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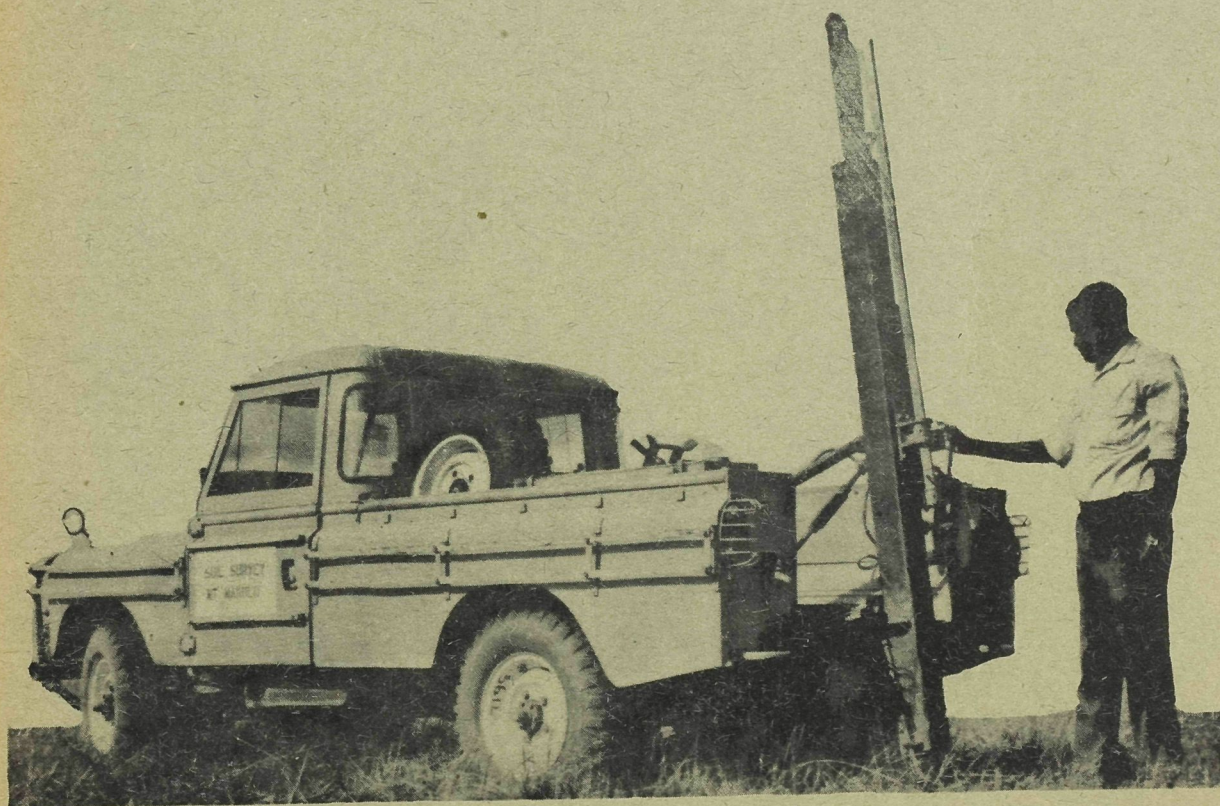


OF ZAMBIA

SOIL SURVEY REPORT No. 51

RECONNAISSANCE SOIL SURVEY OF  
CHIEF MUCHINKA'S AREA  
SERENJE DISTRICT  
CENTRAL PROVINCE

BY  
PETER WOODE



SOIL SURVEY UNIT  
LAND USE BRANCH  
DEPARTMENT OF AGRICULTURE  
1979

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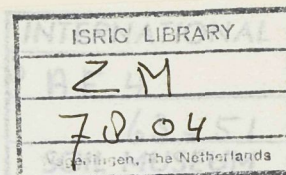
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REPUBLIC OF ZAMBIA

MINISTRY OF AGRICULTURE & WATER DEVELOPMENT

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SOIL SURVEY REPORT NO. 21

RECONNAISSANCE SOIL SURVEY OF CHIEF MACHINIST'S AREA.

SERENUS DISTRICT.

CENTRAL PROVINCE.

BY

PETER WOODS

SOIL SURVEY UNIT, KLM.

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DEPARTMENT OF AGRICULTURE.

1978



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**SUMMARY:**

A reconnaissance soil survey of 164,000 ha was carried out in the area of Chief Muchinka, Serenje District, during July - November, 1977.

The survey area is bounded to the south by the great North road, to the West by the Kasanka River, to the East by the Central Province/Northern Province boundary and to the North by the Latitude 12°44'S.

The parent rock is not constant over the area. Almost the entire area west of the Mulembo river is underlain by gneiss and schist with meta-quartzite outcrops occurring as bands, which follow a North South strike. East of the Mulembo River the parent rock is gneiss belonging to the Basement complex.

The Vegetation is secondary Miombo regrowth, following extensive Chitemene cultivation.

The soils generally have a fine loamy subsoil with a coarse loamy or sandy topsoil. West of the Mulembo River the well drained soils are generally red, whilst east of the Mulembo River the well drained soils are predominantly reddish brown. The entire area is subjected to slight sheet erosion, with a risk of more serious erosion under cultivation. The soils are strongly leached and may have a slight to moderate fertility limitation. They are strongly to very strongly acid in reaction.

Surface water is abundant, with most streams being perennial. Some potential weir sites exist with irrigation potential to adjacent arable lands.

Large tracts of unused arable lands exist. The area West of the Mulembo River is suitable for small scale farming, but less suitable for large scale farming due to frequent rock outcrops within the arable areas. The area East of the Mulembo River is suitable for large scale Commercial farming.

**ACKNOWLEDGEMENT.**

During the field work, the Kabwe Soil Survey Team was assisted by Mr. S. Chilimina (Senior Agriculture Assistant) and Mr. G. Ngosa (Agriculture Assistant), from Mount Makulu Research Station. General Workers were supplied by the Planning Section, Kabwe. The mosaics were prepared and the maps drawn by the Cartographic Section, Kabwe. Particle size and chemical analyses were carried out at Mount Makulu Research Station. The report was typed on stencils by Miss Pearlless Kalunga the help of the above persons and institutions are gratefully acknowledged.



## SUMMARY

A reconnaissance soil survey of 12,000 ha was carried out in the area of Chief Mshikha, Serenje District, during July - November, 1977.

The survey area is bounded to the south by the Great North Road, to the West by the Kasanka River, to the East by the Central Province/Northern Province boundary and to the North by the latitude 12°45'S.

The parent rock is not constant over the area. Almost the entire area west of the Mulambo River is underlain by granites and schists with metamorphic rocks occurring as bands, which follow a North-South strike. East of the Mulambo River the parent rock is granites belonging to the Basement complex.

The vegetation is secondary Miombo woodland, following extensive Chitembo cultivation.

The soils generally have a fine loamy subsoil with a coarse loamy or sandy topsoil. West of the Mulambo River the well drained soils are generally red, whilst east of the Mulambo River the well drained soils are predominantly reddish brown. The entire area is subjected to slight sheet erosion, with a risk of more serious erosion under cultivation. The soils are strongly leached and may have a slight to moderate fertility limitation. They are strongly to very strongly acid in reaction.

Surface water is abundant, with most streams being perennial. Some potential water exists with irrigation potential for adjacent arable lands.

Large tracts of unused arable lands exist. The area west of the Mulambo River is suitable for small scale farming, but less suitable for large scale farming due to frequent rock outcrops within the arable areas. The area east of the Mulambo River is suitable for large scale commercial farming.

## ACKNOWLEDGEMENT

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## INTRODUCTION.

In the Central Province proposals for the Third National Development Plan, a Catchment Conservation Plan was put forward for the area of Chief Muchinka. The area was therefore surveyed at a reconnaissance level to aid the future planning work.

The location is shown on the location map (opposite). The total area is 161,000ha.

Most of the area West of the Mulembo River was surveyed by Messrs. S. Chilimina and G. Ngosa, during July and August, 1977. The survey was carried out from a camp site at the southern tsetse control gate on the Kafinda road, and was supervised by the author. The area east of the Mulembo river was surveyed by Mr. S. Chilimina and the author between September and November, 1977, working from a camp site at Chitambo Hospital.

Access within the area was very poor, making surveying by Land Rover impossible. Few roads or even footpaths entered some areas, and all streams and dambos were carrying water even in early November.

Field work was also hampered by the use of old aerial photographs (1965) Villages had moved and paths disappeared since the photos were taken. A new flight was photographed during 1977 but were available too late for this survey.

The area gave the impression of being almost devoid of young men. However, there is apparently a drift back from the Copperbelt, with an attendant interest in the Agricultural potential of the area. The population density at the time of the survey was low. However, the recent completion of the TAZARA Railways, and the construction of the new road to Luapula Province through the area, may open up the area for development.

Present land use is restricted to subsistence Agriculture, the main crops being cassava and finger millet. The Chitemene system is used, and evidence of this is found everywhere. Late in the dry season much effort is given to collecting caterpillars for eating and for sale. Late burning is practiced to improve the supply of young leafy shoots at the optimum time for the caterpillars, resulting in poor stunted vegetation. The trees are also cut during the collection of the caterpillars, further restricting regrowth. It was noted that the area is almost devoid of termite mounds.



There is one NAMB depot at Katikulula (Chitambo) and Agriculture camps in the area are situated at Katikulula and Yoram Mwanje School. There is a good Hospital at Chitambo, and weekly clinics are held at Yoram Mwanje. There are primary schools at Yoram Mwanje, Chief Muchinka's Court, Mabonde, (near Chitambo) Kakumbi, Kasuko and Nakatambo.

Surface water is abundant, and the planning Officer has identified some weir sites with irrigation potential.

Although the area is free of tsetse fly, the outer fly gate is within the area, and to the north tsetse are found. Cattle are not raised in the area.

The soil characteristics are markedly different to the east and west of the Mulembo River. This is possibly a parent material effect. The soils to the west of the Mulembo are cut by frequent bands of quartzite outcrops. Soils near the outcrops are sandy even at depth.

## ENVIROMENT.

### 1. Location.

The area is located 25km north east of Serenje township, and is defined as follows:-

The area is bounded by the Kasanka river from 36LTA 150558 to 36LTA 985930, thence east along latitude  $12^{\circ}38'S$  to track at 36LTA 545930, then south along the track to GNR at 36LTA 586784, then south along GNR to old cut line at 36LTA 193537, and north along cut line to starting point.

### 2. CLIMATE.

The nearest meteorological station is at Serenje Township, 1547m asl and 25km SW of the survey area. The survey area lies at an altitude of between 1200m and 1440m asl. Rainfall and temperature data is also available from Chitambo Mission, within the survey area (1,2.) with an altitude of 1485m asl. Data is also included from Mpika, 130km NE of the survey area (1).

A summary of the climatological data is given in table 1.

The climate, as elsewhere in Zambia, is strongly seasonal with a long dry season from May to September. The 45 years average rainfall for Chitambo Mission was 1069mm, with 87% of the rainfall occurring between the months of December and March. The survey area lies north of the 1,000mm isohyet, and the soils reflect this, being of the "leached sand veldt" type (3,4), having a moderate fertility limitation throughout the area. Frosts may occur in June and July. It is assumed that the soils have an isohyperthermic temperature regime (4,5), based on extrapolation of results from Kabwe Regional Research Station.

The light textured soils are all subject to slight sheet erosion under existing land use, and there is a hazard of more serious erosion under more intensive cultivation. Rainfall intensity of about 60mm per hour for 30 minutes duration can be expected most years, with intensities of up to 80mm per hour for 30 minutes duration every five years (6). This, coupled with the hilly catchment in parts of the area, should lead to caution in clearing large areas for cultivation.



CHIEF MUCHINKA RECONNAISSANCE

SOIL SURVEY

Location Map

SCALE 1,500,000





TABLE 1. CLIMATOLOGICAL DATA.

Chitambo Station: Lat 12°55'S Long 30°38'E Alt. 1485m asl (Within Survey Area)  
 Serenje Station: Lat 13°15'S Long 30°15'E Alt. 1547m asl (25km SW of Survey Area)  
 Mpika Station: Lat 11°54'S Long 31°26'E Alt. 1402m asl (130km NE of Survey Area)

	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	YEAR
Rainfall mm: Chitambo	-	1	1	15	85	243	276	234	182	27	4	1	1069
Serenje	-	1	1	12	139	280	241	291	161	32	1	-	1159
Mpika	-	1	-	7	96	237	278	226	187	28	4	1	1065
Rain Days (1.0mm): Serenje	-	-	-	1	12	23	16	19	15	3	-	-	89
Mpika	-	-	-	1	8	21	19	19	13	4	-	-	85
Relative Humidity %: Serenje	60	55	49	48	67	81	84	85	81	75	66	63	68
Mpika	61	54	47	44	61	79	83	85	83	78	69	66	68
Frost Days: Serenje	4	-	-	-	-	-	-	-	-	-	1	2	7
Mpika	-	-	-	-	-	-	-	-	-	-	-	-	0
Mean Temperature °C: Chitambo	17.1	18.9	20.8	23.4	23.4	21.1	21.3	21.3	21.2	20.8	19.2	17.6	20.5
Serenje	14.8	16.7	19.6	21.8	21.0	19.9	19.7	19.5	19.4	19.1	16.6	15.0	18.6
Mpika	14.8	16.9	20.1	22.7	21.6	19.9	19.6	19.7	19.7	19.2	17.3	15.2	18.9
Mean Maximum Temperature °C: Chitambo	23.8	26.7	28.3	30.6	30.3	26.2	26.2	26.2	26.4	26.3	25.7	24.3	26.7
Serenje	22.5	24.3	27.9	30.2	28.1	25.8	26.4	25.3	25.8	25.6	24.1	22.5	25.6
Mpika	21.8	23.9	27.3	29.7	28.3	25.7	25.2	25.0	25.1	24.9	23.6	22.0	25.2
Mean Minimum Temperature °C: Chitambo	10.3	11.1	13.4	16.2	16.6	16.0	16.5	16.4	15.9	15.4	12.7	10.9	14.2
Serenje	8.1	9.1	11.9	14.2	15.7	16.0	15.9	15.9	15.5	14.1	10.6	8.3	12.9
Mpika	9.1	10.5	13.6	16.1	16.3	16.2	16.1	16.1	15.9	14.7	12.2	9.5	13.8
Sunshine Hours/day: Serenje	9.0	9.5	9.5	9.4	6.6	4.8	5.0	4.5	6.5	8.3	9.1	8.6	7.6
Mpika	8.9	9.6	9.5	9.2	6.6	4.0	4.4	4.3	5.7	8.1	9.3	9.0	7.4
Potential Evaporation mm: Serenje	115	136	171	198	165	146	140	126	152	144	127	108	1734
Mpika	121	155	189	217	171	140	140	123	143	141	127	111	1778



Sunshine hours and potential evaporation data are computed from a 10 year period (7). Rainfall exceeds evaporation for only four months of the year.

#### GEOLOGY AND TOPGRAPHY.

The area lies within the "Chitambo Concession". A map (scale 1:200,000) and report cover this concession, (8). The eastern part of the area has also recently been mapped at a scale of 1:100,000 (9).

The most prominent features in the area are the quartzite hills to the west and the north, and the frequent bands of outcrops in the west. Away from the hills the ridges are wide and flat, with the rivers following narrow, deeply incised courses. All the rivers are perennial.

West of the Mulembo river the rock is schist and gneiss with bands of fine grained sugary cross-bedded quartzite which outcrop along a north - south strike. This formation also occurs in the extreme North East corner of the survey area.

Immediately East of the Mulembo river the rock is granite - gneiss. The Northern part of this area has granite - gneiss and banded gneiss of adamellitic composition (ie containing a calcium bearing plagioclase and a potassium feldspar in roughly equal amounts). To the South the granite - gneiss is leucocratic (consisting mainly of light coloured minerals) with quartz muscovite, plagioclase, but no biotite.

The area around and to the east of Chitambo Hospital consists of microcline porphyroblastic gneiss. It is a coarse, adamellitic gneiss with microcline porphyroblasts in a ground mass of muscovite, oligoclase - ardesine, quartz and biotite.

Immediately South of Chitambo hospital, and also around the head waters of the Lunika River, areas of deformed and partly granitised quartzite occur, grading into coarse, cross - bedded grit with bands of vein - quartz conglomerate.

#### 3. VEGETATION.

The whole survey area has been under Chitemene cultivation in the past, and the Chitemene is still practiced in the area. Also, late burning is practiced over the whole area to encourage fresh growth of leaves during the growing period of the emperor moth caterpillars, which are collected for food. As a consequence, the forest is stunted and of a secondary character.



The natural vegetation is Miombo woodland (10) characterised by species of *Brachystegia*, *Julbernardia* and *Isoberlinia*. Dominant species are *Brachystegia boehmi*, *B. spiciformis*, *B. gloribunda*, *Julbernardia paniculata*, and *Isoberlinia angolensis*. Also widespread are *Afrormosia angolensis* (mubanga) and *Uapaca* species especially *Uapaca kirkiana* (Musuku).

Patches of Hill Woodland occur on the hills and outcrops, and Laka Basin Chipya vegetation occurs in small patches near the rivers.

The woodland is generally open with *Hyparrhenia* ssp dominating in the grasses.

