

## 6. その他の資料・情報

6-1 敷地測量図

6-2 土質調査結果

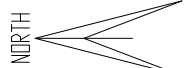
6-3 井戸試掘調査結果

# 6-1 敷地測量図

TOPOGRAPHICAL SURVEY OF MKWICHI COMMUNITY DAY SECONDARY SCHOOL  
 PLOT 47/519 - LILONGWE CITY

BENCHMARKS : 465C 1060805m (Iron peg in concrete)  
 B3 1066112m

CONTOUR INTERVAL : 0.50m



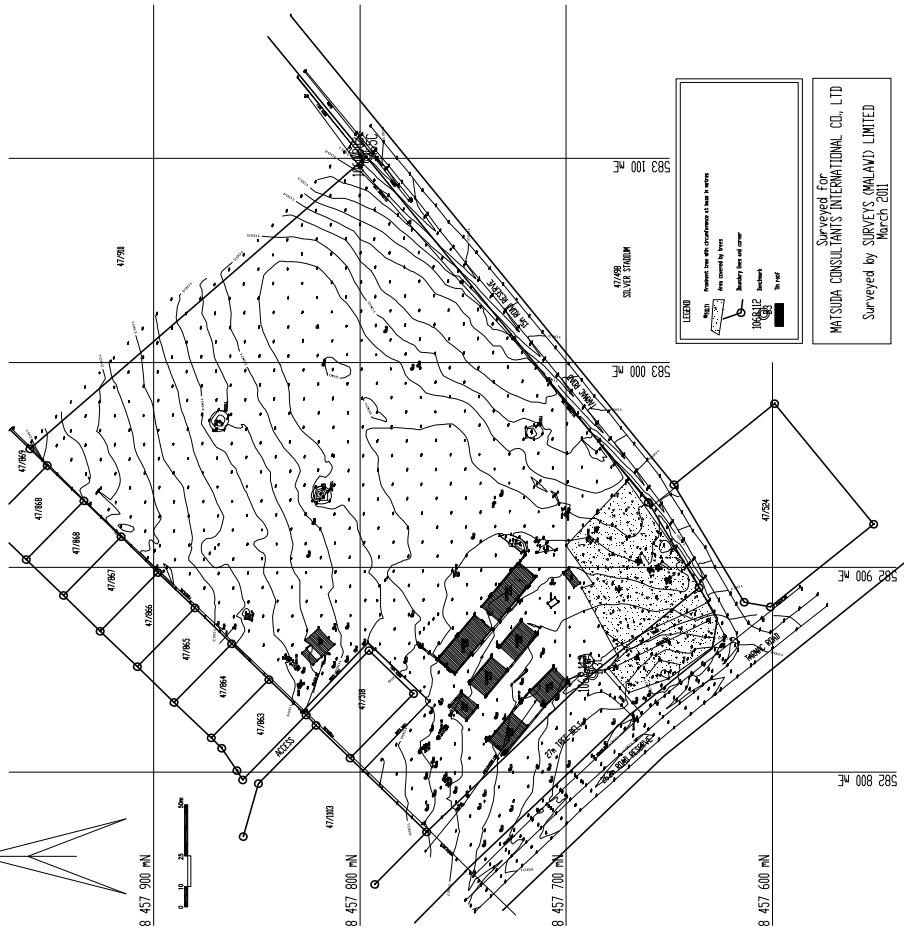
9 457 900 mN



9 457 800 mN

9 457 700 mN

9 457 600 mN



**LEGEND**

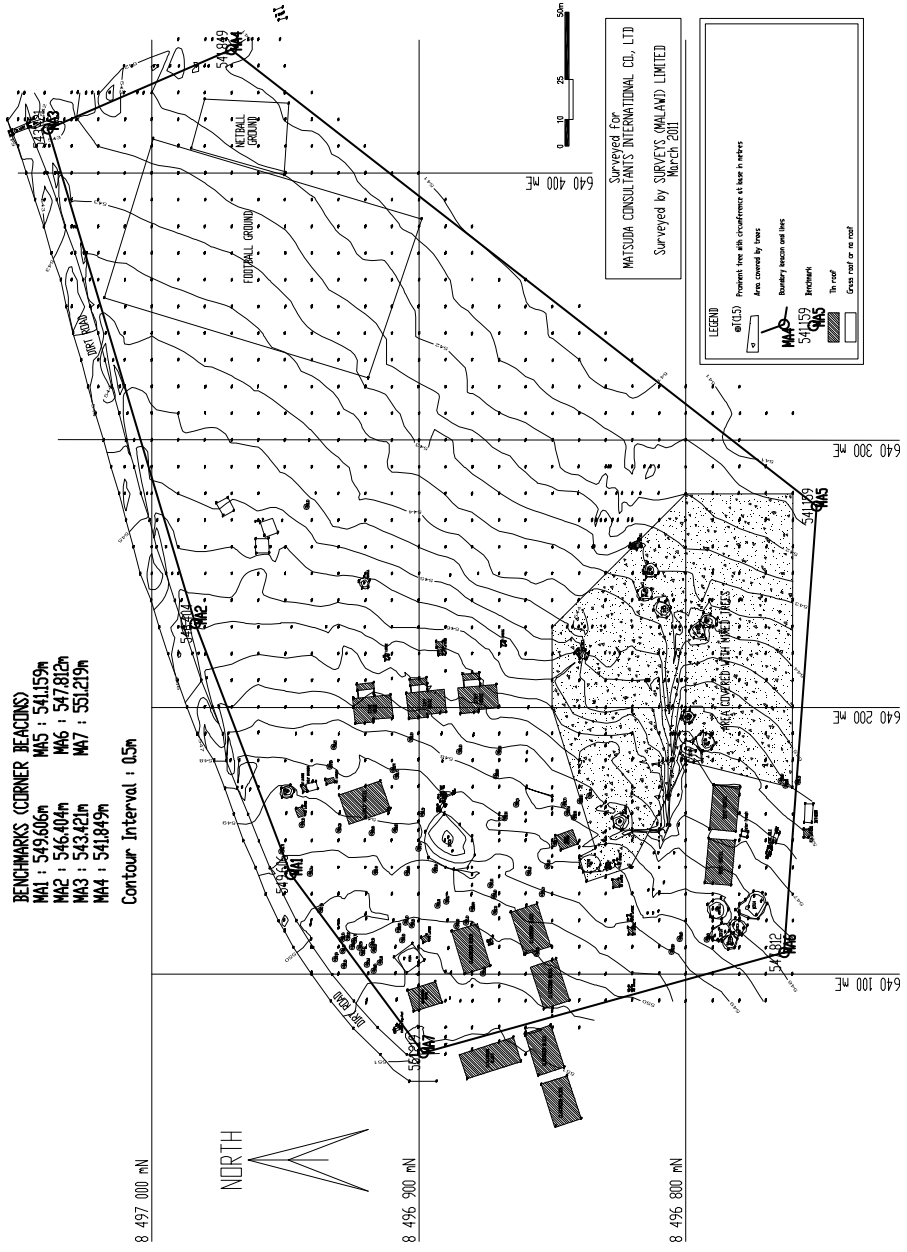
- Contours: Contours with elevations as shown in metric
- Buildings: Area covered by trees
- Infrastructure: Boundary lines and other
- Other: Backsight, Foresight, etc.

