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MINISTRY OF AGRICULTURE AND LIVESTOCK DEVELOPMENT

NATIONAL AGRICULTURAL LABORATORIES

KENYA SOIL SURVEY

SOIL CONDITIONS OF THE LELMOLK SETTLEMENT SCHEME

(UASIN GISHU DISTRICT)

by

V.W.P. van Engelen

SITE EVALUATION REPORT No. P74, JULY 1984

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1. INTRODUCTION

The low lying areas of the recently sub-divided Lelmolk Farm (Lelmolk Settlement Scheme) have drainage problems which make the growing of crops for a part of the subsistence farmers impossible. In order to alleviate this problem the Provincial Irrigation Unit (PIU), Rift Valley intends to install a proper drainage system. However, before such a system could be designed it was felt that more information on the soil conditions was needed. Therefore the PIU requested the Kenya Soil Survey to carry out soil investigations in the low lying areas of the scheme. A quick survey, indicating only major soil patterns with emphasis on drainage, texture and depth, would give enough information on which possible drainage improvement measures could be based.

The scheme was visited during a field trip from 18th to 21st of June, 1984. Fieldwork was executed in collaboration with Mr. F.M. Shitakha.

2. THE ENVIRONMENT

2.1 Location

The survey area is situated about 35 km south of Eldoret in Uasin Gishu District, Rift Valley Province. The coordinates of its centre are $35^{\circ}19'$E and $0^{\circ}20'$N. The settlement scheme covers about 1070 ha of which 353 ha experience drainage problems. The altitude varies between 2170 and 2225 m above sea level.

The survey area can be reached through the Cheptiret-Lessos murram road, 5 km from its junction with the Eldoret-Nakuru tarmac road.

2.2 Climate

The survey area itself has no rainfall station. Therefore the stations of Asusuriet and Farm 47, plateau have been considered as representative. The first lies about 7 km SSW and the second approximately 4 km south of the survey area. Data from these stations are presented in table 1.

Table 1. Climatic data (after Braun, 1977 and 1978, EAMD, 1946 and 1963, and Woodhead, 1968).

a) General

Station No.	Name	Coordinates	Alt. (m)	No. of years	T(°C)
89.35008	Farm 47, plateau	0°17'N,35°21'E	2200	28	15.9
89.35078	Asusuxlet	0°16'N,35°19'E	2170	38	16.1

b) Rainfall (mm)

Station No.	J	F	M	A	M	J	J	A	S	O	N	D	Year
89.35008	25	41	73	127	126	115	152	171	85	43	95	23	1077
89.35078	32	44	78	149	138	110	170	199	104	57	56	50	1187

c) Evaporation (Eo), potential evapotranspiration (Et) in mm and agroclimatic zone (r/Eo in %).

Station No.	Eo	r/Eo	Et											
			J	F	M	A	M	J	J	A	S	O	N	D	Year
89.35008	1634	66	109	109	109	98	87	76	65	76	87	87	87	98	1088
89.35078	1645	72	110	110	110	99	88	77	66	77	88	88	88	99	1100

The two stations can be considered as having similar climatic conditions. The area has a rainy season from April to August/September. Rainfall in this five months growing season is 691-766 mm while the potential evapotranspiration for that period is calculated as 402-407 mm. Without going further into details of rainfall probabilities it appears that the probability to satisfy the crop water requirement, which is estimated as 2/3 Eo, during a five months growing season is more than 95%. In other words in or average 19 out of 20 years a good harvest can be expected. This confirms the findings of Sombroek et.al.(1982), who put the survey area on the wetter side of agroclimatic zone III, a zone with a fairly low risk of failure of an adapted maize crop if soil conditions are not limiting. However, soils with poor drainage conditions (bottomlands) are affected by waterlogging during the growing season and crops fail due to lack of oxygen in the soil rooting zone.

2.3 Geology and geomorphology

The survey area is part of an extensive zone of plateau phonolites. It lies astride two major flows, in particular the Upper and the Lower Uasin Gishu Phonolites (Jennings, 1964).

The lava flows have formed vast plateaus with a gentle dip to the west.