#### SURVEY METHODS.

##### 1. In Field.

Aerial photographs at a scale of 1:20,000 were used in the field, together with 1:50,000 topographical maps. The maps and photos covering the area are:

Aerial Photos, Sereje 1965 :

Run 1	Nos 025 - 055
Run 2	Nos 087 - 119
Run 3	Nos 147 - 181
Run 4	Nos 209 - 239
Run 5	Nos 267 - 300
Run 6	Nos 330 - 358
Run 7	Nos 392 - 419
Run 8	Nos 453 - 478
Run 9	Nos 515 - 536
Run 10	Nos 577 - 586
Run 11	Nos 656 - 663

Topographical Maps, 1:50,000: 1230C1, 1230C2, 1230C3, 1230C4,  
1230A2, 1230D1, 1230D3, 1230D4.

Traverses were planned on the basis of an initial stereoscopic photo interpretation and plotted on both the photos and topographical maps. Magnetic declination was measured on site, and varied between 8.5°W (grid north to magnetic north) in the west of the area 6.5°W (grid north to magnetic north in the east of the area. The traverses did not follow a regular grid, but were planned to collect soil and land information in the most economical manner. They were usually run at approximately right angles to the drainage lines.



Navigation was by prismatic compass, and distance was measured using a cyclometer.

Augering was carried out at intervals along the traverses, using a hand barrel auger with core diameter of 8cm. Augering was carried out to a depth of 120cm wherever no limiting layer was encountered above that depth. Augering was generally carried out at regular intervals of 200m in the West of the area, and 300m in the East. However, where changes were noted between these distances, augering was carried out, and in uniform areas the distance between augering was increased up to 600m at the discretion of the surveyor. Soils were examined at 3,215 sites.

After mapping was completed on the basis of augering, 14 soil pits were dug on representative location within the mapping units. The soils were examined in detail to a depth of 150cm, or down to an impenetrable layer above that depth. 76 samples were taken for particle size analysis, chemical analyses and correlation. The location of the soil pits are shown on the traverse map, and the descriptions given as the "soil profile descriptions and analytical data", appendix 1.

## 2 MAPS.

Initial mapping was carried out under the stereoscope after the soils information gathered in the field had been plotted on the aerial photographs. A mosaic was prepared from the air photographs and the boundaries were transferred to this by eye. The resulting photo map was reduced to scale of 1:50,000 and the boundaries transferred to a base map prepared from the topographical sheets.

## 3. MAP RELIABILITY.

The hilly nature of the country, the rather poor flight characteristics of the air photos, and the preparation of an uncontrolled mosaic led to errors in the mosaic. However these are not very serious at the reduced scale.

Each augering represents about 54ha, but reliability is enhanced by the well defined catenas and the fact that traverses were planned to cross catenas as much as possible. However, much of the mapping relied on photo-interpretation, especially in the North east and in the South West, where access was difficult and hills plentiful. The maps are an indication of predominant soil or land capability units.



For project or farm planning, areas of apparently good potential may be selected from the maps, for subsequent further investigation at a semi detailed level.

## SOILS.

### 1. RELATION TO TOPOGRAPHY AND GEOLOGY.

The survey area falls into two sections. the boundary being roughly along the Mulembo River. To the West of the Mulembo river the bedrock is schist and gneiss, cut by bands of meta - quartzite outcrops, following a north-south strike. In this area the dominant well drained soils are red. Close to the outcrops the texture becomes lighter in the control section, becoming sand or loamy sand at 120cm next to the outcrops. The south west of this area is mainly hills. The ridges are flat (slopes less than 3%) with deeply incised streams. The well drained soils frequently extend to within 100 metres or less of the dambos. Slope breaks beside the dambos usually coincide with bands of quartz and laterite gravel.

East of the Mulembo River the bedrock is mainly granite-gneiss. The soils here are generally reddish brown in colour. Outcrops are usually absent except close to the hills. The ridges are flat. The dambo heads are fringed with a light brownish grey, imperfectly drained, loamy sand soil, not found to the west of the Mulembo River.

### 2. EXPLANATION OF MAPPING UNITS.

Eight mapping units were used, four of them being subdivided into two depth phases. The mapping units correspond with those used in soil survey Report No. 33 (Mutale/Kabundi area) (11). As some of the soils found at Mutale/Kabundi were not found in Muchinka, and some new soils were found in Muchinka, the numbering of the mapping units is not consecutive.

The mapping units are generally associations the soil names given referring to the dominant soil in the unit. The units are separated on the basis of drainage, texture and colour.

The dominant well drained soil west of the Mulembo is mapping unit 12a possibly a Kasama loamy sand. Close to the rock outcrops the texture becomes lighter and mapping unit 7 occurs. Frequently the area of this unit is too small to map.

East of the Mulembo River the dominant soil is mapping unit 1a, Mutumbi series). Piedmont soils occurring in this area have also been mapped. as mapping unit 7.



All hills, large outcrops and extensive / shallow soils not obviously shallow phases of other units, have been mapped as mapping unit 9.

The soils of the area have predominantly loamy sand or sandy loam topsoils, and the few soils occurring with sandy clay loam topsoils have been included in mapping units 1a (yellowish red) and 12a (red).

All moderately well drained soils have been mapped as mapping unit 2. This unit is predominantly a brownish yellow sandy clay loam soil with a sandy loam topsoil. A few heavier moderately well drained soils have been included in the same unit. Two imperfectly drained soils were identified. Mapping unit 6 is common throughout the area, being a pale brown sandy clay loam or sandy loam soil. It occurs along dambo and river fringes. Mapping unit 14 occurs almost exclusively to the east of the Mulembo River, either as extensive units or around dambo heads. It is a deep, light brownish grey loamy sand soil, with a distinctive white pattern on the aerial photographs.

Very little investigation was made of the dambos, and all poorly and very poorly drained soils are included in mapping unit 13. Mapping unit 5 (Soil Survey Report No.33) was not mapped separately but occurs within mapping Unit 13.

Depth phases are given the suffix a for soils with an effective depth of more than 60cm, and b for soils with an effective depth of less than 60cm. (See Appendix 3).



### 3. DESCRIPTION OF INDIVIDUAL MAPPING UNITS.

#### Mapping Unit 1a. MUTUMBI sandy loam (43900 ha)

Deep to moderately deep, well drained, yellowish red (5YR5/8) to strong brown (7.5YR5/8) sandy clay loam soil. Topsoil textures are predominantly coarse loamy but may be sandy or loamy. The soils are located on crest, upper or middle slope sites. Mapping unit 7 may occur as an inclusion (20%).

Profiles CEP 1/77, CEP 3/77, CEP 11/77, CEP 12/77 and CEP 16/77 are representative.

#### Generalised profile description:

- 0-5cm Dark brown sandy loam with weak crumb structure.
- 5-15cm Dark brown or yellowish red sandy loam with weak subangular block structure.
- 15-40cm Yellowish red sandy clay loam with weak subangular block structure.
- 40-150cm Yellowish red sandy clay loam with weak subangular blocky structure. Laterite gravel occurs which may be medium in size and hard at the bottom of the profile.

Typical LUB code: 1/2-BCCC - -  
AE<sub>1</sub>-(5YR5/8)GR

Typical Land Capability Classification: S2c., S2de

This unit is well suited for rainfed crops of maize, millet, sorghum, beans (including soya), sunflower, cassava, and virginia tobacco. It is well suited for most crops under irrigation. For wheat production it is moderately well suited for both rainfed and irrigated crops.

Mapping Unit 1b. (14,500ha) is similar to Mutumbi sandy loam but is moderately shallow to shallow.

Typical LUB code: 3 - BC - - - g  
AE<sub>1</sub>-(5YR4/8)GR

Typical Land Capability Classification: S3de, Gde

#### Mapping Unit 2a. MUTALE sandy loam. (9,600 ha)

Deep to moderately deep, moderately well drained, yellowish red (7.5YR6/6) to brownish yellow (10YR6/6) sandy clay loam soils with coarse loamy topsoils. Occurs on lower slopes, sometimes in association with mapping unit 6a, and with inclusions (20%) having fine loamy topsoil.

Profiles CEP 6/77 and CEP 13/77 are representative.

#### Generalised profile description:

- 0-10cm Dark brown loamy sand to sandy clay loam with weak crumb structure.
- 10-60cm Reddish yellow or yellowish brown sandy clay loam with weak subangular block structure.



60-100cm Reddish yellow or yellowish brown sandy clay with weak subangular blocky structure, few distinct yellow mottles and few fine gravels.  
100-150+cm As above with many coarse laterite gravels.

Typical LUB code: 1(10)BCEE - -  
AE<sub>1</sub>W<sub>1</sub>(10YR5/8)-

Typical Land Capability Classification: S2we , S2dw

This unit is well suited for rainfed crops of finger millet, beans (including soya), and cassava. It is moderately well suited for most other crops except groundnuts, potatoes and citrus.

Mapping Unit 2b. (12,100 ha) is similar to Mutale sandy loam but is moderately shallow to shallow.

Typical LUB code: 3(10)BC- - g  
AE<sub>1</sub>W<sub>1</sub>(10YR5/8)-

Typical Land Capability Classification: S3dw , Gdw

Mapping Unit 6a. TEKETEKE sand. (4,700 ha)

Deep to moderately deep, imperfectly drained grey (10YR6/1) to pale brown (10YR6/3) coarse loamy soil with a fine loamy lower subsoil. The topsoil may be sandy. The soil occurs in association with mapping unit 14 on lower slopes, and has inclusions (20%) having fine loamy topsoil.

Profile CEP 14/77 is representative.

Generalised profile description:

0-30cm Greyish brown structurless sand.  
30-70cm Light yellowish brown loamy sand with weak massive structure and common distinct brownish yellow mottles.  
70-100cm Brownish yellow sandy clay loam with weak subangular blocky structure and common distinct reddish yellow mottles  
100-150cm Brownish yellow sandy clay with weak subangular blocky structure, many pronounced red mottles and many iron concretions.

Typical LUB code: 1 - - AXGC - -  
AE<sub>1</sub>W<sub>2</sub>(10YR6/3)-

Typical Land Capability Classification: S3wt

This unit is moderately well suited for the production of cassava, but other crops are not recommended.

Mapping Unit 6b. (3,100 ha) is similar to Teketeke sandy but is moderately shallow to shallow.

Typical LUB code: 3 - - XB- - g  
AE<sub>1</sub>W<sub>2</sub>(10YR6/3)-

Typical Land Capability Classification: S3dw , Gdw



Mapping Unit 7. (2,000 ha)

Deep to moderately deep, well drained to somewhat excessively drained, red (2.5YR4/8) or reddish brown (5YR4/4) sandy piedmont soils. Located close to the quartzite ridges.

No profile was dug in this unit.

Typical LUB code: 1 - AAXX - -  
BE<sub>1</sub>-(2.5YR4/8) Sg

Typical Land Capability Classification: S3te , S4te

This unit is moderately to poorly suited for the production of virginia tobacco, but other crops are not recommended.

Mapping Unit 9. (14,800 ha)

Extensive shallow soils or large outcrops and hills. The soils are usually well drained. Soil depth is less than 30cm. The soil is generally unsuitable for agricultural purposes, or suitable only for summer grazing.

Typical Land Capability Classification: Gdr, Ur

Mapping Unit 12a. KASAMA sandy loam/sand clay loam. (19,700ha)

Deep to moderately deep, well drained red (2.5YR4/6) fine loamy soil with coarse loamy topsoil. May occur associated with bands of sandstone outcrops 100-200metres apart, with a sandy loam textured control section next to the outcrops. Mapping unit 7 occurs as an inclusion close to the outcrops. KABUNDI sandy loam (11) occurs in association with this unit.

Profiles CEP2/77 and CEP5/77 are representative.

Profile CEP15/77 is representative of KABUNDI sandy loam

Generalised profile description:

0-9cm	Dark reddish brown sandy loam with weak crumb structure.
9-40cm	Dark red sandy clay loam with weak subangular blocky structure.
40-80cm	Dark red sandy clay loam with weak to moderate subangular blocky structure.
80-150+cm	Red sandy clay loam with weak to moderate subangular blocky structure and few fine gravels.

Typical LUB code: 1(10) BCCC - -  
AE<sub>1</sub>-(2.5YR4/6) SF

Typical Land Capability Classification: S2e , S2de

This unit is well suited for rainfed crops of maize, millet, sorghum, beans (including soya), sunflower, cassava, and virginia tobacco. It is well suited for most crops under irrigation. For wheat production it is moderately well suited for both rainfed and irrigated crops.



Mapping Unit 12b. (13,600 ha) is similar to Kasama sandy loam but is Moderately shallow to shallow.

Typical LUB code: 3(10)BC - - - g

AE<sub>1</sub>-(2.5YR4/6)SF

Typical Land Capability Classification S3de . , Gde

Mapping Unit 13. (17,900 ha)

Association of poorly to very poorly drained (dambo) soils. Clours are pale brown or greyish brown with predominantly coarse to fine loamy textures in the control section, and sandy topsoils. shallow soils with scattered rock outcrops occur as inclusions. Mapping unit 5 of soil Survey Report No.33 is found within this association, but was not mapped seperately.

Profiles CEP 13/77 and CEP 18/77 are examples of soils in the unit.

Generalised Profile Descriptions:

- |         |   |
|---------|---|
| 0-10cm  | Very dark grey sandy loam with weak crumb structure and common distinct yellowish red mottles.                  |
| 10-60cm | Light brownish grey sandy loam with weak massive structure and common distinct yellowish red mottles.           |
| 60-90cm | Light brownish grey sandy clay with weak subangular blocky structure and many distinct yellowish brown mottles. |
| 90+cm   | Grey sandy clay loam and as above.  |

Typical LUB code: 1(10) BBDE - -

A-W<sub>3</sub>(10YR6/2)

Typical Land Capability Classification: GW

The dambo soils are suitable for winter grazing. They could be improved by the planting of torpedoo grass. Rice production may be possible but the dambos would have to be further investigated for this.

Mapping Unit 14. (5,000 ha)

Deep imperfectly drained pale yellow (2.5Y5/6), sandy soil with sandy topsoil, occuring on dambo fringes, especially at dambo heads.

Profile CEP 4/77 is representative.

Generalised profile description:

- |         |  |
|---------|--|
| 0-15cm  | Dark greyish brown structurless sand.  |
| 15-35cm | Greyish brown sand with weak massive structure and few distinct reddish brown mottles.   |
| 35-80cm | Light olive brown sand with weak massive structure and common distinct reddish yellow mottles.   |
| 80-120  | Brownish yellow sand with weak subangular blocky structure, common distinct strong brown mottles and few fine gravels.   |
| 120+cm  | Brownish yellow loamy sand with weak subangular blocky structure, many pronounced red mottles and few fine and coarse gravels. Boundary to weathering sandstone. |



Unit 14 Cntd.

Typical LUB code: 1 - AAAX --  
 AE<sub>1</sub>W<sub>2</sub>(2.5Y5/6)SF

Typical Land Capability Classification: S3tw , S4tw

This Unit is suitable for winter grazing. Virginia tobacco and cassava could be grown, but the soil is poorly suited.

#### 4. CHEMICAL AND PHYSICAL PROPERTIES OF THE SOILS.

Some average chemical parameters are given in table 2 for the two well drained associations (units 1a and 12a), and the moderately well drained association (unit 2a). It can be seen that 12a is more acidic than 1a, with an associated lower base saturation percentage. Mutumbi sandy loam (unit 1a) is the best Agricultural soil in the survey area, although it has a low level of organic carbon in the topsoil and a low cation exchange capacity.

Unit 2a (moderately well drained) is similar to unit 1a, but more acid.

All the soils in the area have a low cation exchange capacity due to leaching ~~fr~~<sup>m</sup> high rainfall. An oxic B horizon is usually present.

TABLE 2. Average Chemical Data for Three Soils.

Mapping Unit.	Organic C%	Base Sat. %	pH	CEC/100g clay.
1a top (A)	0.80	82.5	5.3	-
1a sub (B2)	-	56	5.1	9.7
12a top (A)	0.86	43	4.7	-
12a sub (B2)	-	25	4.2	12
2a top (A)	0.66	97	5.4	-
2a sub (B2)	-	51	4.6	12

The soils generally have a weak, fine, subangular blocky structure. They are porous and friable with no hindrance to root penetration, and a moderate permeability. All the soils suffer from slight sheet erosion, and under cultivation this could become severe unless soil conservation measures are undertaken.

#### LAND CAPABILITY CLASSIFICATION.

Land capability classification (12) was carried out and the land capability map drawn separately to the soils map. The distribution of land capability classes is given in table 3.



The LUB land classification system is designed to indicate the relative suitability of land for rainfed medium and large scale commercial farming. For arable land, maize, tobacco and, to a lesser extent, soya beans, sunflower and groundnuts are the main crops considered; use of ox or tractor cultivation, adequate use of fertilizers, pesticides and weed control measures are assumed, together with a high level of management or technical supervision, which will ensure that the land does not deteriorate under arable use. For non arable land, it is assumed that grazing will be the major use, and that this will be practiced in such a way that the land does not deteriorate, whether under intensive or extensive grazing management.

A summary of the LUB code and land capability classification for dry-land and irrigated crops is given in appendix 3.

#### CROP SUITABILITY CLASSIFICATION.

In table 4 the various land capability classes are listed according to their crop suitability rating (13). The table includes crops considered most suitable for the area, but absence of a crop from the table should not be taken as an indication of unsuitability.