Surveyed for  
 MATSUDA CONSULTANTS INTERNATIONAL CO., LTD  
 Surveyed by SURVEYS (MALAWI) LIMITED  
 March 2011

# TOPOGRAPHICAL SURVEY OF MATENJE COMMUNITY DAY SECONDARY SCHOOL

BENCHMARKS (CORNER BEACONS)  
 MA1 : 549.606m    MA5 : 541.159m  
 MA2 : 546.404m    MA6 : 547.812m  
 MA3 : 543.421m    MA7 : 551.219m  
 MA4 : 541.849m

Contour Interval : 0.5m



# TOPOGRAPHIC SURVEY OF LIVALADZI COMMUNITY DAY SECONDARY SCHOOL

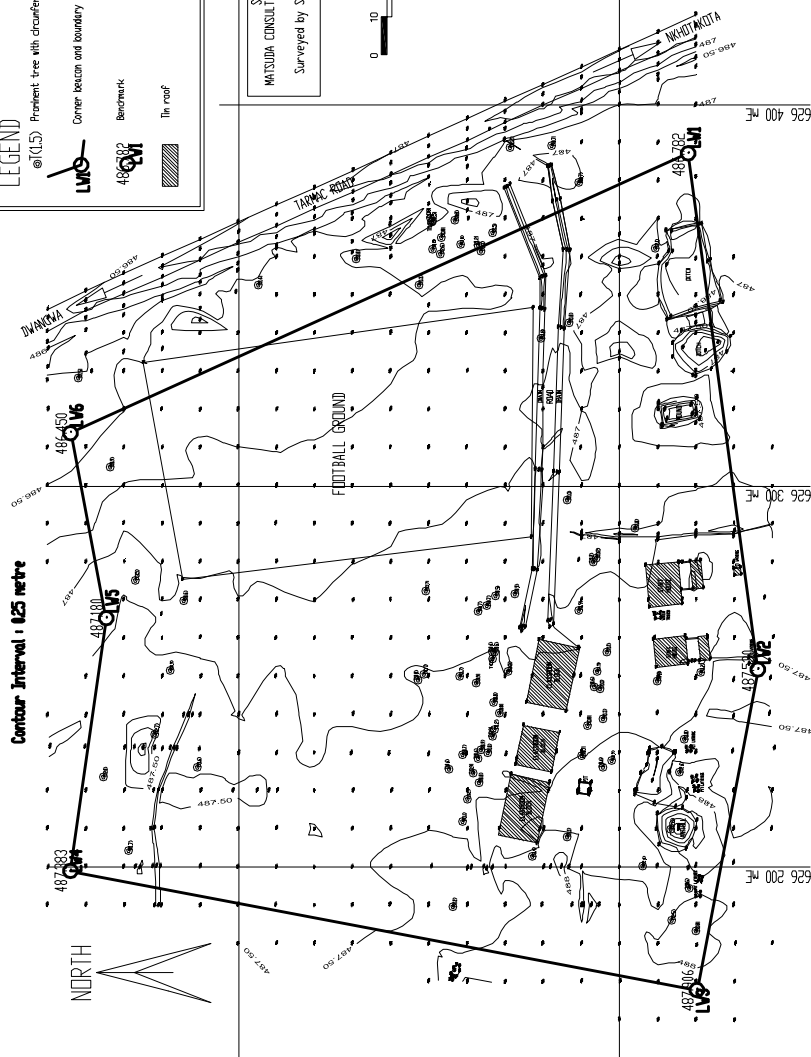
**BENCHMARKS (CORNER STATIONS)**  
 LV1 : 485.72m    LV4 : 487.33m  
 LV2 : 487.53m    LV5 : 487.18m  
 LV3 : 487.56m    LV6 : 486.55m