Small rivers have cut wide, flat-bottomed valleys 10 to 15 m below the plateaus, which in places are bordered by a 1 to 2 m high escarpment. Small depressions (bottomlands) and valleys with an extremely low gradient occur in the plateaus. They are prone to waterlogging during the rainy season.

A typical relief feature of the bottomlands is the presence of rather large mounds (anthills?) of varying height and diameter. They can be up to 1 m in height and 2 to 5 m in diameter. The maximum density is 20 per ha.

3. THE SOILS

3.1 Introduction

No previous study of the soils at a reasonable detail was available. However, some information could be drawn from the "Exploratory soil map of Kenya" (Sombroek et.al., 1982). This map distinguishes two types of soils: rhodic FERRALSOLS, petroferric phase and mollic GLEYSOLS, partly petroferric phase.

During the fieldwork soils information was gathered through augerhole observations made on several transects in the bottomlands. The depth of observation was 1.2 m unless blocked by stones or rock. At some sites pH and electrical conductivity (EC) of a 1:2.5 (v/v) soil/water extract were measured.

Observations and soil boundaries were plotted on a 1:5,000 topographical map furnished by the PIU. The final map is a reduction by pantograph to a scale of 1:10,000.

Soils were classified according to the FAO-Unesco legend of their "Soil map of the World" (1974).

For a correct use and interpretation of this investigation it is important to realise that this type of survey does not allow for a comprehensive mapping of all soil characteristics. Only major soil patterns could be distinguished with rather wide ranges in certain specific soil characteristics.

3.2 Description of the soils

The various mapping units are grouped according to their physiography which is reflected by the first capital letter of the mapping unit code (for plateaus, bottomlands and alluvial valley the codes are L, B and A respectively). The second letter of the code denotes the parent material in this case I for phonolites. The numerals indicate variations within soil characteristics. P, p and m are depth class codes. For their explanation see "Key to depth classes" on appendix 1.

L Soils of the plateaus

Not much attention has been given to the soils of the plateaus as they are outside the scope of this study.

Nevertheless, in order to arrive at a soil map for the whole settlement scheme some scattered surface observations were made, completed with information derived from Sombroek et.al. (1982).

The soils of the plateaus are all developed on phonolites.

Mapping unit LIlm

Extent and slope : 720 ha, slopes between 1 and 4%. However, steeper slopes may occur at the fringes of the plateaus.

General : This mapping unit covers the greater part of the scheme. The relief is very gently undulating to undulating. Erosion is slight, mainly in the form of rain splash and rillwash, Land use is cultivation of maize, beans and some potatoes.

Soils : The soils consist of well drained, moderately deep to deep, dark red (2.5YR 3/6), friable clay over petroplinthite. The soils are classified as rhodic FERRALSOLS, petroferric phase.

Mapping unit LI2P

Extent and slope : 15 ha, slopes 1 to 4% with steeper slopes at the fringes of the plateau.

General : This mapping unit occurs just west of the Lessos-Cheptiret road where it overlies phonolitic lavas. Erosion is slight in the central part of this unit to moderate on the edges of the plateaus. Land use is mixed; the deeper soils are cultivated (mainly maize and beans) while the shallow soils are used for grazing.

Soils : The soils consist of well drained, shallow, dark red, friable, gravelly and stony clay. Rock outcrops occur as well.

B Soils of the bottomlands

All the soils of the bottomlands are developed on infill derived from phonolites.

Mapping unit BIl

Extent and slope : 8 ha, slopes less than 1%.

General : This mapping unit occupies a small area at the transition zone between the bottomlands and the alluvial

valley. The relief is flat to very gently undulating. Drainage is somewhat better than in the soils further south. Land use is cultivation of maize and beans.

Soils : The soils consists of imperfectly to poorly drained, deep, very dark greyish brown (10YR 3/2), friable to firm clay. Fine, strong brown (7.5YR 5/6) mottles occur in the surface horizon and -deeper downwards. The 20 cm thick topsoil consists of very dark grey to black (10YR 3/1-10YR 5/1) humus rich, clay loam to clay.
The soils are classified as mollic GLEYSOLS.