The rating is based on the assumption that the crops will be grown at an average level of management. It is important to realise that most crops are tolerant of a wide range of soil conditions. Crop yields depend greatly on management, and good crops can sometimes be obtained from poor soils in years with favourable weather.

The soils are divided into four suitability classes as follows:

##### Suitability class 1, well suited:

Under good management the crop grows well and can produce high yields. For the crop under consideration, the soil has favourable physical properties, has a moderate fertility level and is responsive to good management.

##### Suitability class 2, moderately suited:

Under good management the crop grows moderately well or is subject to occasional hazard or failure, or requires extra effort (expenditure) to produce high yields. The soil may have somewhat low fertility level, or the response to management may be low.

##### Suitability class 3, poorly suited:

The crop will either not grow, it will produce poor yields, or it will be subject to great hazard or failure. The soil has unfavourable physical or chemical characteristics that can not easily be amended, or occurs in an unfavourable climatic environment for the crop. Response to management is low.

##### Suitability class 4, not suited:

The crop will not grow or will grow only after expensive land improvements (such as drainage). The crop cannot be recommended for cultivation.

The crop suitability ratings are based on recommendations in Technical Guide No 7 (2) and Land Use Planning Guide, Chapter 2 (12).



Table 3. DISTRIBUTION OF LAND CAPABILITY CLASSES.

(Area covered by 1:50,000 sheets 1230C4 & 1230D3).

LAND CLASS	SHEET 1230C4		SHEET 1230D3		TOTAL AREA		LAND TYPE
	ha	%	ha	%	ha	%	
S2e	23,400	34	25,300	40	48,700	37	ARABLE LAND.
C2e	100	-	1,300	2	1,400	1	
S2de	1,800	3	-	-	1,800	1	
S2w	3,400	5	4,200	7	7,600	6	
S3d	1,600	2	2,200	3	3,800	3	MARGINAL ARABLE LAND.
S3w	3,000	4	2,200	3	5,200	4	
S3re	600	1	-	-	600	$\frac{1}{2}$	
S3te	100	-	300	1	400	$\frac{1}{2}$	
S3tw	-	-	2,200	3	2,200	2	
S4tw	1,100	2	1,500	2	2,600	2	GRAZING LAND.
Gdr	13,800	20	7,400	12	21,200	16	
Gdw	5,800	9	4,800	8	10,600	8	
Gw	5,300	8	8,600	13	13,900	10	
Ur	8,000	12	4,100	6	12,100	9	UNSUITABLE LAND.
TOTAL	68,000	100	64,000	100	132,000	100	-



**TABLE 4.** Crop Suitability Ratings for Chief Muchinka's area.

Crops:	S2e	S2d	S2w	S3d	S3t	S3w	S4t	C2e	C2d	C2w	C3d	C3w
<u>Rainfed crops:</u>												
Maize	1	2	2	3	3	3	4	1	2	2	3	3
Wheat	2	2	2	4	4	3	4	2	2	2	4	3
Bulrush millet	1	1	2	3	2	3	3	1	1	2	3	3
Finger millet	1	1	1	2	2	3	3	1	1	1	2	3
Sorghum	1	1	2	3	2-3	3	3	1	1	2	3	3
Groundnuts	2	2	3	4	3	3	4	2	3	3	4	4
Soya beans	1	2	1	3	3	3	4	1	2	1	3	3
Beans	1	2	1	3	3	3	4	1	2	1	3	3
Sunflower	1	2	2	3	3	3	4	1	2	2	3	3
Cassava	1	1	1	3	2	2	3	1	2	3	3	3
Potatoes & tomatoes	3	3	3	3	4	4	4	3	3	3	3	4
Other Veg.	2	2	2	4	4	3	4	2	2	2	4	3
Bananas	2	2	2	3	4	3	4	2	2	2	3	2
Citrus	2	2	3	3	3	4	4	2	2	3	3	4
Virginia Tobacco	1	2	2	3	2	3	2-3	2	2	3	3	4
<u>Irrigated crops:</u>												
Wheat	1-2	2	2	3-4	4	3	4	1-2	2	2	3	3
Potatoes & tomatoes	1	2	2	3	3	3	4	1	2	2	3	3
Other Veg.	1	2	2	3	3	3	4	1	2	2	3	3
Bananas	1	2	2	3	3-4	3	4	1	2	2	3	2-3
Citrus	1	2	2	3	3	4	4	1	2	2-3		4
Coffee	1	2-3	2	3-4	3-4	3-4	4	1	2-3	2-3	3-4	3-4



DEVELOPMENT POTENTIAL AND LAND USE.

The development potential of the area is high, providing problems related to the remoteness from supplies and markets can be overcome. The area to the west of the Mulembo River is ideal for the expansion of small scale agriculture.

The land south of Yoran Mwanje School, between Kapondo hill and the Musola river offers potential for irrigation. Two good weir sites were located at UTM coordinates 143756 and 139766 on Map 1230 C4, along the Musola River, which could supply this area by gravity flows.

The rest of the area to the west of the Mulembo River is not recommended for large scale agriculture due to the occurrence of frequent outcrops, making the planning of large fields difficult.

East of the Mulembo River there is a very large tract of land centred around UTM coordinate 3585 on Map 1230D3 is unused and uninhabited, and contains over 4,000ha of mapping unit 1a (S2 e ). This could probably be subdivided into small commercial farm units.

A self - help road has been constructed from Chief Muchinka's Court to Chitambo Hospital. However, it lacks bridges across the Mulembo, Kankutu and Kansansya, and could benefit from slight re-routing, grading, and the provision of mitre drains. Improvement of this road would reduce the existing 50KM trip from Muchinka Court to Chitambo Via the Great North Road, to a 20KM distance. It would also, with the construction of feeder roads en route, open up the unused arable lands it passes through.



**GLOSSARY.**

- Arenaceous rocks.** Medium-grained sedimentary rocks, dominantly made up of grains of sand size, ie 0.1-2mm diameter.
- Association.** A group of two or more related soils with similar drainage, parent material, and position.
- Basement complex.** Precambrian (older than 450million years) complex of igneous and metamorphic rocks.
- Catena.** A sequence of soils of about the same age, derived from similar parent material and occurring under similar climatic conditions, but having different characteristics due to variations in topography and drainage.
- Chitemene cultivation.** Cultivation restricted within a larger clearing to patches on which chopped branches and trunks have been collected and burnt. After a few years cultivation the land is allowed to revert to bush.
- Control section.** That part of the soil profile which in deep soils lies between 25 cm and 100 cm.
- Dambo.** A low lying, gently sloping treeless tract of country which is seasonally waterlogged by seepage from surrounding high ground assisted by rainfall, and which frequently contains the natural drainage channel for the removal of excess surface run-off.
- Effective depth.** The thickness of soil available for satisfactory root development.
- Erosion class.** Visible evidence of erosion at or in the vicinity of the sampling point is assessed as slight, moderate or severe.
- Fertility limitation.** Fertility is regarded in the Land Capability system when the soil fails to respond to normal farming practices (fertilizer, manure, lime etc) due to inherent chemical properties.
- Gneiss.** A coarse grained rock in which granular minerals (quartz, feldspars, garnets etc.) alternate with bands in which schistose minerals (mica, chlorite, amphibole etc.) predominate. The rock splits normally in slabs more than 10 cm thick.
- Gravel.** Rock particles measuring from 0.2cm to 7.5cm in diameter.
- Hindrance to cultivation.** Gravel, stones, boulders, rock or laterite outcrops occurring within 20cm of the soil surface, or termite mounds, in sufficient quantities to hinder or prevent normal agricultural cultivation practices.



Igneous rocks.	Rocks which have been formed by the consolidation of molten rock material.
Inclusion.	Soils which cover less than 20% of the area of a mapping unit.
Isohyperthermic temperature regime.	The mean annual soil temperature is 22°C or higher and the difference between mean summer and mean winter soil temperature is less than 5°C at 50cm or at a lithic or paralithic contact, whichever is shallower.
Land Capability classification.	The system used in Zambia to indicate the relative suitability of the land for rainfed medium and Large scale commercial farming. It assumes ox or tractor cultivation and a high level of management.
Laterite.	A highly weathered material rich in secondary oxides of iron, aluminium or both. It is nearly devoid of bases and primary silicates, but it may contain large amounts of quartz and kaolinite. It is either hard or capable of hardening on exposure to wetting and drying.
Leaching.	The removal of material <sup>in/</sup> solution from the soil.
Limiting material.	Rock, laterite, gravel, hardpan, etc., which is limiting to crop root development.
LUB code.	"Land Use Branch code." A short hand code used to record the various soil and land characteristics observed in the field.
Magnetic declination.	The difference between magnetic north (the direction a compass points) and true north (the direction of the north pole), or between magnetic north and grid north (the direction of the vertical grid lines on topographic maps).
Mapping unit.	Each separate soil or association of soils shown on the map and identified by a symbol.
Matrix	Material within which large particles are embedded.
Metamorphic rocks.	Sedimentary rocks which have been altered by earth movements and/or molten material.
Metaquartzite.	A metamorphosed arenaceous rock in which the constituent grains have recrystallised and developed an interlocking mosaic texture, with little or no trace of cementation.
Miombo woodland.	A two-storeyed woodland with an open or partially closed canopy of semi-evergreen trees 15-20m high, characterised by species of Brachystegia, Isoberlinia, Julbernardia and Marquesia. The forest floor is covered by a more or less dense cover. Most Miombo woodland is secondary regrowth.
Mosaic.	A Composite photographic representation of an area made up from individual aerial photographs.



Mottling.	Spots of different colour or shades of colour interspersed with the dominant soil matrix colour.
Parent material.	The unconsolidated and more or less chemically weathered mineral or organic matter from which soil is developed.
pH.	A measure of the acidity or alkalinity of the soil.
Physiographic position.	Position within the relief of an area.
Psammite.	Metamorphic arenaceous rocks.
Reconnaissance survey.	A survey where each field recording represents from 45ha to 150ha, and mapped at a scale of from 1:50,000 to 1:100,000. Can be used for general area planning and feasibility studies, but not for project or farm planning.
Slope break.	The position where either a change in steepness of slope or form of slope takes place. Often corresponds with a change in soil characteristics.
Soil boundary.	The division between two soil types in the field. It is often diffuse as there is usually a zone of transition between two soil types.
Soil colour.	The dominant colour of the soil in any given horizon, measured on Munsell standard colour charts. For land capability classification the colour is taken of moist soil at 50cm deep.
Soil horizon.	A layer of soil, approximately parallel to the soil surface, with distinct characteristics produced by soil forming processes.
Soil profile.	A vertical section of the soil through all its horizons.
Soil series.	The basic unit of soil classification, consisting of soils which are essentially alike in all major profile characteristics, except the texture of the surface horizon and depth of the soil.
Strike.	The direction of the general trend or run of geological or topographic features.
Structure.	The combination of primary soil particles into units or peds, which are classified on the basis of shape, size and distinctness.
Texture.	The relative proportions of different sized groups of soil grains.
Thermic temperature regime.	Soils with 5°C or more difference between mean summer and winter temperatures at 50cm depth, and with mean annual soil temperature of 15-22°C.
Topographic map.	Map showing the physical features of an area, especially the relief and contours of the land.



Topsoil.	The upper 20-25cm of the soil profile, with concentration of living and dead organic matter. (may be thinner if erosion is severe).
Ustic moisture regime.	In 7 or more years out of 10 the moisture control section (30-90cm in sands and loamy sands, 10-30cm in finer textured soils) is dry in some or all parts for more than 90 days (cumulative), but is not dry in all parts for more than half the year.
UTM coordinates.	Grid references given in the Universal Transverse Mercator system, as used on the 1:50,000 topographic maps used in Zambia.
Wetness class.	The degree of wetness within the rooting range during the rainy season (the growing season). A poorly drained soil will remain fully or partially waterlogged in the root region for long periods. This restricts the ammount of air around the roots, and results in poor crop growth. Four wetness classes are defined in the land capability system.



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SOIL PROFILE DESCRIPTION AND LABORATORY DATA.

APPENDIX 1.

Profile	Soil Name:	Mapping Unit:	Page:
CEP 1/77	Mutumbi Sandy Loam	1a .....	25
CEP 2/77	Kasama Sandy Clay Loam	12a .....	27
CEP 3/77	Mutumbi Sandy Loam	1a .....	29
CEP 4/77	Un-named lower slope soil	14 .....	31
CEP 5/77	Kasama Sandy Loam	12a .....	33
CEP 6/77	Mutale Sandy Loam	2a .....	35
CEP 11/77	Mutumbi Sandy Clay Loam	1a .....	37
CEP 12/77	Mutumbi Sandy Clay Loam	1a .....	39
CEP 13/77	Mutale Sandy Loam	2a .....	41
CEP 14/77	Teketeke Sand	6a .....	43
CEP 15/77	Kabundi Sandy Loam	12a .....	45
CEP 16/77	Mutumbi Sandy Loam	1a .....	47
CEP 17/77	Un-named dambo soil	13 .....	49
CEP 18/77	un-named dambo soil	13 .....	51
Methods. ....			53

SUMMARY OF SOIL CLASSIFICATION:

- Mapping Unit 1 - Orthic and xanthic Ferralsols (FAO)  
Typic Haplustox and Eutruxtox (USDA)
- Mapping Unit 2 - Xanthic Ferralsol (FAO)  
Typic Haplustox and Eutruxtox (USDA)
- Mapping Unit 6 - Ferralic Arenosol over xanthic Ferralsol (FAO)  
Typic Psammaquent over Typic Ochraquox (USDA)
- Mapping Unit 7 - Not Classified
- Mapping Unit 9 - Lithosols (FAO)  
Shallow Oxisols (USDA)
- Mapping Unit 12 - Rhodic Ferralsol (FAO)  
Typic Haplustox (USDA)
- Mapping Unit 13 - Dystric Gleysol (FAO)  
Tropaquent (USDA)
- Mapping Unit 14 - Ferralic Arenosol (FAO)  
Tropaquent (USDA)



Soil Name: Mutumbi Sandy Loam ?

Profile No.: CEP 1/77

Location: Chief Muchinka's Area, Serenje District.

Mapping Unit: 1a

UTM coord.: 198858 sheet 1230C4

Land cap. class: S2e

Physiography: Plateau, middle slope.

Date sampled: 22/9/77

Elevation: 1395 m asl.

Slope: 1-3%

Parent Material: Gneiss?

Permeability: Moderate

Vegetation and Use: Miombo savannah.

Drainage: Well

<u>Horizon</u>	<u>DEPTH(cm)</u>	<u>DESCRIPTION</u>
A2	0-5	Brown (7.5YR5/4) dry, dark brown (7.5YR3/2) moist; <u>sandy loam</u> ; strong medium & coarse crumb structure; slightly hard dry, friable moist; slightly sticky & plastic; few medium, common fine & very fine pores; common medium, many fine roots; clear smooth boundary.
B1	5-14	Reddish brown (5YR5/4) dry; (5YR4/4) moist; sandy clay loam; moderate fine & medium sub-angular blocky structure; hard dry, friable moist; non sticky & plastic; few coarse, common medium, many fine & very fine pores; few coarse, common fine & medium roots; gradual smooth boundary.
B21	14-30	As above except Yellowish red (5YR5/6) dry, (5YR4/6) moist; slightly sticky; common coarse medium & fine roots
B22	30-55	Yellowish red (5YR5/6) dry, (5YR4/8) moist; sandy clay loam; moderate fine & medium sub-angular blocky structure; hard dry, friable moist; slightly sticky & plastic; few medium, many fine & very fine pores; common fine, medium & coarse roots; few fine gravels; diffuse smooth boundary
B23	55-77	Yellowish red (5YR5/8) dry, (5YR4/8) moist; clay; weak fine & medium subangular blocky structure; very hard dry, firm moist; slightly sticky & plastic; thin patchy cutans; few medium, many fine & very fine pores; few coarse common fine & medium roots; few fine gravels; diffuse smooth boundary.
B24	77-113	As above except; Sandy clay; no cutans; few stones.
B25	113-155+	As above except: Sandy clay loam; slightly hard dry no stones.

Tentative classification **Tropeptic Eutruxox** (USDA).

Orthic Ferralsol (FAO).



ANALYTICAL DATA

Profile No.: CEP 1/77

Grain size:

Depth (cm)	Lab. No.	Clay 0.002 %	Silt 0.002 -0.05 %	F.sand 0.05 -0.2 %	M.sand 0.2 - 0.5 %	C.sand 0.5 - 2.0 %	Texture
0-5	4006	18	15	45	19	3	SL
5-14	4007	20	18	51	9	2	SCL
14-30	4008	29	19	37	2	SCL	
30-55	4009	23	13	51	12	1	SCL
55-77	4010	49	12	26	10	3	C
77-113	4011	38	16	37	8	1	SC
113-155+	4012	26	19	41	13	1	SCL

Chemical data:

Depth (cm)	Ex. Ca m.e.%	Ex. Mg m.e.%	Ex. K m.e.%	Ex. Na m.e. $\frac{1}{2}$	CEC m.e.%	CEC m.e.%
0-5	5.10	1.15	0.18	0.10	7.1	39.4
5-14	2.20	0.80	0.10	0.06	3.1	15.5
14-30	1.15	0.85	0.12	0.13	3.2	11.0
30-55	0.60	0.65	0.09	0.06	3.3	14.4
55-77	0.40	0.40	0.09	0.08	3.5	7.1
77-113	0.65	0.35	0.05	0.07	2.7	7.1
113-150+	0.50	0.40	0.04	0.05	2.6	10.0
Depth (cm)	Org. C %	Total N %	Avail. P ppm	pH (CaCl <sub>2</sub> )	Base Sat. %	
0-5	1.36	0.08	27.9	5.5	92	
5-14	0.31	0.04	ND	5.4	100	
14-30	ND	ND	ND	5.1	70	
30-55	ND	ND	ND	4.3	42	
55-77	ND	ND	ND	4.2	28	
77-113	ND	ND	ND	4.3	42	
113-150+	ND	ND	ND	4.2	39	

ND: Not determined.