Contour Interval : 0.25 metre

**LEGEND**

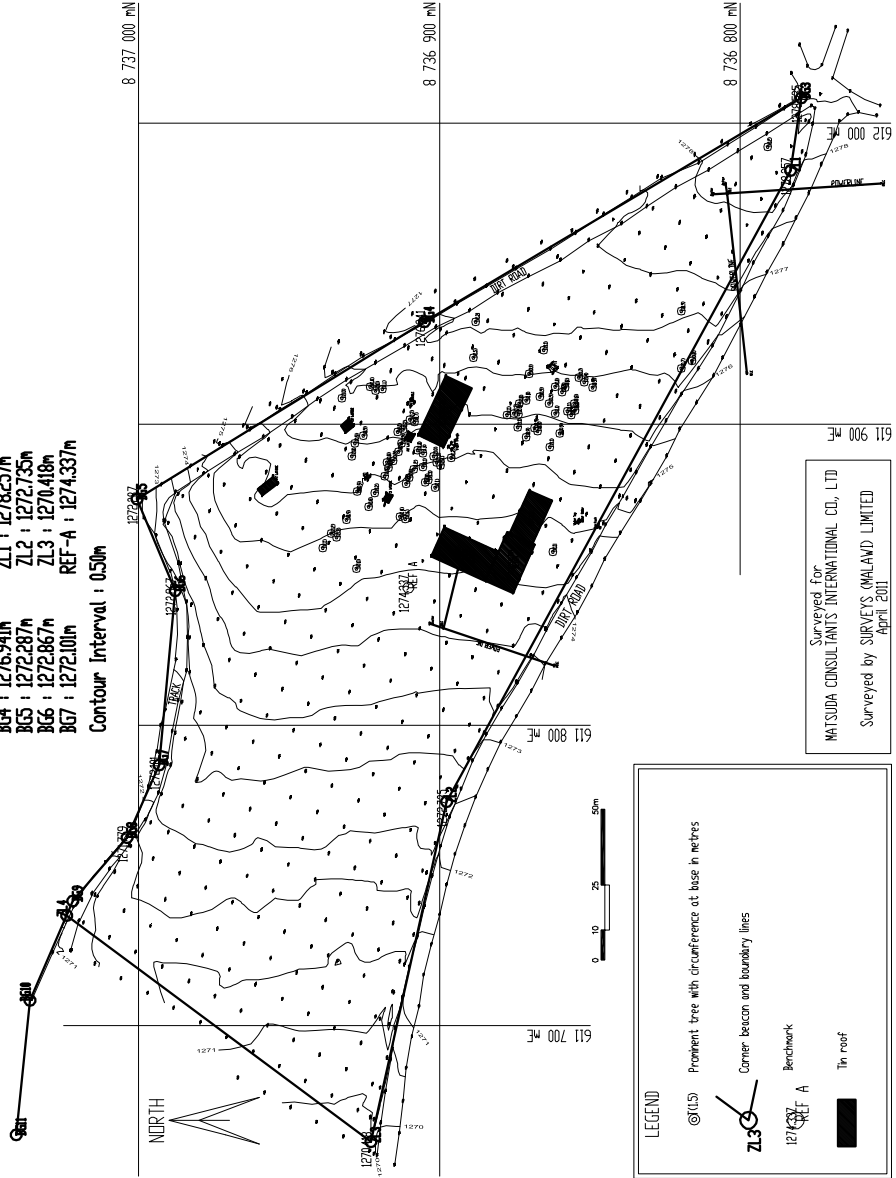
- ①(L.S) Prominent tree with circumference of base in metres
- Corner Station and boundary lines
- Benchmark
- Tin roof

8 605 600 mN  
 Surveyed for  
 MHSUDA CONSULTANTS INTERNATIONAL CO. LTD  
 Surveyed by SURVEYS MALAWI LIMITED  
 MARCH 2011



# TOPOGRAPHIC SURVEY OF ZOZOLO COMMUNITY DAY SECONDARY SCHOOL

**BENCHMARKS (Iron Peg in Concrete)**  
 B63 : 1278.535m      B68 : 1271.779m  
 B64 : 1276.941m      ZL1 : 1278.257m  
 B65 : 1272.287m      ZL2 : 1272.735m  
 B66 : 1272.867m      ZL3 : 1270.418m  
 B67 : 1272.101m      REF-A : 1274.337m  
 Contour Interval : 0.50m