Mapping unit BI2p

Extent and slope : 57 ha, slopes less than 1%

General : This unit is found in the central bottomland in between the deep soils of unit BI3 and the shallow to moderately deep ones of unit BI2P. The relief is flat to very gently undulating.

Hardly any cultivation takes place and if so the results are poor. The majority of the unit is left for grazing. Carex spp. are the dominant grasses.

Soils : The soils consist of imperfectly to poorly drained, moderately deep to deep, very dark greyish brown to dark brown (10YR 3/2-10YR 4/3), friable to firm clay. Medium to coarse, strong brown mottles (7.5YR 5/6-7.5YR 5/8) occur throughout the soil and in places 1-2% ferromanganese nodules with a diameter of 2-4 mm occur. The rotten rock is met at a depth of 70 to 100 cm.
The soils are classified as eutric GLEYSOLS.

Mapping unit BI2P

Extent and slope : 195 ha, slopes less than 1%

General : This unit covers the "heads" of the bottomlands. The relief is flat to very gently undulating. The land is used for grazing althoggh efforts have been made to cultivate the deeper soils, however with poor results.

Soils : The soils of this unit are basically the same as those of unit BI2p except for soil depth. About 50% of the unit has shallow soils (soil depth less than 50 cm) with locally bedrock within 25 cm, while the rest of the unit has mode-

rately deep soils. The pH ranges between 6.0 and 6.5 in the topsoil and is about 6.5 in the subsoil. The electrical conductivity is low throughout the profile. Values of less than 0.4 mS/cm were recorded.
The soils are classified as eutric GLEYSOLS, partly lithic phase.

Mapping unit BI3

Extent and slope : 43 ha, with slopes less than 1%

General : This mapping unit occupies the lower part of the central bottomland. The relief is flat. Land is mainly used for grazing, and Carex spp. are the dominant grasses.

Soils : The soils are poorly drained and deep. They consist of very dark grey (10YR 3/1), mottled, very firm clay. Common, fine, yellowish brown mottles occur in the subsoil. The topsoil consists of 20 to 40 cm grey to very dark grey (10YR 5/1-10YR 3/1) mottled, friable clay loam. The pH varies between 6.2 and 6.6 and the electrical conductivity is less than 0.1 mS/cm.
The soils are classified as eutric PLANOSOLS.

A Soils of the alluvial valley

The soils of the alluvial valley are developed on alluvium derived from the surrounding phonolite plateaus.

Mapping unit AI1

Extent and slope : 51 ha, with slopes less than 2%

General : This unit occupies the flat to very gently undulating valley of the Kerita river at the northern side of the settlement scheme. The valley bottom lies about 5 m below the surface of the plateaus. The vegetation is grassland and the land use is exclusively grazing. Flooding can occur in the rainy season.

Soils : The soils are poorly drained and deep. They consist of greyish brown to very dark greyish brown (10YR 5/2-10YR3/2) mottled, friable to firm clay. Mottles are abundant and medium in size with a strong brown colour (7.5YR 5/8).

Light brownish grey to pale brown mottles (10YR 6/2-10YR 6/3) occur in the deeper subsoil. The soils are medium acid (pH 5.6-5.9) and non-saline (EC less than 0.05 mS/cm). They are classified as eutric GLEYSOLS.

4. CONCLUSIONS AND RECOMMENDATIONS

Table 2 resumes drainage conditions and depths of the soil mapping units.

Table 2. Drainage and depth of the mapping units

soil mapping unit	drainage	depth
LIlm	well drained	moderately deep to deep
LI2P	"	shallow
BIl	imperfectly to poorly drained	deep
BI2p	"	moderately deep to deep
BI2P	"	shallow to moderately deep
BI3	poorly drained	deep
AIl	"	"

As most of the bottomlands exhibit imperfect to poor drainage conditions crops suffer from waterlogging (asphyxia). Improvement of the soil drainage is prerequisite for any agricultural development. The fine texture (clay) does not permit the installation of a subsurface drainage system because of the expected low permeability of the soil. A solution for the -waterlogging problem could be found in the construction of a surface drainage system, whereby cambered beds and shallow drains can evacuate the excess water. Experiences elsewhere (Nyandat, pers. comm.) give an optimum width of the cambered beds of about 10 m and a maximum height of about 25 cm. The infiltration rates can only be very slightly improved by the incorporation into the soil of harvest residues, manure, etc. The workability of the soils might be another problem as they are very hard whe when dry and very sticky and plastic when wet.