APPENDIX 1.

Soil Name: Kasama Sandy Clay Loam      Profile No: CEP2/77  
 Location: Chief Muchinka's area, Serenje District.      Mapping Unit: 12a  
 UTM coord.: 183807 sheet 1230C4      Land cap. class: S2e  
 Physiography: Plateau, mid slope      Date sampled: 22/9/77  
 Elevation: 4700 m asl      Slope: 1-3%  
 Parent Material: Sandstone/Gneiss?      Permeability: Moderate.  
 Vegetation and Use: Miombo savannah      Drainage: Well.

HORIZON	DEPTH (cm)	DESCRIPTION
A1	0-3	Dark brown (7.5YR4/4) dry, very dark greyish brown (10YR3/2) moist; sandy clay loam; strong fine crumb structure; slightly hard dry, friable moist; slightly plastic & sticky; few coarse & medium, many fine & very fine pores; few medium, many fine roots; clear smooth boundary
A2	3-9	Reddish brown (5YR4/4) dry, dark reddish brown (5YR3/4) moist; sandy clay loam; strong fine crumb structure; hard dry friable moist; slightly sticky & plastic; few medium, common coarse, many fine & very fine pores; few coarse & medium, many fine roots; gradual smooth boundary.
B21	9-19	Red(2.5YR5/8) dry & moist(2.5YR4/6); sandy clay loam; moderate fine & medium subangular blocky structure; slightly hard dry. friable moist; slightly plastic & sticky; few coarse, common fine & medium pores; few medium & coarse, common fine roots; smooth diffuse boundary.
B22	19-150+	As above except: Few fine gravels increasing to common below 86 cm.

Tentative classification: Typic Haplustox (USDA)  
 Rhodic Ferralsol (FAO)

37-41? As above except: Sandy clay; no cutans; few stones.  
 41-155+ As above except: Sandy clay loam; slightly hard dry no stones.

Tentative classification: Typic Haplustox (USDA),  
 Rhodic Ferralsol (FAO).



ANALYTICAL DATA.

Profile No: CEP 2/77

Grain size:

Depth (cm)	Lab. No.	(mm)					Texture
		Clay 0.002 %	Silt 0.002 -0.05 %	F.sand 0.05 -0.2 %	M.sand 0.2 - 0.5 %	C.sand 0.5- 2.0 %	
0-3	4013	30	15	44	9	2	SCL
3-9	4014	29	11	46	12	2	SCL
9-19	4015	34	10	42	12	2	SCL
10-42	4016	22	9	54	13	2	SCL
42-86	4017	22	7	59	10	2	SCL
86-120	4018	26	10	58	5	1	SCL
120-150+	4019	32	12	51	4	1	SCL

Chemical data:

Depth (cm)	Ex.Ca m.e.%	Ex.Mg m.e.%	Ex.K m.e.%	Ex.Na m.e.%	CEC m.e.%	CEC m.e.% 100 gr clay
0-3	3.45	1.45	0.20	0.12	10.8	36.0
3-9	0.85	0.50	0.09	0.08	5.4	18.6
9-19	0.40	0.40	0.05	0.07	4.0	11.8
19-42	0.30	0.30	0.04	0.06	3.1	14.1
42-86	0.35	0.40	0.03	0.06	2.5	11.4
86-120	0.30	0.40	0.03	0.06	2.4	9.2
120-150+	0.30	0.30	0.02	0.08	2.5	7.8

Depth (cm)	Org.C %	Total N %	Avail.P ppm	pH (CaCl <sub>2</sub> )	Base Sat. %
0-3	1.64	0.13	26.4	4.7	48
3-9	0.16	0.06	ND	4.2	28
9-19	ND	ND	ND	4.2	23
19-42	ND	ND	ND	4.1	23
42-86	ND	ND	ND	4.1	34
86-120	ND	ND	ND	4.1	33
120-150+	ND	ND	ND	4.1	28

ND: Not determined.



Soil Name: Mutumbi Sandy Loam

Profile No. CEP 3/77

Location: Chief Muchinka's area, Serenje District.

Mapping unit: 1a

UTM coord.: 242647 sheet 123004

Land cap. class: S2e

Physiography: Middle slope.

Date sampled: 29/9/77

Elevation: 1485 m asl.

Slope: 1-3%

Parent Material: GNEISS

Permeability: Moderate

Vegetation and Use: Old Chitemene

Drainage: Well

<u>HORIZON</u>	<u>DEPTH (cm)</u>	<u>DESCRIPTION</u>
A1	0-5	Dark brown (10YR3/3) dry, very dark greyish brown (10YR3/2) moist; <u>sandy loam</u> ; weak fine and medium crumb structure; soft dry, slightly friable moist; slightly plastic, slightly sticky; few medium, common fine and very fine pores: common medium, many fine roots; clear smooth boundary.
AB	5-16	Light brown (7.5YR6/4) dry, brown (7.5YR5/4) <b>moist</b> sandy loam; weak fine and medium subangular blocky structure; slightly hard dry, friable moist; slightly plastic, slightly sticky; few coarse, common fine and medium pores; few medium, common fine roots; clear smooth boundary.
B21	16-41	Strong brown (7.5YR5/6) dry, strong brown (7.5YR5/8) moist; <u>sandy clay loam</u> ; weak fine and medium subangular blocky structure; slightly hard dry, friable moist; slightly plastic, slightly sticky; few coarse, common medium, many fine pores; few coarse, common medium, many fine roots; few fine gravel; gradual smooth boundary.
B22	41-146 +	As above with few medium distinct grey mottles.

Tentative classification: Xanthic Ferralsol (FAO)

Typic Haplustox (USDA)



## ANALYTICAL DATA

Profile NO.: CEP 3/77 Grain size:

Depth (cm)	Lab. No.	(mm)					Texture
		Clay	Silt	F.sand	M.sand	C.sand	
		0.002	0.002	0.05	0.2-	0.5 -	
		%	-0.05	-0.2	0.5	2.0	
			%	%	%	%	
0-5	4126	10	17	61	10	2	SL
5-16	4127	19	8	56	12	5	SL
16-41	4128	27	10	48	11	4	SCL
41-65	4129	35	14	37	9	5	SCL
65-102	4130	23	25	41	8	3	SCL
102-146+	4131	32	12	46	5	5	SCL

## Chemical data:

Depth (cm)	Ex.Ca	Ex.Mg	Ex.K	Ex.Na	CEC	CEC m.e.%
	m.e.%	m.e.%	m.e.%	m.e.%	m.e.%	100 gr clay
0-5	2.30	0.85	0.28	0.51	5.0	50.0
5-16	0.60	0.50	0.12	0.06	2.6	13.7
16-41	0.30	0.70	0.13	0.02	2.8	10.4
41-65	0.30	1.10	0.11	0.06	3.4	9.7
65-102	0.20	0.60	0.10	0.40	3.2	13.9
102-146+	0.25	0.40	0.10	0.04	2.8	8.8

Depth (cm)	Org. C	Total N	Avail. P	pH	Base Sat.
	%	%	ppm	(CaCl <sub>2</sub> )	%
0-5	0.08	0.11	24.8	4.9	79
5-16	ND	0.11	ND	4.5	49
16-41	ND	ND	ND	4.4	41
41-65	ND	ND	ND	4.5	46
65-102	ND	ND	ND	4.3	29
10-146+	ND	ND	ND	4.3	28

ND: Not determined.



APPENDIX 1

Soil Name: Not Named. Profile No.: 4/77  
Location: Chief Muchinkas area, Serenje Dist. Mapping Unit: 14  
UTM Coord: 215635 sheet 1230C4 Land cap. class: S3tw  
Physiography: Lower slope Date sampled: 29/9/77  
Elevation: 1470 m asl. Slope: 1-3%  
Parent Material: Quartzite Permeability: Moderate  
Vegetation and Use: Light tree savanah Drainage: Imperfect

HORIZON	DEPTH (cm)	DESCRIPTION:
A1	0-9	Dark greyish brown (10YR 4/2) dry; very dark grey (10YR 3/1) moist; <u>sand</u> ; few fine faint reddish brown mottles; weak fine crumb structure; soft dry; loose moist; non sticky, non plastic; few coarse, common medium, many fine pores; few coarse, many fine and medium roots; clear smooth boundary.
A21	9-16	Greyish brown (10YR 5/2) dry, very dark greyish brown (10YR 3/2) moist; <u>sand</u> ; few fine faint reddish brown mottles; weak fine sub-angular blocky structure; soft dry, friable moist; non sticky, non plastic; few coarse, common fine and medium pores; few medium common fine roots; smooth gradual boundary.
A22	16-36	As above except; few fine distinct reddish brown mottles; slightly hard dry.
C1	36-80	Pale yellow (2.5YR 7/4) dry, light olive brown (2.5YR 5/6) moist; <u>sand</u> ; common medium distinct reddish yellow mottles; weak fine subangular blocky structure; slightly hard dry, friable moist; non sticky, non plastic; few fine and medium pores; common fine roots; few fine gravel; wavy clear boundary.
C2	80-119	Brownish yellow (10YR 6/8) moist; <u>sand</u> ; common medium distinct strong brown mottles weak fine subangular blocky structure; slightly friable moist; non plastic, non sticky; few medium, common fine pores; few fine roots; few fine gravels; smooth clear boundary.
C3	119-136	As above except <u>loamy sand</u> with many coarse pronounced red mottles, massive; slightly plastic; common soft iron concretions; clear wavy boundary.
	136+	Paralithic contact; dark red weathered sandstone.

Tentative classification: Tropaequent (USDA)  
 Ferralic Arenosol (FAO)



APPENDIX 1

ANALYTICAL DATA

Profile No.: CEP 4/77

Grain size: (mm)

Depth (cm)	Lab. No.	Clay 0.002 %	Silt 0.002 -0.05 %	F.sand 0.05 -0.2 %	M.sand 0.2- 0.5 %	C.sand 0.5- 2.0 %	Texture
0-9	4132	0	9	55	32	4	S
9-16	4133	6	3	56	30	5	S
16-36	4134	0	8	52	35	5	S
36-80	4135	4	5	74	16	1	S
80-119	4136	4	4	62	28	2	S
119-136+	4137	9	5	66	28	2	LS

Chemical Data:

Depth (cm)	Ex.Ca m.e.%	Ex.Mg m.e.%	Ex.K m.e.%	Ex.Na m.e.%	CEC m.e.%	CEC m.e.% 100 gr clay
0-9	0.20	0.10	0.06	0.04	2.3	-
9-16	0.10	0.05	0.04	0.06	1.6	26.7
16-36	0.10	0.05	0.02	0.03	1.0	-
36-80	0.20	0.05	0.01	0.03	0.8	20.0
80-119	0.10	0.05	0.00	0.04	0.6	15.0
119-136+	0.15	0.05	0.02	0.06	0.9	10.0

Depth (cm)	Org.C %	Total N %	Avail.P ppm	pH (CaCl <sub>2</sub> )	Base Sat.
0-9	0.16	ND	9.9	4.3	17
9-16	ND	ND	ND	4.3	16
16-36	ND	ND	ND	4.5	20
36-80	ND	ND	ND	4.5	36
80-119	ND	ND	ND	5.4	32
119-136+	ND	ND	ND	5.2	31

ND: Not determined



Soil Name: Kasama Sandy Loam.Profile No.: CEP 5/77Location: Chief Muchinka area, Serenje District.Mapping unit: 12aUTM coord.: 182661 sheet 1230C4Land cap. class: S2ePhysiography: Middle slope.Date sampled: 29/9/77Elevation: 1440 m asl.Slope: 1-3%Parent Material: QUARTZITEPermeability: Moderate..Vegetation and Use: Miombo savannahDrainage: well.

<u>HORIZON</u>	<u>DEPTH (cm)</u>	<u>DESCRIPTION</u>
A1	0-8	Yellowish red (5YR5/6) dry, dark reddish brown (5YR3/4) moist; <u>sandy loam</u> ; weak fine & med. crumb structure; slightly hard dry, slightly friable moist; slightly plastic & sticky; few coarse, common medium, many fine pores; many fine & medium roots; clear smooth boundary.
B2	8-190+	Red (2.5YR4/6) dry, dark red (2.5YR3/6) moist; <u>sandy clay loam</u> ; weak fine & medium subangular blocky structure; slightly hard dry, friable moist; slightly sticky & plastic; common medium, many fine & very fine pores; few medium, common fine roots, diffuse smooth boundary.

Tentative classification: Rhodic Ferralsol (FAO).

Typic Haplustox. (USDA).

Tentative classification: Tropical (USDA)

Ferralsol (FAO)



## ANALYTICAL DATA

Profile NO.: CEP 5/77

Grain size:

..(mir)

Depth (cm)	Lab. No.	Clay 0.002	Silt 0.002	F.sand 0.05	M.sand 0.2	C.sand 0.5	Texture
			0.002	0.05	0.2	0.5	
			0.002	0.05	0.2	0.5	
		%	%	%	%	%	
0-8	4138	16	6	51	25	2	SL
8-38	4139	21	3	54	21	1	SCL
38-74	4140	26	11	41	18	4	SCL
74-125	4141	32	17	31	17	3	SCL
125-190+	4142	29	7	44	18	2	SCL

Chemical data:

Depth (cm)	Ex.Ca m.e.%	Ex.Mg m.e.%	Ex.K m.e.%	Ex.Na m.e.%	CEC m.e.%	CEC m.e.% 100 gr clay
0-8	0.80	0.45	0.11	0.02	3.5	21.9
8-38	0.20	0.10	0.04	0.04	2.5	11.9
38-74	0.30	0.15	0.03	0.04	2.2	8.5
74-125	0.20	0.20	0.03	0.10	2.5	22.7
125-190+	0.20	0.20	0.02	0.05	2.3	7.9

Depth (cm)	Org.C %	Total N %	Avail.P ppm	pH (CaCl2)	Base Sat. %
0-8	0.08	ND	25.5	4.7	39
8-38	ND	ND	ND	4.3	15
38-74	ND	ND	ND	4.3	24
74-125	ND	ND	ND	4.3	21
125-190+	ND	ND	ND	4.3	20



APPENDIX 1.

<u>Soil Name:</u> Mutale Sandy loam	<u>Profile No.</u> CEP 6/77
<u>Location:</u> Chief Muchinka area, Serenje	<u>Mapping Unit:</u> 2a
<u>UTM coord.:</u> 173707 sheet 1230C4	<u>Land cap. class:</u> S2we
<u>Physiography:</u> Lower slope.	<u>Date sampled:</u> 29/9/77
<u>Elevation:</u> 1365 m asl	<u>Slope:</u> 1-3%
<u>Parent Material:</u> GNEISS	<u>Permeability:</u> Moderate.
<u>Vegetation and Use:</u> Miombo Savannah.	<u>Drainage:</u> Moderate.

<u>HORIZON</u>	<u>DEPTH (cm)</u>	<u>DESCRIPTION:</u>
A1	0-10	Brown (10YR 5/3) dry, dark greyish brown (10YR 4/2) moist; <u>sandy loam</u> ; weak fine crumb structure; loose dry & moist; slightly plastic, non sticky; common fine & very fine pores; many fine & medium roots; clear smooth boundary.
B1	10-24	Brownish yellow (10YR 6/6) dry, (10YR 5/4) moist; <u>sandy clay loam</u> ; few fine faint reddish yellow mottles, weak fine & medium subangular blocky structure; slightly hard dry, friable moist; slightly sticky & plastic; common fine & medium pores; few fine & coarse, common medium roots; clear smooth boundary.
B2	24-163+	Brownish yellow (10YR 6/6) dry, yellowish brown (10YR 5/8) moist; <u>sandy clay</u> ; few fine distinct light yellowish brown mottles; weak fine & medium subangular blocky structure; slightly hard dry, friable moist; slightly sticky & plastic; few coarse, common fine & medium pores (few below 115cm); common fine & medium roots; few fine gravels with few iron concretions below 115cm

Tentative classification: Xanthic Ferralsol (FAO)  
Typic Haplustox (USDA)



APPENDIX 1

ANALYTICAL DATA

Profile No. : CEP 6/77 Grain size:  
(mm)

Depth (cm)	Lab. No.	Clay 0.002 %	Silt 0.002 -0.05 %	F.sand 0.05 -0.2 %	M.sand 0.2- 0.5 %	C.sand 0.5- 2.0 %	Texture
0-10	4143	12	16	63	8	1	SL
10-24	4144	24	14	55	6	1	SCL
24-65	4145	40	15	41	3	1	SC
65-115	4146	40	14	42	3	1	SC
115-163+	4147	38	15	43	3	1	SC

Chemical data:

Depth (cm)	Ex.Ca m.e.%	Ex.Mg m.e.%	Ex.K m.e.%	Ex.Na m.e.%	CEC m.e.%	CEC m.e.% 100 gr clay
0-10	1.60	0.90	0.28	0.05	3.0	25.0
10-24	0.30	0.50	0.29	0.02	3.1	12.9
24-65	0.50	0.70	0.24	0.01	4.3	10.8
65-115	0.30	0.70	0.18	0.01	4.8	12.0
115-163+	0.30	0.50	0.13	0.02	4.2	11.1

Depth (cm)	Org.C %	Total N %	Avail.P ppm	pH (CaCl <sub>2</sub> )	Base Sat. %
0-10	0.74	ND	7.7	5.3	94
10-24	0.19	ND	ND	4.3	36
24-65	ND	ND	ND	4.3	34
65-115	ND	ND	ND	4.3	25
115-163+	ND	ND	ND	4.2	23

ND: Not determined



APPENDIX 1.