**LEGEND**

- ⊙(15) Prominent tree with circumference at base in metres
- ZL3 Corner beacon and boundary lines
- 1274.337 REF-A Benchmark
- Tin roof

Surveyed For  
 MATSUDA CONSULTANTS INTERNATIONAL CO., LTD  
 Surveyed by SURVEYS (HAWAII) LIMITED  
 April 2011

TOPOGRAPHICAL SURVEY OF MPAMBA COMMUNITY DAY SECONDARY SCHOOL

BENCHMARKS (Iron Peg in Concrete)

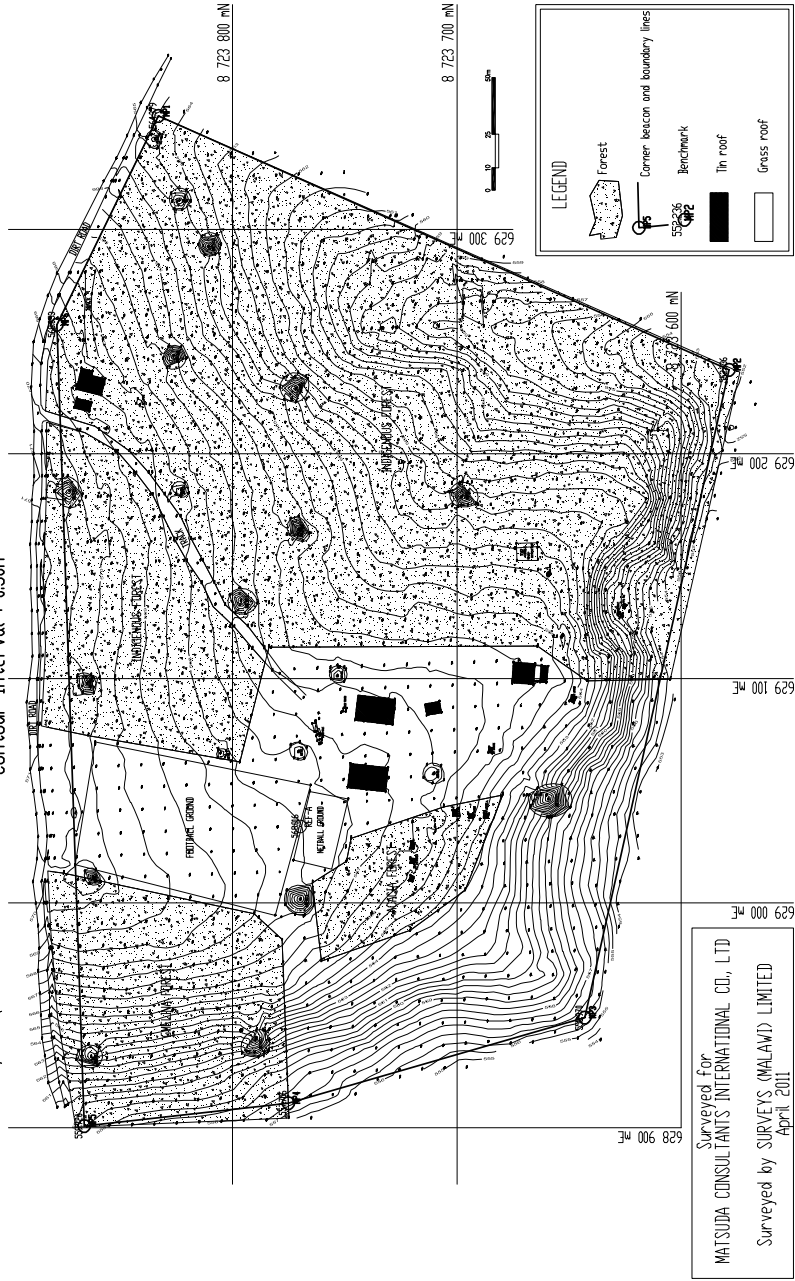
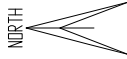
MP1 : 564.379m MP5 : 559.726m