The construction of more than 50 cm deep drains in unit BI2P may be impossible because of the shallowness of the soil cover over bedrock.

Taking into account the above mentioned soil constraints and the expected improvements for agriculture after the installation of cambered beds and a surface drainage system, it is considered opportune to install such a system in the bottomlands.

Improvement of the grassland quality (elimination of unwanted species) together with increased surface drainage could be another possibility for development.

5. REFERENCES

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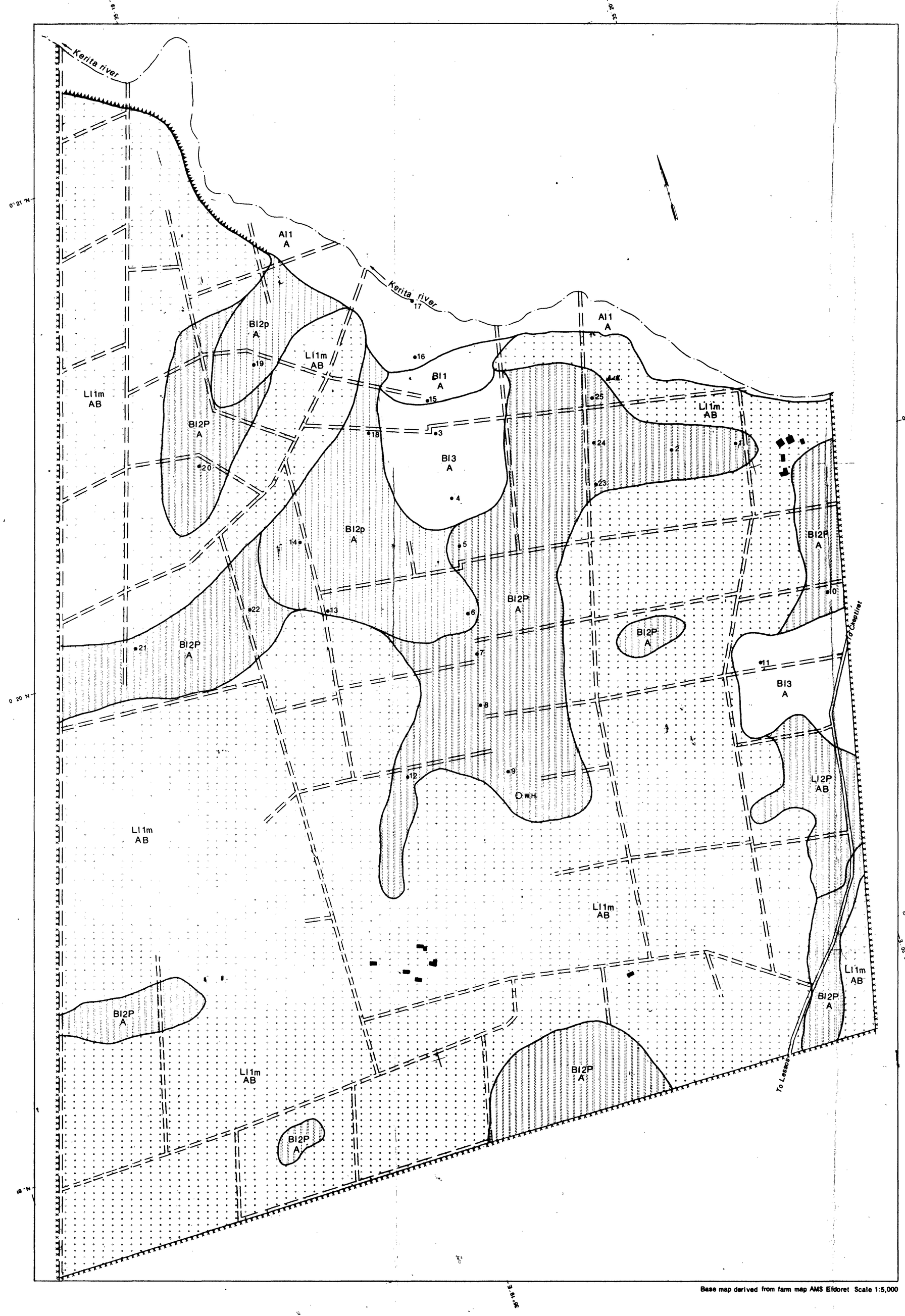
PRELIMINARY SOIL MAP OF THE LELMOLK SETTLEMENT SCHEME