Soil Name: Mutumbi Sandy Clay Loam

Location: Chief Muchinka Area, Serenje Dist.

UTM coord.: 357913 sheet 1230D1

Physioograph: Mid/lower slope

Elevation: 1275 m asl

Parent Material: Gneiss

Vegetation and Use: Miombo savannah

Profile No.: CEP 11/77

Mapping Unit: 1a

Land cap. class: S2e

Date sampled: 8/11/77

Slope: 1-3%

Permeability: Moderate

Drainage: Well

<u>HORIZON</u>	<u>DEPTH (cm)</u>	<u>DESCRIPTION</u>
A2	0-6	Light yellowish brown (10YR 6/4) dry, dark Yellowish brown (10YR 4/4) moist; <u>sandy loam</u> ; fine moderate crumb structure; slightly hard dry, friable moist; plastic & sticky; few medium, common fine & very fine pores; few coarse, common medium, many fine roots; clear smooth boundary.
B1	6-16	Light reddish brown (5YR 6/4) dry, yellowish red (5YR 5/6) moist; <u>sandy clay loam</u> ; few medium distinct reddish brown mottles; weak fine & medium subangular blocky structure; hard dry, slightly firm moist; plastic & sticky; few fine, common very fine & medium pores; few coarse, common fine & medium roots; gradual smooth boundary.
B21	16-125	Reddish yellow (5YR 6/6) dry, yellowish red (5YR 5/6) moist; <u>clay loam</u> ; weak fine subangular blocky structure; slightly hard dry, friable moist plastic & sticky; thin patchy cutans; few medium & coarse, many fine & very fine pores; few fine, medium, & coarse roots; few fine gravels in lower 45cm; clear smooth boundary.
B22	125-167+	Yellowish red (5YR 5/6) dry, (5YR 5/8) moist; <u>clay loam</u> ; weak fine subangular blocky structure; slightly hard dry, loose moist; plastic & slightly sticky; common fine & medium pores; few fine & medium roots; few coarse & many fine laterite & quartz gravels.

Tentative classification: Orthic Ferralsol (FAO)  
Typic Eutruster (USDA)



APPENDIX 1

ANALYTICAL DATA

Profile No.: CEP 11/77 Grain size: (mm)

Depth (cm)	Lab. No.	Clay 0.002 %	Silt 0.002 -0.05 %	F.sand 0.05 -0.2 %	M.sand 0.2- 0.5 %	C.sand 0.5- 2.0 %	Texture
0-6	5067	18	26	39	12	5	SL
6-16	5068	23	25	33	13	6	SCL
16-40	5069	33	25	28	10	4	CL
40-80	5070	33	30	20	8	9	CL
80-125	5071	34	25	26	10	5	CL
125-167+	5072	35	27	24	10	4	CL

Chemical Data

Depth (cm)	Ex.Ca m.e.%	Ex.Mg m.e.%	Ex.K m.e.%	Ex.Na m.e.%	CEC m.e.%	CEC m.e.% 100 gr clay
0-6	2.20	0.90	0.44	0.04	4.2	23.3
6-16	1.75	0.95	0.42	0.04	3.9	17.0
16-40	2.10	1.00	0.47	0.04	3.6	10.9
40-80	2.20	1.05	0.30	0.04	3.6	10.9
80-125	2.60	1.10	0.38	0.04	4.0	11.8
125-167+	2.30	1.20	0.48	0.04	4.1	11.7

Depth (cm)	Org.C %	Total N %	Avail.P ppm	pH (CaCl <sub>2</sub> )	Base Sat. %
0-6	1.01	0.03	ND	5.7	85
6-16	0.35	0.02	2.2	5.3	81
16-40	ND	ND	ND	5.8	100
40-80	ND	ND	ND	6.4	100
80-125	ND	ND	ND	6.2	100
125-167+	ND	ND	ND	6.1	100

ND: Not determined



Soil Name: Mutumbi Sandy Clay Loam. Profile No.: CEP 12/77

Location: Chief Muchinka's area, Serenje District. Mapping Unit: 1a

UTM coord.: 367753 sheet 1230D3

Land cap. class: S2e

Physiography: Middle slope.

Date sampled: 8/11/77

Elevation: 1395 m asl.

Slope: 1-3%

Parent Material: Gneiss

Permeability: Moderate

Vegetation and Use: Miombo savannah.

Drainage: Well

<u>Horizon</u>	<u>Depth (cm)</u>	<u>DESCRIPTION</u>
A2	0-7	Yellowish.brown (10YR5/4) dry, dark yellowish brown (10YR3/4) moist; sandy loam; weak fine crumb structure; soft dry, slightly friable moist; slightly plastic & sticky; many medium, fine & micro pores; few medium, many fine roots; clear smooth boundary.
B1	7-29	Yellowish red (5YR5/6) dry, (5YR4/8) moist; <u>sandy clay</u> loam; weak fine subangular blocky structure; soft dry, loose moist; slightly plastic & sticky; few coarse, many fine & medium pores; common medium, many fine roots; smooth gradual boundary.
B21	29-59	Yellowish red (5YR5/6) dry, (5YR4/8) moist; <u>sandy clay</u> ; weak medium subangular blocky structure; slightly hard dry, friable moist; slightly plastic & sticky; common medium, many fine pores; common medium, many fine roots; few fine & coarse gravels; smooth diffuse boundary.
B22	59-155+	Reddish yellow (5YR6/8) dry, yellowish red (5YR5/8) moist; <u>sandy clay</u> ; weak fine sub-angular blocky structure; slightly hard dry, friable moist; slightly plastic & sticky; many fine, common medium pores; common fine & medium roots; few fine gravels in lower 40 cm.

Tentative classification: Orthic Ferralsol (FAO)

Typic Eutrustox (USDA)



## ANALYTICAL DATA.

Profile No.: CEP 12/77

Grain size:  
(mm)

Depth (cm)	Lab. No.	Clay 0.002	Silt 0.002	F.sand 0.05	M.sand 0.2 -	C.sand 0.5 -	Texture
		%	%	%	%	%	
0-7	5073	17	10	54	16	3	SL
7-29	5074	33	7	38	16	6	SCL
29-59	5075	35	16	27	16	6	SC
59-92	5076	46	8	26	15	5	SC
92-122	5077	41	8	12	34	5	SC
122-155+	5078	39	12	8	34	7	SC

## Chemical data:

Depth (cm)	Ex. Ca m.e. %	Ex. Mg m.e. %	Ex. K m.e. %	Ex. Na m.e. %	CEC m.e. %	CEC m.e. % 100 gr clay
0-7	2.15	0.75	0.28	0.02	4.3	25.3
7-29	1.60	0.60	0.19	0.02	3.2	9.7
29-59	1.45	0.60	0.22	0.04	3.1	8.9
59-92	0.95	1.00	0.15	0.01	3.1	6.7
92-122	0.90	0.90	0.20	0.02	2.8	6.8
122-155+	0.90	0.95	0.24	0.02	2.8	7.2

Depth (cm)	org. C %	Total N %	Avail. P ppm	pH (CaCl <sub>2</sub> )	Base Sat. %
0-7	0.66	0.03	ND	6.0	74
7-29	0.66	0.02	10.3	5.8	75
29-59	ND	ND	ND	5.9	75
59-92	ND	ND	ND	6.1	68
92-122	ND	ND	ND	6.3	72
122-155+	ND	ND	ND	6.4	75

ND: Not determined.



APPENDIX 1.

Soil Name: Mutale Sandy Loam

Profile No.: CEP 13/77

Location: Chief Muchinka area, Serenje District.

Mapping unit: 2a

UTM coord.: 444739 sheet 1230D3

Land cap. class: S2we

Physiography: Lower slope

Date sampled: 8/11/77

Elevation: 1425 m asl.

Slope: 3-5%

Parent Material: Gneiss

Permeability: Moderate

Vegetation and Use: Miombo savannah

Drainage: Moderately well

<u>HORIZON</u>	<u>DEPTH (cm)</u>	<u>DESCRIPTION</u>
A2	0-10	Greyish brown (10YR 5/2) dry, dark brown (10YR 3/3) moist; <u>sandy loam</u> ; weak fine crumb structure; slightly soft dry, slightly friable moist; slightly plastic, non sticky; common medium, many fine & very fine pores; common medium, many fine roots; clear smooth boundary.
AB	10-35	Light yellowish brown (10YR 6/4) dry, dark yellowish brown (10YR 4/4) moist; <u>sandy loam</u> ; few fine distinct yellowish brown mottles; weak medium subangular blocky structure; slightly hard dry, friable moist; slightly plastic & sticky; common fine & medium pores; few coarse common medium many fine roots; gradual smooth boundary.
B21	35-67	Brownish yellow (10YR 6/6) dry, yellowish brown (10YR 5/6) moist; <u>sandy clay loam</u> ; weak fine subangular blocky structure; slightly hard dry, friable moist; slightly plastic & sticky; few medium, many fine pores; few coarse, common medium and fine roots; diffuse smooth boundary.
B22	67-98	As above except: few fine distinct greyish brown mottles and few fine gravels.
B23	98-115+	As above except: few fine roots only and very many coarse gravels.

Tentative classification: Xanthic Ferralsol (FAO)  
Typic Eutrastox (USDA)



## ANALYTICAL DATA

Profile No.: CEP 13/77 Grain size:  
(mm)

Depth	Lab.	Clay	Silt	F.sand	M.sand	C.sand	Texture
(cm)	No.	0.002	0.002	0.05	0.2 --	0.5 --	
			-- 0.05	-- 0.2	0.5	2.0	
		%	%	%	%	%	

0-10	5079	11	11	60	13	5	SL
10-35	5080	17	9	43	26	5	SL
35-67	5081	30	7	40	19	4	SCL
67-98	5082	28	6	40	19	7	SCL
98-115	5083	23	11	41	17	8	SCL

## Chemical data:

Depth	Ex.Ca	Ex.Mg	Ex.K	Ex.Na	CEC	CEC m.e.%
(cm)	m.e.%	m.e.%	m.e.%	m.e.%	m.e.%	100 gr clay
0-10	2.25	0.60	0.30	0.04	3.1	28.2
10-35	1.00	0.30	0.18	0.03	2.5	14.7
35-67	1.80	0.55	0.26	0.04	3.3	11.0
67-98	1.60	0.55	0.26	0.04	3.6	12.9
98-115	1.50	0.60	0.22	0.04	3.2	13.9

Depth	Org.C	Total N	Avail.P	pH	Base Sat.
(cm)	%	%	ppm	(CaCl2)	%
0-10	0.58	0.03	ND	5.4	100
10-35	0.39	0.02	19.7	4.9	60
35-67	ND	ND	ND	4.8	80
67-98	ND	ND	ND	4.9	68
98-115	ND	ND	ND	5.0	74

ND: Not determined



APPENDIX 1.

Soil Name: Teketeke Sand

Location: Chief Muchinka's area, Serenje District.

UTM coord.: 403736 sheet 1230D3

Physiography: Footslope - dambo head.

Elevation: 1440 m asl.

Parent Material: Gneiss

Vegetation and Use:

Profile No.: CEP 14/77

Mapping unit: 6a

Land cap. class: S3tw

Date sampled: 8/11/77

Slope: 1-3%

Permeability: Moderate

Drainage: Imperfect.

<u>HORIZON</u>	<u>DEPTH(cm)</u>	<u>DESCRIPTION</u>
A2	0-15	Greyish brown (10YR 5/2) dry, dark greyish brown (10YR 4/2) moist; <u>sand</u> ; structureless; loose dry and moist; non sticky and plastic; common medium, many fine and very fine pores; many fine and medium roots; clear smooth boundary.
IC 1g	15-30	Pale brown (10YR 6/3) dry, brown (10YR 5/3) moist; <u>sand</u> ; few fine distinct strong brown mottles; weak massive structure; soft dry, slightly friable moist; non sticky and plastic. few medium, many fine and very fine pores; common medium, many fine roots; clear smooth boundary.
IC 2g	30-70	Olive brown (2.5Y 3/4) dry, light yellowish brown (2.5Y 6/4) moist; <u>loamy sand</u> ; common fine distinct brownish yellow mottles; weak massive structure; soft dry, slightly friable moist; non sticky and plastic; few medium, many fine pores; few fine and medium roots; clear smooth boundary.
II B 1	70-100	Very pale brown (10YR 7/4) dry, brownish yellow (10YR 6/6) moist; <u>sandy clay loam</u> ; common medium distinct reddish yellow mottles; weak fine subangular blocky structure; soft dry, friable moist; slightly plastic and sticky; few fine pores; few fine roots; common iron concretions; clear smooth boundary.
II B2	100-147+	Yellow (10YR 7/6) dry, brownish yellow (10YR 6/6) moist; <u>sandy clay</u> ; many medium and coarse pronounced red mottles; weak fine subangular blocky structure; hard dry, friable moist; slightly plastic and sticky; few fine pores; few fine roots; many iron concretions.

Tentative classification: Ferralic Arenosol over Xanthic Ferralsol (FAO)  
Typic Psammaquent over Typic Ochraqnox (USDA)



Profile No.: CEP 14/77

## ANALYTICAL DATA

Grain size:(mm)

Depth (cm)	Lab. No.	Clay 0.002 %	Silt 0.002 -0.05 %	F.sand. 0.05 -0.2 %	M.sand 0.2 - 0.5 %	C.sand 0.5 - 2.0 %	Texture
0-15	5084	5	7	38	34	16	S
15-30	5085	5	6	39	35	15	S
30-70	5086	8	6	36	33	17	LS
70-100	5087	35	7	27	17	14	SCL
100-147+	5088	36	10	26	17	11	SC

## Chemical data:

Depth (cm)	Ex.Ca m.e.%	Ex.Mg m.e.%	Ex.K m.e.%	Ex.Na m.e.%	CEC m.e.%	CEC m.e.% 100gr clay
0-15	0.85	0.30	0.10	0.00	1.5	30.0
15-30	0.30	0.15	0.04	0.01	0.7	14.0
30-70	0.40	0.20	0.08	0.01	1.0	12.5
70-100	0.15	0.20	0.27	0.01	3.4	9.7
100-147+	0.15	0.10	0.13	0.01	3.3	9.2

Depth (cm)	Org.C %	Total N %	Avail.P ppm	pH (CaCl <sub>2</sub> )	Base Sat. %
0-15	0.66	0.02	ND	5.1	83
15-30	0.19	0.02	2.1	5.1	71
30-70	ND	ND	ND	4.8	69
70-100	ND	ND	ND	4.3	20
100-147+	ND	ND	ND	4.3	12



<u>Soil Name:</u> Kabundi Sandy Loam.	<u>Profile No.:</u> CEP 15/77
<u>Location:</u> Chief Muchinka's area, Serenje District.	<u>Mapping Unit:</u> 12a
<u>UTM coord.:</u> 435815 sheet 1230D3	<u>Land cap. class:</u> S2e
<u>Physiography:</u> Middle slope.	<u>Date sampled:</u> 8/11/77
<u>Elevation:</u> 1380 m asl.	<u>Slope:</u> 1-3%
<u>Parent Material:</u> QUARTZITE	<u>Permeability:</u> Moderate.
<u>Vegetation and Use:</u> Miombo Savannah	<u>Drainage:</u> Well

<u>HORIZON</u>	<u>DEPTH (cm)</u>	<u>DESCRIPTION</u>
A2	0-8	Yellowish red (5YR5/6) dry, reddish brown (5YR4/4) moist; sandy loam; weak fine crumb structure; slightly soft dry, loose moist; slightly plastic, non sticky; common medium, many fine & very fine pores; many fine & medium roots; clear smooth boundary.
B21	8-28	Red (2.5YR4/6) dry, dark red (2.5YR3/6) moist; sandy loam; weak fine subangular blocky structure; slightly hard dry, slightly friable moist; slightly plastic & sticky; few coarse, common medium, many fine & very fine pores; many fine & medium roots; diffuse smooth boundary.
B22	28-93	As above except: sandy clay loam; thin, patchy cutans; common medium, many fine roots.
B23	93-163+	As above except: no cutans: few medium, common fine roots; few fine gravels in lower 30 cm.