MP2 : 552.236m MP6 : 568.853m

MP3 : 555.970m REF-A : 568.016m

MP4 : 557.706m

Contour Interval : 0.50m



# TOPOGRAPHIC SURVEY OF EZONDWENI COMMUNITY DAY SECONDARY SCHOOL

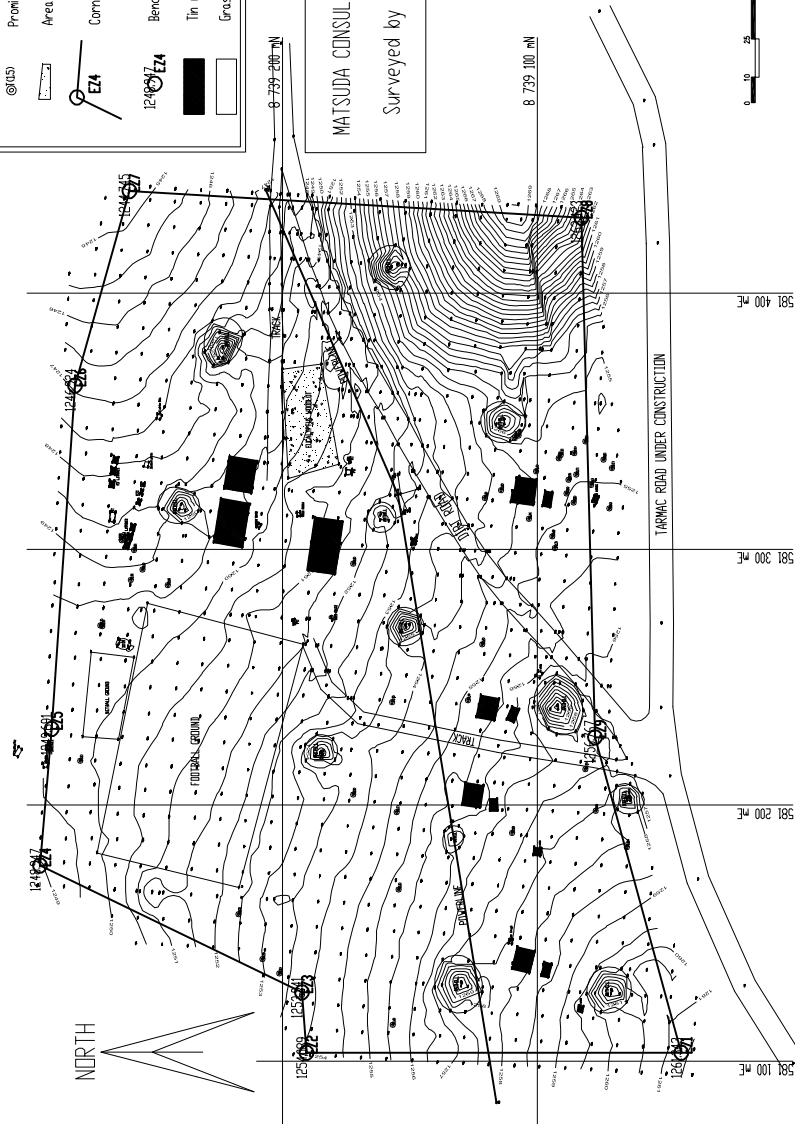
BENCHMARKS (Iron Peg in Concrete)  
 EZ1 : 1261.343m  
 EZ2 : 1254.089m  
 EZ3 : 1253.941m  
 EZ4 : 1248.947m  
 EZ5 : 1,249.691m  
 EZ6 : 1246.924m  
 EZ7 : 1244.745m  
 EZ8 : 1263.423m  
 EZ9 : 1256.767m

Contour Interval : 0.50m

**LEGEND**

- ⊙(45) Prominent tree with circumference at base in metres
- Area covered by trees
- Corner beacon and boundary lines
- Benchmark
- Tin roof
- Grass roof