Appendix 1 to report No. P 74

(UASIN GISHU DISTRICT)



Base map derived from farm map AMS Eldoret Scale 1:5,000

Scale 1:10,000

0 0.5 1 Km

LEGEND

L PLATEAUS (slopes 0–4%)

Ll Soils developed on phonolites

- Ll1m — well drained, moderately deep to deep, dark red, friable clay, over petroplinthite (murram) (inferred) (rhodic FERRALSOLS, petroferric phase)
- Ll2P — well drained, shallow, dark red, friable, gravelly and stony clay (inferred)

B BOTTOMLANDS (slopes 0- 1%)

Bl Soils developed on infill derived from phonolites

- Bl1 — imperfectly drained to poorly drained, deep, very dark greyish brown, mottled, friable to firm, clay, with a humic topsoil (mollic GLEYSOLS)
- Bl2p — imperfectly drained to poorly drained, moderately deep to deep, very dark greyish brown to dark brown, mottled, friable to firm, clay (eutric GLEYSOLS)
- Bl2P — as in Bl2p, but shallow to moderately deep (eutric GLEYSOLS, partly lithic phase)
- Bl3 — poorly drained, deep, very dark grey, mottled, very firm clay, underlying 20 to 40cm of grey to very dark grey, mottled, friable clay loam (eutric PLANOSOLS)

A ALLUVIAL VALLEY (slopes 0–2%)

Al Soils developed on alluvium derived from phonolites

- Al1 — poorly drained, deep, greyish brown to very dark grey-ish brown, mottled, friable to firm, clay (eutric GLEYSOLS)

KEY TO DEPTH CLASSES

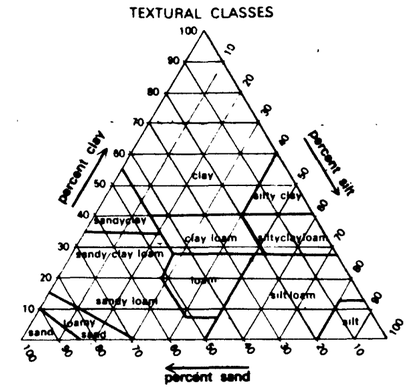
thickness soil in cm	code and symbol+ over rock	code and symbol+ over petro-plinthite	name
0-50	P		shallow
50-80	p	m	moderately deep
80-120			deep

+ *If a complex of depth classes occurs within one unit, only the code and symbol of the shallowest depth class are indicated*

KEY TO SLOPE CLASSES

slope %	slope class code	name of the macrorelief
0-2	A	flat to very gently undulating
2-5	B	gently undulating

TEXTURAL CLASSES



KEY

- soil mapping code
- Bl2P — depth class code
- A — slope class code
- soil boundary
- • 14 — augerhole, with reference number
- 1 sq cm — 1 ha
- O W.H. — waterhole
- survey area boundary
- all weather road
- farm track
- scarp
- building

SURVEY AND MAP PREPARATION 1984

soil survey ..... V.W.P. van Engelen and F.M. Shitakha

map compilation ..... V.W.P. van Engelen

map correlation ..... J.R. Rachilo

cartography ..... D.M. Olulo

Drawing No. 84068