Tentative classification: Ferric Acrisol (FAO)  
Oxic Paleustult (USDA)



## ANALYTICAL DATA.

Profile No.: CEP 15/77

Grain size:  
(mm)

Depth (cm)	Lab No.	Clay 0.002 %	Silt 0.002 -0.05 %	F.sand 0.05 -0.2 %	M.sand 0.2- 0.5 %	C.sand 0.5- 2.0 %	Texture
0-8	5089	15	21	55	5	4	SL
8-28	5090	17	19	54	5	5	SL
28-60	5091	26	25	41	5	3	SCL
60-93	5092	23	21	48	4	4	SCL
93-127	5093	22	20	46	3	9	SCL
127-163+	5094	22	20	47	3	8	SCL

## Chemical data:

Depth (cm)	Ex.Ca m.e.%	Ex.Mg m.e.%	Ex.K m.e.%	Ex.Na m.e.%	CEC m.e.%	CEC m.e.% 100 gr clay
0-8	0.80	0.40	0.20	0.01	3.5	23.3
8-28	0.60	0.40	0.09	0.01	2.3	13.5
28-60	0.45	0.75	0.10	0.00	2.3	9.0
60-93	0.30	1.00	0.10	0.00	2.6	17.3
93-127	0.15	0.40	0.39	0.00	2.4	14.1
127-163+	0.15	0.30	0.28	0.00	2.4	9.2

Depth (cm)	Org. C %	Total N %	Avail. P ppm	pH (CaCl <sub>2</sub> )	Base Sat. %
0-8	0.86	0.05	ND	4.9	40
8-28	0.47	0.03	6.6	4.7	48
28-60	ND	ND	ND	4.9	57
60-93	ND	ND	ND	5.2	54
93-127	ND	ND	ND	4.8	39
127-163+	ND	ND	ND	4.7	30

ND: Not determined.



Soil Name: Mutumbi Sandy Loam.

Profile No.: CEP 16/77

Location: Chief Muchinka's area, Serenje

Mapping unit: 1a

UTM coord.: 551770 sheet 1230D3

Land cap. class: S2e

Physiography: Upper slope.

Date sampled: 15/11/77

Elevation: 1545m asl.

Slope: 1-3%

Parent Material: Gneiss.

Permeability: Moderate.

Vegetation and Use: Miombo Savannah.

Drainage: Well.

<u>HORIZON</u>	<u>DEPTH (cm)</u>	<u>DESCRIPTION</u>
A2	0-10	Greyish brown (10YR5/2) dry, very dark greyish brown (10YR-3/2) moist; <u>loamy sand</u> ; weak fine crumb structure; soft dry, friable moist; slightly plastic & sticky; few medium, many fine & very fine pores; few coarse, many fine & medium roots; clear smooth boundary.
B1	10-27	Reddish yellow (5YR6/6) dry, yellowish red (5YR5/6) moist; <u>sandy loam</u> ; weak fine subangular blocky structure; soft dry, friable moist; slightly plastic & sticky; few coarse, common medium, many fine pores; common medium & coarse, many fine pores; clear smooth boundary.
B21	27-55	Reddish yellow (5YR6/8) dry, yellowish red 5YR5/8) moist; <u>sandy clay loam</u> ; weak fine subangular blocky structure; slightly hard dry, friable moist; slightly plastic & sticky; few medium & coarse, many fine pores; few fine, medium & coarse roots; smooth gradual boundary.
B22	55-125	As above except: <u>sandy clay</u> ; common medium, many fine pores; few fine & medium roots; diffuse smooth boundary.
B23	125-155+	As above except: <u>clay loam</u> ; few fine roots.

Tentative classification: Xanthic Ferralsol (FAO)  
Typic Haplustox (USDA)



APPENDIX 1.

ANALYTICAL DATA

Profile No.: CEP 16/77

Grain size:  
(mm)

Depth (cm)	Lab. No.	Clay 0.002 %	Silt 0.002 - 0.05 %	F.sand 0.05 - 0.2 %	M.sand 0.2 - 0.5 %	C.sand 0.5 - 2.0 %	Texture
0-10	5095	12	6	42	36	4	LS
10-27	5096	15	5	55	21	4	SL
27-55	5097	31	8	41	18	2	SCL
55-85	5098	42	7	36	14	1	SC
85-125	5099	35	9	46	9	1	SC
125-155+	5100	39	19	26	14	2	CL

Chemical data:

Depth (cm)	Ex.Ca m.e.%	Ex.Mg m.e.%	Ex.K m.e.%	Ex.Na m.e.%	CEC m.e.%	CEC m.e.% 100 gr clay
0-10	1.80	0.85	0.16	0.01	ND	ND
10-27	0.25	0.60	0.20	0.01	4.0	26.7
27-55	0.20	0.45	0.19	0.00	2.4	7.7
55-85	0.15	0.60	0.18	0.01	3.2	7.6
85-125	0.20	0.50	0.18	0.01	3.0	8.6
125-155+	0.10	0.40	0.18	0.01	4.0	11.8

Depth (cm)	Org. C %	Total N %	Avail. P ppm	pH CaCl2)	Base Sat. %
0-10	0.90	0.05	22.7	5.2	ND
10-27	0.35	0.02	9.8	4.9	27
27-55	ND	ND	ND	4.6	35
55-85	ND	ND	ND	4.8	29
85-125	ND	ND	ND	4.9	30
125-155+	ND	ND	ND	4.7	17

ND: Not determined



APPENDIX 1.

Soil Name: Not Named

Profile No.: CEP 17/77

Location: Chief Muchinka's area,  
Serenje District.

Mapping unit: 13

UTM coord.: 560765 sheet 1230D4

Land cap. class: Gw

Physiography: Dambo

Date sampled: 15/11/77

Elevation: 1530 m asl.

Slope: 3-5%

Parent Material: Gneiss

Permeability: Moderate.

Vegetation and Use: Grassland.

Drainage: Poor.

<u>HORIZON</u>	<u>DEPTH (cm)</u>	<u>DESCRIPTION</u>
A2	0-10	Very dark grey (10YR3/1) moist; <u>sandy loam</u> ; common fine distinct rusty root channels; weak fine crumb structure; slightly friable moist; slightly sticky & plastic; few medium many fine & very fine pores; many fine roots; clear smooth boundary.
B1	10-32	Very dark greyish brown (10YR3/2) moist; <u>sandy loam</u> ; few fine distinct yellowish red mottles; massive; friable moist; slightly plastic & sticky; few medium, many fine pores; few medium many fine roots; clear smooth boundary.
B21	32-60	Light brownish grey (10YR6/2) moist; <u>sandy loam</u> ; common fine distinct yellowish brown mottles; massive; friable moist; slightly plastic & sticky; few medium, many fine pores; common fine roots; clear smooth boundary.
B22	60-91	Light brownish grey (10YR6/2) moist; <u>sandy clay</u> ; many medium distinct brownish yellow mottles; weak fine subangular blocky structure; friable moist; plastic & slightly sticky; many fine & medium pores; common fine roots; clear smooth boundary.
B23	91-101+	Grey (5Y6/1) moist; <u>sandy clay loam</u> ; common medium distinct brownish yellow mottles; weak medium subangular blocky structure; friable moist; plastic & slightly sticky; few fine pores; few fine roots; boundary to water table.

Tentative classification: Dystric Gleysol (FAO)  
Tropaquent (USDA)



ANALYTICAL DATA

Profile No.: CEP 17/77

Grain size:  
(mm)

Depth (cm)	Lab No.	Clay 0.002 %	Silt 0.002 - 0.05 %	F.sand 0.05 - 0.2 %	M.sand 0.2 - 0.5 %	C.sand 0.5 - 2.0 %	Textur
0-10	5101	14	13	52	19	2	SL
10-32	5102	12	7	65	15	1	SL
32-60	5103	15	9	50	23	3	SL
60-91	5104	36	6	34	22	2	SC
91-101+	5105	29	4	32	32	3	SCL

Chemical data:

Depth (cm)	Ex.Ca m.e.%	Ex.Mg m.e.%	Ex.K m.e.%	Ex.Na m.e.%	CEC m.e.%	CEC m.e.% 100 gr clay
0-10	1.00	0.40	0.20	0.01	4.4	31.4
10-32	0.70	0.15	0.10	0.01	3.4	28.3
32-60	0.50	0.20	0.06	0.00	4.4	29.3
60-91	1.40	0.45	0.14	0.01	8.0	22.2
91-101+	1.20	0.30	0.10	0.01	2.4	8.3

Depth (cm)	Org.C %	Total N %	Avail.P ppm	pH (CaCl <sub>2</sub> )	Base Sat. %
0-10	1.13	0.03	ND	4.3	36
10-32	0.97	ND	4.9	4.3	28
32-60	0.19	ND	ND	4.4	17
60-91	ND	ND	ND	4.5	25
91-101+	ND	ND	ND	4.6	67

ND: Not determined



Soil Name: Not Named.  
Location: Chief Muchinka's area,  
 Serenje District.

Profile No.: CEP 18/77  
Mapping unit: 13

UTM coord.: 430715 sheet 1230D3

Land cap. class: Gw

Physiography: Dambo

Date sampled: 15/11/77

Elevation: 1455 m asl.

Slope: 3-5%

Parent Material: Mica phillite

Permeability: Moderate rapid.

Vegetation and Use: Grassland.

Drainage: Poor.

<u>HORIZON</u>	<u>DEPTH (cm)</u>	<u>DESCRIPTION</u>
A2	0-15	Dark greyish brown (10YR4/2) dry, very dark greyish brown (10YR3/2) moist; <u>loamy sand</u> ; common fine distinct rusty root channels, weak fine crumb structure; soft dry, slightly friable moist; non plastic, slightly sticky; common medium, many fine & very fine pores; common medium, many fine roots; clear smooth boundary.
A3	15-35	As above except: <u>sandy loam</u> ; weak fine subangular blocky structure; slightly plastic;
B21	35-58	Greyish brown (10YR5/2) moist; <u>sandy loam</u> ; many medium distinct strong brown mottles; massive; friable moist; non plastic, slightly sticky; few coarse, many fine & medium pores. common fine roots. few fine gravels; clear smooth boundary.
B22	58-105+	Light brownish grey (2.5Y6/2) moist; <u>sandy loam</u> ; many medium & coarse distinct brownish yellow mottles; massive; loose moist; slightly sticky in upper 20cm; common medium, many fine & very fine pores; common fine & medium roots; few fine gravels in upper 20cm with common coarse & fine gravels below.

Tentative classification: Dystric Gleysol (FAO)  
 Tropaquent (USDA)



ANALYTICAL DATA

Profile No.: CEP 18/77

Grain size:  
(mm)

Depth (cm)	Lab. No.	Clay 0.002 %	Silt 0.002 - 0.05 %	F.sand 0.05 - 0.2 %	M.sand 0.2 - 0.5 %	C.sand 0.5 - 2.0 %	Tex ture
0-15	5106	10	7	43	20	20	LS
15-35	5107	12	8	45	20	15	SL
35-58	5108	13	11	37	12	27	SL
58-80	5109	7	13	34	14	32	SL
80-105	5110	8	16	36	17	23	SL

Chemical data:

Depth (cm)	Ex.Ca m.e.%	Ex.Mg m.e.%	Ex.K m.e.%	Ex.Na m.e.%	CEC m.e.%	CEC m.e.% 100 gr clay
0-15	1.10	0.30	0.10	0.00	2.0	20.0
15-35	0.30	0.15	0.16	0.00	1.8	15.0
35-58	0.25	0.10	0.08	0.00	1.0	<b>7.7</b>
58-80	0.40	0.15	0.06	0.00	1.0	<b>14.3</b>
80-105	0.20	0.10	0.03	0.00	1.0	12.5

Dpeth (cm)	Org.C %	Total N %	Avail.P ppm	pH (CaCl <sub>2</sub> )	Base Sat. %
0-15	0.55	ND	ND	4.3	75
15-35	0.23	ND	5.4	4.3	<b>34</b>
35-58	ND	ND	ND	4.7	<b>43</b>
58-80	ND	ND	ND	4.8	61
80-105	ND	ND	ND	5.4	33

ND: Not determined



SOIL PROFILE DESCRIPTIONS AND ANALYTICAL DATA.

Methods:

In the soil profile descriptions, the style and nomenclature of the FAO Guidelines for soil Description (1967) have been used. These are based on those of the US. Department of Agriculture described in detail in the USDA Soil Survey Manual.

Two points need to be made clear:-

1. Texture classes are those of the USDA system. The major difference between this and the older "International system" is in the limit between the silt and sand fractions. In the "International system", this limit is at 0.02mm, while for the USDA system, it is at 0.05mm. Experience shows that the 0.05mm limit correlates more closely with soil 'Feel' and behaviour than the 0.02mm limit previously used in Zambia\*. The analytical data given for each profile description includes only USDA particle-size classes.
2. Soil reaction classes relate to pH as determined in calcium chloride. pH figures for individual horizons and subhorizons are given in the analytical tables. pH determined in calcium chloride is generally lower (by an average of 0.7 of a unit) than pH determined in water. This needs to be kept in mind if comparing data in this report with those given in reports or text-books for soils in other parts of the world where the pH in water method is used.

The following methods were used in obtaining the analytical data quoted for each profile described :

Particle-size classes: After grinding; samples down to a depth of 40-50 cm were pretreated with hydrogen peroxide to correct for organic matter. Samples high in carbonates (pH 7.0) are also treated with hydrochloric acid. Then after dispersion by calgon (sodium hexametaphosphate + sodium carbonate), clay and silt were determined by the hydrometer method and sand classes by wet sieving. The limit between the silt and sand fractions is 0.05 mm.

Organic Carbon: For mineral soil layers, organic carbon percentage was determined by the Walkley-Black method, the results being multiplied by 1.3 to arrive at a total carbon figure assuming 77% efficiency. In order to convert organic carbon figures to organic matter percentage, the carbon figures should be multiplied by 1.72.



Nitrogen: Total Nitrogen percentage was determined by the Kjeldahl method using a copper catalyst.

Cation Exchange Capacity (CEC) and exchangeable cations:. These were determined on the ammonium acetate extract at pH 7.0. CEC was determined by leaching out the excess ammonium acetate with alcohol and final leaching with a sodium chloride solution to replace absorbed ammonia.

Exchangeable Ca and Mg: Determined by atomic absorption.

Exchangeable K and Na: Measured on an EEL flame photometer.

Base Saturation percentage (BSP): BSP was calculated as  
$$\frac{\text{Me Ca} + \text{Me Mg} + \text{Me K} + \text{Me Na}}{1} \times 100$$

pH: Soil reaction was determined by glass electrode in 0.01 M.  $\text{CaCl}_2$  using a Soil to  $\text{CaCl}_2$  solution ratio of 1:5.

Available Phosphorus: So-called "available P" was determined by Bray's No. 1 method.

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\* The trend internationally is to raise the limit still further. Several European countries use 0.06 mm as the silt/ sand limit, and the USA National Co-operative Soil Survey proposes to change to this limit sometime in future. This limit is in general use by engineers.



# INTERPRETATION OF SOIL ANALYSIS

The Soil s Advisory Section at Mount Makulu has issued a pamphlet "A guide to the meaning of Soil Analyses" from which the following data are largely used as to interpret the soil analyses and assess the nutrient status for the profile descriptions given in this report.

## PH

The Calcium chloride method gives much more accurate laboratory results and gives a truer measure of what the soil acidity will be under field conditions during during the growing season.

Values obtained by this method are on average about 0.7 units lower than the water pH but in individual soils the difference may be considerably more or less.

It is therefore necessary to draw up an entirely new scale of desirable and critical pH ranges by which to interpret the significance of calcium-chloride pH values. Local experience shows that the following may be safely used as a guide:

Above 7.5 .... Strongly alkaline. Usually unsatisfactory and requiring further investigation.

6.5-7.5 ..... Alkaline, usually on account of the presence of free lime. Satisfactory for most crops, though higher than desirable.

6.0-6.5 ..... Neutral. Highly satisfactory for lucerne, clovers, wheat and barley. Satisfactory for most other crops, but higher than desirable for tobacco.

5.5-6.0 ..... Slightly acid. Highly satisfactory for almost all crops, including tobacco. Lime is not required except in special circumstances.

5.0-5.5 ..... Medium acid. Satisfactory for most crops, but to maintain the pH in this range under regular cultivation liming will be necessary at a suitable stage in the rotation, especially in the higher rainfall areas.

4.5-5.0 ..... Strongly acid. There is a progressive risk of fertility being adversely affected, and the need for lime is becoming urgent.

Below 4.5 ..... Very strongly acid. Severe infertility is likely and liming is essential before planting.

## Organic Carbon

Low 1%

Medium 1-2%

High 2%



### Total Nitrogen

The total N content of a soil is related to its organic matter content. It varies greatly with texture, rainfall, topsoil-subsoil etc.

The following are characteristic ranges of total nitrogen in soils of Zambia.

Texture	Total Nitrogen Per cent.
Sands .....	0.02-0.05
Sandy loams .....	0.04-0.07
Sandy clay loams .....	0.06-0.10
Clays .....	0.10-0.15

### C.E.C.

The cation exchange capacity (CEC) is a measure of the capacity of the soil to hold nutrients against leaching. Calcium is the most tightly held being followed by Mg K N. C.E.C. is dependent on the type and amount of clay and of organic matter. For comparison reasons it is useful to express them in me%/100gr clay.

Following is a guide line for CEC/100gr clay

- Low 16 me% or less
- Medium 16 - 24 me%
- High 24 me% or more

### Base Saturation Percentage(B.S.P.)

This is the relative proportion of the adsorbed H and Al and the exchangeable cations. A rather definite correlation exists between the B.S.P. and its pH.

