abundance	—	—	few (<2%	few (<2%	common (<10%
Boulders	Abundance	—	—	—	—	—
	Shape	angular	angular	angular	angular	angular
	Nature	weath. lmst + sand	weathered lmst. + sand	weathered lmst + sand	weathered lmst. + sand	weathered lmst. + sand
50. Structure	grade	med. strong	strong	strong	strong	strong
	class	med. + fine	medium	med.	med.	medium
	type	subang. bl.	ang. blocky	ang. bl.	ang. bl.	ang. bl.
51. Consistence	wet	sticky/plastic	v. st. / v. pl.	v. st / v. pl.	v st / v pl.	v st. / v pl.
	moist	firm	firm	firm	firm	sl. friable
	dry *	—	—	—	—	—
52. Cutans	quantity					
	thickness					
	nature					
	location					
53. Slickensides/Pressurefaces		—	—	—	common sl. sides	few sl. sides
54. Pores	abundance	common	few / common	common	common	few
	size	med. + fine	med / fine	fine + v. fine	fine + v. fine	v. fine
55. Roots	abundance	common	common	few	few	few
	size	fine + med.	fine	fine	fine	fine
56. Nodules	abundance	common	common	common	common	common
	size	med. + small	med. + small	small	small	small
	hardness	moder. hard	mod. hard	hard	hard	hard
	shape	round	round	round	round	round
	colour	black	black / red brown	black / red br.	black / brown	black / red brown
	nature	Mn	Mn / Fe	Mn / Fe	Mn / Fe	Mn / Fe
57. Pans/Cementation		—	—	—	—	—
58. Biological activity		common wormcasts	common wormcasts	few wormcasts	—	—
59. pH (field)		6½	6½	6	7	8
60. Reaction HCl		0	0	0	0	+
61. Boundary	width	abrupt	gradual	gradual	gradual	clear
	topography	wavy	diffuse	irregular	irregular	irregular
62. Sample type and no.		soil hyl	2 pf A1, 2, 3	3 pf 2, 8 a	4 pf 4, 5, 6	5 -

* profile is moist throughout, so no 'dry' observations possible

(continued on next form)

SOIL SURVEY UNIT
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EXAMPLE

AUGER HOLE OBSERVATION FORM

Observation no.: [illegible] (year/1:12,500 toposheet/no.) Date: [illegible]
Survey area: Manchester Described by: [illegible]
Location: [illegible] Parish: St. James Aerial photo no.: [illegible]
L.P.I. Unit: HLx2 Preliminary map unit: HX2 Final map unit: HX1
Local soil name (Green Book): Lucky Hill Clay Loam no.: 75
Proposed (new) series: "Hazelyn"
USDA Soil Taxonomy: Aeric Tropudult, clayey, mixed, iso hyperthermic

Landform of surrounding country: foothills of limestone and shale (Cm)
Physiographic position of site: lower slope towards a depression

Slope form: concave	Drainage: Moderately well drained	Erosion: nil
Slope gradient: 12 %	Depth groundwater: >200 cm	Mass movement: nil
Elevation: 155 m.	Dry to: — cm, Moist to: 20 cm	Sedimentation: nil
Microtopography: animal tracks	Flooding: Na	Presence salt/alkali: none
	Effective soil depth: >200 cm	Surface sealing: none

Parent rock/material: alluvium / colluvium of non calc. shales and limestone
Rock outcrop: 0 % Surface stoniness: 1-2 % Surface gravelliness: 1-2 %

Vegetation/land use: unimproved pasture
Remarks: —

Horizon	Depth (cm)	Colour dry	Colour moist	Mottling	Texture	Gravel Stones	Consistence dry	Consistence moist	Consistence wet	Nodules	pH	Reaction
Ap	0-20	—	10YR 4/4	—	C	v. few gravels	~~sticky~~ plastic	firm	sticky plastic	few hard round fe + Mn	5½	0
Btg1	20-60	—	10YR 6/8	distinct 10YR 7/4 and 5YR 5/8	C	v. few gravels	—	firm	very sticky + very plastic	few hard round fe + Mn	4½	0
Btg2	60-90+	—	10YR 7/4	common distinct 5YR 5/8	C	—	—	firm	very sticky + very plastic	common hard round fe + Mn	4½	0

TECHNICAL GUIDES ISSUED BY THE JAMAICA SOIL SURVEY PROJECT

TG-1 Soil fertility assessment course (Lecture notes); R.A. Leyder and F.R. Westerhout (ed.). (March 1988, 100 pp.)
(Publication list December 1988: LM-1)

TG-2 Laboratory procedures for the Soil Survey Unit Laboratory; Laboratory Staff. (December 1988, 190 pp.)
(Publication list December 1988: LM-2)

TG-3 Explanatory notes on laboratory procedures; Laboratory staff. (December 1988, 90 pp.)
(Publication list December 1988: LM-3)

TG-4 Guide for the laboratory determination of the soil type; F.R. Westerhout. (December 1988, 8 pp.)
(Publication list December 1988: LM-4)

TG-5 Guidelines for Soil Description; P.H. Oldeman. (May 1989, 36 pp.)

TG-6 Simple checklist for Soil Taxonomy classification; P.A.M. van Gent. (April 1989, 11 pp.)

TG-7 Guidelines for writing the chapter on Land Evaluation in Soil Survey Reports; N.H. Batjes. (April 1989, 13 pp.)