Following are approximate figures for B.S.P:

- Low 35%
- Medium 35 - 50%
- High 50%

### Available phosphorus

Available Phosphorus (Resin extract) p.p.m.P	Available Phosphorus Status	Yield increases that may be expected with adequate dressing of phosphatic fertilizer ,if other nutrients are also adequate
Less than 3.	Acutely deficient.	Very large (up to double the yield).
3 - 7.	Deficient.	Large (increases of one to two thirds).
7 - 15	Marginal.	Small (increases of less than one thirds).
15 - 25	Adequate	No response likely
above 25	Rich	No response likely



Electrical Conductivity (E.Ce)

This refers to the electrical conductivity of a suspension of one part of soil in five parts of distilled water (1:5)  
This analyses are only being carried out on dambo soils and soils in the hot valley areas where salinity is suspected. The interpretation of conductivity figures depends on factors such as texture of the soil and type of crops to be grown and it is very difficult to give a simple guide.

The following is an attempt and rough guide expressed in mmhos/cm, at 25°C.

Salinity effects mostly negligible: 0-2 mmhos

Yields of very sensitive crops may be restricted: 2-4 mmho

Yields of many crops restricted: 4-8 mmhos

Only tolerant crops yield satisfactorily: 8-16 mmhos

Only a few very tolerant crops yield satisfactorily :>16 mmhos.

Exchangeable Potassium

Potash Status	Exchangeable Potassium mg-equiv./100gr. of Soil)		
	Sands	Sandy-loams	Typical reddish-brown clay
Deficient (responses to potash likely) ..	Below 0.05	Below 0.1	Below 0.15
Marginal (some response likely, if other conditions are suitable for high yield) ..	0.05 -0.1	0.1-0.2	0.15-0.3
Adequate(responses unlikely, but maintenance dressing usually desirable).....	0.1-0.25	0.2-0.3	0.3-0.5
Rich (no potash require) ...	Above 0.25	Above 0.3	Above 0.5



APPENDIX 3.

THE LAND CAPABILITY SYSTEM

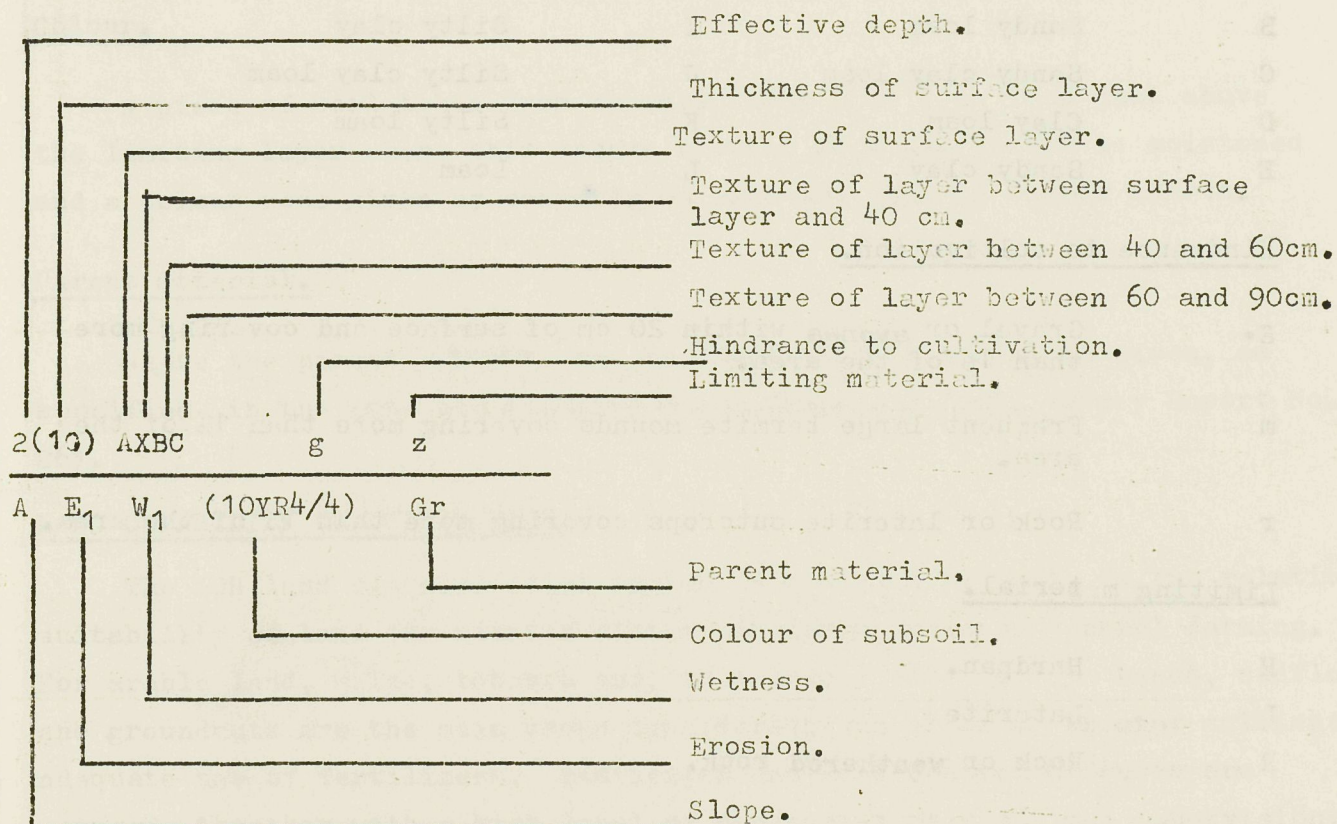
THE LUB CODE.

This code has replaced the older CONEX code, and below is a description of the version in use at the time of the survey.

Soil and land characteristics are described according to standard symbols, five characteristics being recorded above a line, and five below as follows:

EFFECTIVE DEPTH.	THICKNESS OF SURFACE HORIZON.	TEXTURE.	HINDRANCE TO CULTIVATION.	LIMITING MATERIAL
SLOPE.	EROSION.	WETNESS	COLOUR.	PARENT MATERIAL.

Example:



A range of symbols describes each of the above characteristics. These are given below.



APPENDIX 3

Effective depth.

1. More than 90 cm deep.
2. 60-90cm deep.
3. 30 - 60cm deep.
4. Less than 30cm deep.
5. Rock and/or gravel on surface.

Thickness of surface horizon

Given as cm thick only if less than 20cm thick.

Texture.

A	Sand	F	Clay
X	Loamy sand	G	Cracking clay
B	Sandy loam	I	Silty clay
C	Sandy clay loam	J	Silty clay loam
D	Clay loam	K	Silty loam
E	Sandy clay	L	Loam

Hindrance to cultivation.

- g. Gravel or stones within 20 cm of surface and covering more than 1% of the area.
- m Frequent large termite mounds covering more than 1% of the area.
- r Rock or laterite outcrops covering more than 1% of the area.

Limiting material.

- H Hardpan.
- L Laterite
- R Rock or weathered rock.

Slope.

- O - 1%
- A 1 - 3%
- B 3 - 5%
- C 5 - 8%
- D 8 - 12%
- E More than 12%



APPENDIX 3

Erosion.

-	No erosion
E <sub>1</sub>	Slight erosion
E <sub>2</sub>	Moderate erosion.
E <sub>3</sub>	Severe erosion.

Wetness factor.

-	No wetness limitation.
W <sub>1</sub>	Slight wetness.
W <sub>2</sub>	Moderate wetness.
W <sub>3</sub>	Severe wetness.

Colour.

A piece of soil taken from approximately 50cm ( or from just above the limiting layer where this occurs between 20cm and 50 cm) is moistened and a colour code given by comparison with the Munsell colour charts.

Parent material.

Where the parent stones can be identified, a symbol is given, as specified in the Land Use Planning Guide, Chapter 2 (Soil Survey Report No. 26).

LAND CAPABILITY CLASSIFICATION.

The LUB land classification system is designed to indicate the relative suitability of land for rainfed medium and large scale commercial farming. For arable land, maize, tobacco and, to a lesser extent, soya beans, sunflower and groundnuts are the main crops considered; use of ox or tractor cultivation, adequate use of fertilizers, pesticides and weed control measures are assumed, together with a high level of management or technical supervision, which will ensure that the land does not <sup>deteriorate</sup> under arable use. For non arable land, it is assumed that grazing will be the major use, and that this will be practiced in such a way that the land does not deteriorate, whether under intensive or extensive grazing management.



APPENDIX 3

There is a primary division into four land types, as follows:

1. Arable land,
2. Marginal arable land.
3. Grazing land.
4. Unsuitable land.

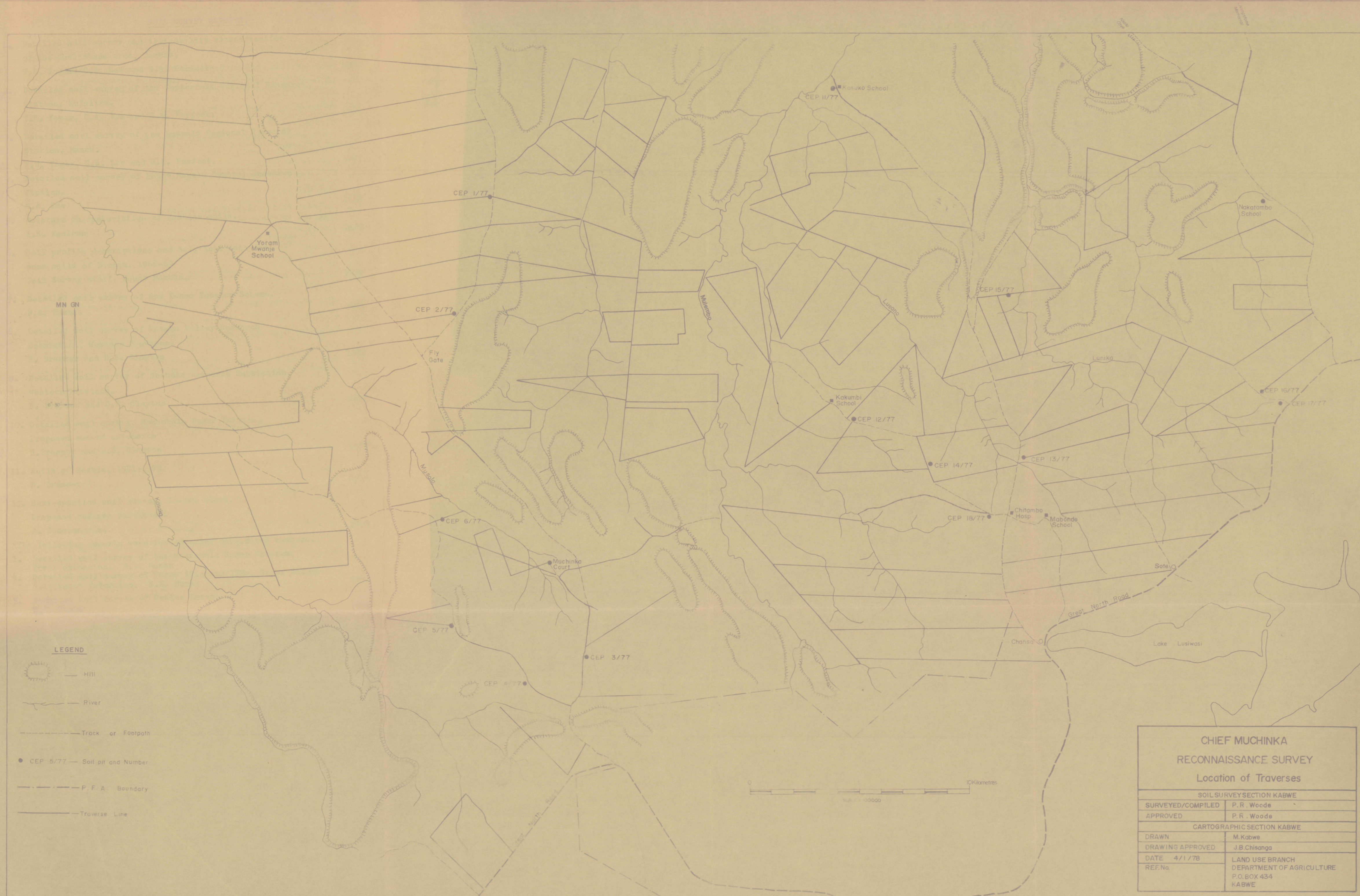
The arable and marginal arable lands are subdivided into three clayey ('C') and four sandy ('S') land classes. 'C' Land classes have a topsoil texture of sandy clay loam or heavier. 'S' land classes have a topsoil texture of sandy loam or lighter. The land classes are as follows:

- |       |                              |
|-------|------------------------------|
| C1,S1 | Good arable land.            |
| C2,S2 | Moderately good arable land. |
| C3,S3 | Poor arable land.            |
| S4    | Very poor arable land.       |

The land classes are subdivided into subclasses by including symbols to indicate the kind of limitations. The symbols are as follows:

- |   |                            |
|---|----------------------------|
| d | Depth to limiting layer.   |
| e | erosion.                   |
| g | Gravely or stoney topsoil  |
| m | Termite mounds             |
| r | rock or laterite outcrops. |
| s | slope.                     |
| t | texture                    |
| w | wetness                    |
| f | fertility.                 |







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1. Detailed soil survey and irrigability classification of the Chalimbana area, Zambia. 1967  
T.U. Yager, C.A. Lee and G.A. Perfect.
2. Detailed soil survey of the Copperbelt Regional Research Station, Mufulira. 1968  
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3. Detailed soil survey of the Luapula Regional Research Station, Mansa. 1968  
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4. Detailed soil survey of Mount Makulu Central Research Station. 1968  
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5. Moisture characteristics of Zambian soils. 1970  
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6. Soil profile descriptions and analytical data for some soils of Zambia, 1968-69. 1970  
Soil Survey staff, Mount Makulu.
7. Detailed soil survey of New Kaoma Tobacco Scheme. 1971  
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8. Detailed soil survey of Katiba Valley Research Substation, Western Province. 1973  
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9. Detailed soil survey of Sesheke Research Substation, Western Province. 1973  
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10. Detailed soil survey, Nakambala Sugar Estates, Proposed second extension. 1973  
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12. Semi-detailed soil survey, Sasare Block, data for Proposed refugee settlement. 1973  
A. Commissaris.

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4. Detailed soil survey of Farms 171a and 172a, Upper Kaleya Settlement Extension. N.E. Mumba. 1971
5. Detailed soil survey of Heales Estate N.E. Mumba. 1971



13. Detailed soil survey, Nakambala Sugar Estates, proposed extension 3 (Farms 554A, 554B, 554Rem, 1342, 1343, 1343 Rem)  
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14. Detailed soil survey, ZAMIC Chisamba Farms (Ntendere, Nsadzuzi, Penyaonse Blocks)  
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15. Detailed soil survey, Mungu River Area (Farms 41a, 42a, 1328a, 1329a)  
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16. Detailed soil survey, Pemba Village  
A.L.T.M. Commissaris 1974
17. Reconnaissance soil survey, Kalunsa area  
O. Haugboth 1974
18. Detailed soil survey, Kabwe Regional Research Station  
O. Haugboth 1974
19. Detailed soil survey, Msekera Regional Research Station  
A.L.T.M. Commissaris 1974
20. Detailed soil survey, Mochipapa Regional Research Station  
J.C. Schmidt and A. Njós 1974
21. Reconnaissance soil survey, Mukonchi East Block  
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22. Reconnaissance soil survey, Mkushi West  
O. Haugboth 1974
23. Reconnaissance soil survey, Kalichero Area  
A.L. T. M. Commissaris 1974
24. Reconnaissance soil survey, Big Concession  
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25. Semi-detailed soil survey, Nakambala Sugar Estates, Extension 4 (Farms 553A, 553 Rem, and 555).  
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26. Land Capability: Land Use Planning Guide, Chapter 2 1974
27. Detailed soil survey of Masumba Research Substation  
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28. Semi-detailed soil survey of Chipangali West A. Commissaris 1975
29. Semi-detailed soil survey of Chinjala Ranch A. Commissaris 1975
30. Semi-detailed soil survey of selected areas for Chipata Squatter Re-organisation Scheme. A. Commissaris 1975
31. Detailed soil survey of Dunelm Estates  
A. Commissaris 1975
32. The Sandveldt Soils of Central Province  
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33. Reconnaissance Soil Survey of the Mutale-Kabundi area  
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By R. Sorensen 1976
34. Detailed Reconnaissance Soil Survey, Mwinuna, East  
Extension Copperbelt Province.  
By A. Commissaris 1976
35. Reconnaissance Soil Survey, Big Consession-North-Western  
Part. Central Province  
By A. Commissaris 1976
36. Detailed Reconnaissance Soil Survey, Mpusu-Kaporosa area  
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37. Reconnaissance Soil Surveys, Parts of the Mkushi District  
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38. Detailed soil survey of the Chifwesa Groundnuts Scheme  
Northern Province  
By L.A. Van Sleen 1976
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40. Detailed soil survey of the Lubu Valley with settlement  
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41. Detailed soil survey of the Misamfu Regional Research  
Station Northern Province.  
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42. Detailed Reconnaissance Soil Survey of the Mambwe I.D.Z.  
Area Northern Province.  
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43. Semi-detailed soil survey of the Munkonge T.B.Z. Area,  
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44. Reconnaissance Soil Survey of the proposed second Sugar  
Estate Luena Area, Luapula Province.  
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45. Semi-detailed Soil Survey of the proposed second Sugar  
Estate Luena Area.  
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46. Detailed soil survey of Magoye Regional Research Station  
Southern Province  
By V.R. Chinene 1977
47. Rapid Reconnaissance soil survey of the Mwinilunga  
and Solwezi Districts N.W. PROVINCE.  
By. P. Heilmann 1978

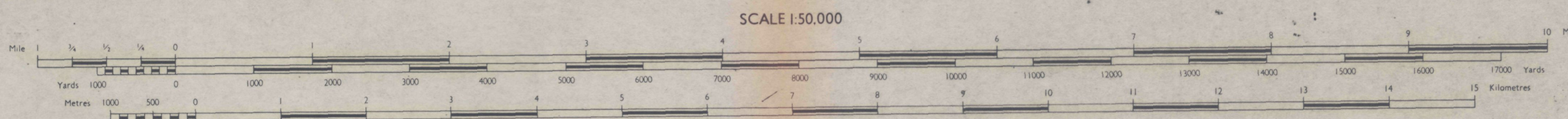


48. Detailed soil survey of the Nakambala Extensions Area,  
Southern Province  
By A. Commissaris and . Storrb 1978
49. Detailed soil survey of the Katito proposed wheat scheme  
Mbala, Northern Province  
By J. Slørdal and B. Nyendwa 1978
50. Detailed Reconnaissance soil survey of the Senga Hill area  
Northern Province  
By B. Nyendwa 1978
51. Reconnaissance soil survey of Chief Muchinka's area,  
Serenje District, Central Province  
By. P. Woode
52. Rapid Reconnaissance soil survey of Chief Kafinda's area  
Serenje District, Central Province  
By P. Woode 1978
53. Semi-detailed soil survey of the Mpongwe Block I and II  
GRZ/EEC irrigated wheat scheme, Copperbelt Province  
By P. Heilmann 1978
54. Semi-detailed soil survey of Nyangombi settlement  
scheme, North-Western Province  
By. P. Helmann 1978
55. Semi-detailed soil survey of Jivundu Settlement scheme,  
North- Eastern Province  
By P. Helmann 1978
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Southern Province  
By P. Helmann 1978
56. Detailed soil survey of Kateshi Rucom Coffee Estate,  
Northern Province  
By J. Slørdal 1978
49. Detailed soil survey of the Katito proposed wheat scheme  
Mbala, Northern Province  
By J. Slørdal and B. Nyendwa 1978
57. Semi-detailed soil survey of Mr. Musakanya's Estate  
Northern Province  
By J. Slørdal 1978
50. Detailed soil survey of the Senga Hill area  
Northern Province  
By B. Nyendwa 1978
51. Semi-detailed soil survey of Mbala State Ranch  
Northern Part  
Northern Province  
By: J. Slørdal 1978
52. Rapid Reconnaissance soil survey of Chief Kafinda's area
59. Detailed soil Survey of eight proposed rice schemes,  
Northern and Luapula Provinces  
By J. Slørdal 1978
53. Semi-detailed soil survey of the Mpongwe Block I and II  
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ADMINISTRATIVE BOUNDARIES  
SERENJE DISTRICT  
CENTRAL PROVINCE  
TRUST LAND No. 11

RELIABILITY DIAGRAM  
AIR PHOTOGRAPHY  
JUNE-JULY 1965

1230 C1	1230 C2	1230 D1
1230 C3	1230 C4	1230 D3
1330 A1	1330 A2	1330 B1

SHEET HISTORY  
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Air Photography by Air Survey Ltd., January 1965.  
Field Completion by Ministry of Lands and Natural Resources, Lusaka, Zambia, 1966.

### CHIEF MUCHINKA RECONNAISSANCE SOIL SURVEY SOIL LEGEND

- WELL DRAINED SOILS ON CREST, UPPER AND MIDDLE SLOPES**
- 1 Well drained, loamy sand, sandy loam or sandy clay loam, over yellowish red to reddish brown sandy clay loam. Laterite gravel common in lower subsoil.
- 12 Well drained, loamy sand or sandy loam, over red sand clay loam. Frequently associated with bands of sandstone outcrops 100-200 metres apart, mapping unit 7 occurs as an inclusion close to the outcrops.
- 7 Deep to moderately deep well to somewhat excessively well drained, sand, over red to dark red sand to sandy loam. Occurs close to rock outcrops in the piedmont position.
- MODERATELY WELL DRAINED SOILS ON LOWER SLOPES**
- 2 Moderately well drained, sandy loam or sandy clay loam, over yellowish red to brownish yellow sandy clay loam. Occasionally occurs in association with mapping unit 6
- IMPERFECTLY DRAINED SOILS ON LOWER SLOPES AND DAMBO EDGES.**
- 6 Imperfectly drained, sand or loamy sand, over light grey to pale brown sandy loam, with abrupt change to sandy clay loam in lower subsoil. Occurs in association with mapping unit 14.
- 14 Deep, imperfectly drained, sand or loamy sand, over light brownish grey loamy sand, occurring at dambo heads.
- POORLY AND VERY POORLY DRAINED SOILS IN DAMBOS**
- 13 Association of dambo soils. Typically deep poorly drained, sand to sandy loam, over pale brown sandy loam to sandy clay loam. Shallow soils with scattered rock outcrops occur as inclusions.
- OTHER SOILS**
- 9 Extensive shallow soils or large outcrops and hills.
- NB Suffix a denotes deep to moderately deep soils (eg 2a)  
Suffix b denotes moderately shallow to shallow soils (eg 1b)  
XXXX Bands of rock outcrops

Survey by P.R. Woods 1977

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Grid North  
True North  
Magnetic North  
7°42' 35'

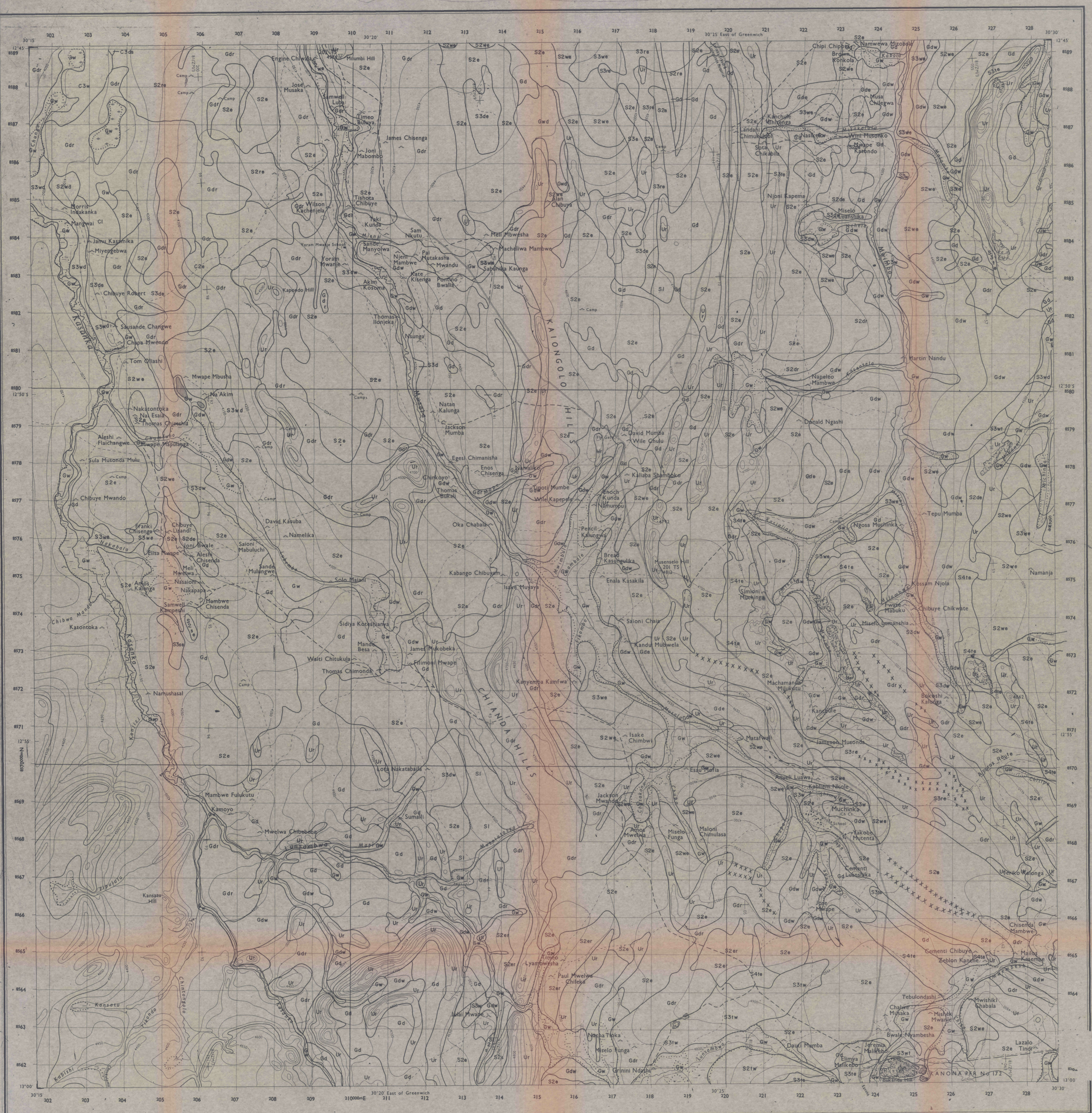
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36L  
TA

UTM Zone 36  
Transverse Mercator  
Clarke 1880 (Modified)  
Metre  
3750 East of Greenwich  
Datum  
500,000 Easting  
10,000,000 Northing  
New 1950 Arc

TO GIVE A GRID REFERENCE ON THIS SHEET  
LETTERS TA 181 751  
REFERENCE TA 181 751

TO GIVE A GRID REFERENCE ON THIS SHEET  
LETTERS TA 181 751  
REFERENCE TA 181 751





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ADMINISTRATIVE BOUNDARIES
SERENJE DISTRICT
CENTRAL PROVINCE
TRUST LAND No. 11

RELIABILITY DIAGRAM
AIR PHOTOGRAPHY
JUNE-JULY 1963

INDEX TO ADJOINING SHEETS
1230 C1 1230 C2 1230 D1
1230 C3 1230 C4 1230 D3
1330 A1 1330 A2 1330 B1

LAND CLASSIFICATION LEGEND

ARABLE LAND	MAP COLOUR	UNSUITABLE LAND	MAP COLOUR
C1 Good arable land (No limitations)	C1... Dark red S1... Light red	Uw Permanently wet land (Limitations... w only)	Uw... Blue
C2 Moderately good arable land (Limitations as below)	C2... Dark brown S2... Light brown	U Other unsuitable land (Limitations as below)	U... Purple
MARGINAL ARABLE LAND		LIMITATIONS APPLIED (Except to C1, S1, S4t Uw)	
C3 Poor arable land (Limitations as below)	C3... Dark yellow S3... Light yellow	d... depth to limiting layer e... erosion g... gravelly stony topsoil m... large termite mounds r... rocks or irregular relief s... slope	f... texture heavy clay or deep sand w... wetness z... gravelly or stony subsoil (a... alkali or salt) (f... fertility)
S4t Very poor arable land (Limitations... only)	S4t... Very light yellow	XXXX Bands of rock outcrops	
GRAZING LAND			
Gw Winter grazing land (Limitations w or w as below)	Gw... Blue green		
G Summer grazing land (Limitations as below)	G... Light green		

Survey by P.R. Woods 1977

Copies of this soil map may be obtained from Department of Agriculture, Land Use Branch, P.O. Box RW 291 Lusaka

GRID ZONE DESIGNATION	36L
180,000 M.S.D. IDENTIFICATION	TA
POINT V. 201 TS	LETTERS TA
EAST	TA 18 75
NORTH	TA 181 751
REFERENCE	TA 181 751

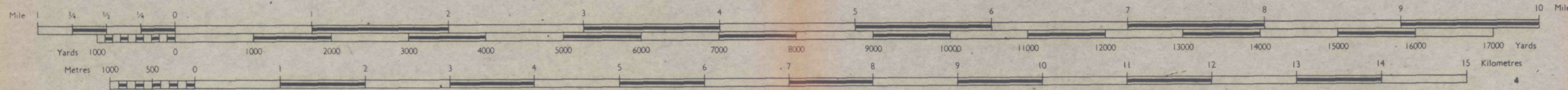
First Edition prepared by the British Government's Ministry of Overseas Development (Directorate of Overseas Surveys) under the Special Commonwealth African Assistance Plan, 1967 (D.O.S. 424).  
Air Photography by Fairley Survey Ltd., June-July 1963.  
Field Completion by Ministry of Lands and Natural Resources, Lusaka, Zambia, 1966.





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ADMINISTRATIVE BOUNDARIES  
SERENJE DISTRICT  
CENTRAL PROVINCE  
TRUST LAND No. XX

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AIR PHOTOGRAPHY  
JUNE 1973 1963

1230 C2	1230 D1	1230 D2
1230 C4	1230 D3	1230 D4
1330 A2	1330 B1	1330 B2

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Aerial Photography by Aerial Survey Ltd., June/July 1965.  
Map Completion by Ministry of Lands and Natural Resources, Lusaka, Zambia, 1966.

### CHIEF MUCHINKA RECONNAISSANCE SOIL SURVEY SOIL LEGEND

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- Well drained, loamy sand or sandy loam, over red sand clay loam. Frequently associated with bands of sandstone outcrops 100-200 metres apart, mapping unit 7 occurs as an inclusion close to the outcrops.

#### MODERATELY WELL DRAINED SOILS ON LOWER SLOPES

- Moderately well drained, sandy loam or sandy clay loam, over yellowish red to brownish yellow sandy clay loam. Occasionally occurs in association with mapping unit 6

#### IMPERFECTLY DRAINED SOILS ON LOWER SLOPES AND DAMBO EDGES

- Imperfectly drained, sand or loamy sand, over light grey to pale brown sandy loam, with abrupt change to sandy clay loam in lower subsoil. Occurs in association with mapping unit 14.
- Deep, imperfectly drained, sand or loamy sand, over light brownish grey loam sand, occurring at dambo heads.

#### POORLY AND VERY POORLY DRAINED SOILS IN DAMBOS

- Association of dambo soils. Typically deep poorly drained, sand to sandy loam, over pale brown sandy loam to sandy clay loam. Shallow soils with scattered rock outcrops occur as inclusions.

#### OTHER SOILS

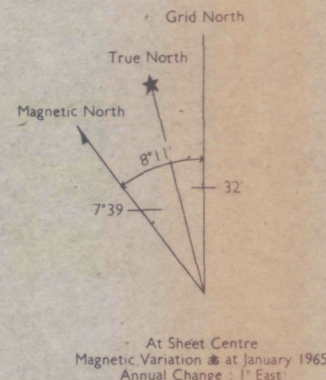
- Extensive shallow soils or large outcrops and hills.

Suffix a denotes deep to moderately deep soils (eg 2a)  
Suffix b denotes moderately shallow to shallow soils (eg 1b)

Survey by P.R. Woode 1977

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M.H.C



At Sheet Centre  
Magnetic Variation 8° at January 1965  
Annual Change 1' East

The numbered lines indicate the 1000 metres Universal Transverse Mercator Grid Zone 36.

Curves 180° (Universal Transverse Mercator) and 180° (Universal Transverse Mercator) are shown.

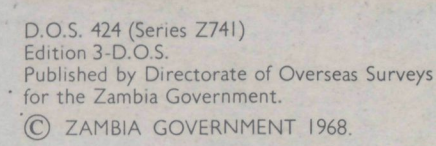
TO GIVE A GRID REFERENCE FOR THIS SHEET  
LETTERS 36-40 (Universal Transverse Mercator) and 180° (Universal Transverse Mercator) are shown.

POINT 204 15  
LETTERS 36-40 (Universal Transverse Mercator) and 180° (Universal Transverse Mercator) are shown.

REFERENCE TA 516 691  
Units: Metres, Feet, Yards, Kilometres, Miles

U.T.M. Zone 36  
Transverse Mercator  
Clarke 1880 (Modified)  
Metre  
3300' East of Greenwich  
Equator  
0.9996  
100,000' Easting  
100,000' Northing  
1960-1969 Arc





The ruler displays distances in three units: miles, yards, and metres. The top scale shows miles from 0 to 10, with corresponding yard markings from 0 to 17,000. The bottom scale shows metres from 0 to 15,000. The ruler is marked with major intervals every 1,000 yards or 1,000 metres, and minor intervals every 500 yards or 500 metres.

Users noting corrections or additions to this map are requested to annotate and send it to the Director of Overseas Surveys, Tolworth, Surrey, England, or to the Surveyor-General, Ministry of Lands and Mines, Lusaka, Zambia. The map will be replaced.

a NORTHERN PROVINCE  
MPIKA DISTRICT  
TRUST LAND No XX

b Excluded from Trust Land No XX

## MAP COLOUR

U... Purple

ure heavy clay or deep sand  
tness  
avelly or stony subsoil  
(kali or salt)  
ertility)

Gw...Blue green

G... Light green

M.H.C.

Copies of this soil map may be obtained from Department of Agriculture, Land Use Branch, P.O. Box RW 291 Lusaka