Surveyed for  
 MATSUDA CONSULTANTS INTERNATIONAL CO., LTD  
 Surveyed by SURVEYS (MALAWI) LIMITED  
 April 2011



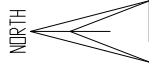
# TOPOGRAPHIC SURVEY OF EDINGENI COMMUNITY DAY SECONDARY SCHOOL

BENCHMARKS (IRON PEGS IN CONCRETE)

REF-A : 1200.568m

REF-B : 1201.510m

Contour Interval : 0.50m





**6-2 土質調査結果 (Abstract)**

**MALAWI POLYTECHNIC  
CIVIL ENGINEERING DEPARTMENT**

**REPORT ON GEOTECHNICAL INVESTIGATIONS ON THE PROJECT  
FOR RE-CONSTRUCTION AND EXPANSION  
OF SELECTED COMMUNITY DAY SECONDARY SCHOOLS (CDSSs)  
PHASE II**

**TO: MATSUDA INTERNATIONAL CONSULTANTS**

**PREPARED BY: TUTULE MSUKWA, MPhil, BSc Civil Eng,  
Reng.**

**Geotechnical Engineer**

**May 2011**

## **INTRODUCTION**

### **1.1 General**

Matsuda International Consultant contacted Malawi Polytechnic, Civil Engineering Department to conduct geotechnical investigations and recommend appropriate bearing capacity of structures on various sites in Malawi, namely; Mkwichi CDSS in Lilongwe District, Matenje CDSS in Salima District, Liwaladzi CDSS in Nkhotakota, Mpamba CDSS in Nkhata-Bay and Edingeni, Ezondweni and Zolozolo CDSS in Mzimba district.

Site reconnaissance, insitu testing and soil sampling for all the sites were carried out from 24th March 2011 to 31<sup>st</sup> March 2011. Laboratory testing proceeded immediately at the Malawi Polytechnic Laboratory in Blantyre.

### **1.2 Project Description**

It is our understanding that the project involves the construction of new standard classroom blocks, laboratory blocks and staff houses in the selected CDSSs. From our knowledge of schools structures in Malawi it is our understanding that the structures to be built will be ground level structures with no storeys and that the structures will be mainly load bearing walls resting on standard mass concrete strip footings.

### **1.3 Objectives of the Soil Investigation**

The purpose of the geotechnical exploration exercise was to:

1. To determine the subsoil conditions under the proposed sites for the construction of tanks.
2. To determine the engineering properties of the subsoil.
3. To comment on the type of foundation to be adopted.
4. To assess the bearing capacity of the soil in line with standard strip footings of width 690mm.

## **2 Soil Sampling and Testing**

In all there were eight sites. In all the sites, trial pits were dug in order to reveal the soil profile, carry out insitu tests and get samples for laboratory testing. Location for trial pits were agreed with Matsuda Consultants. The trial pits were approximately two metres deep. Insitu tests carried out, were Water Penetration test (WPT) and Dynamic Cone Penetration Test (DCP). The soil samples recovered from the trial pits were taken to the Polytechnic laboratory, and examined to confirm the field descriptions. Representative samples were then selected for classification tests (plasticity and grading test) and compaction test. Where possible undisturbed samples for triaxial testing were collected.

### **2.1 Mkwichi CDSS**

Six trial pits for sample collection and testing were dug at and around Mkwichi CDSS. In addition three more pits were dug for Water penetration test. Furthermore 50 points were selected for DCP testing.

Observations on trial pits at 2m depth and classification tests indicated that the soils were basically dark brown firm sandy clays with traces of gravel size materials but nevertheless some pits, pit 4 and 5 showed the presence of a decomposed light grey rock which was difficult to cultivate.

From the triaxial test, the worst case scenario was observed on Pit no. 6 which gave an angle of friction of 11.6 degrees and cohesion intercept of 63kN/m<sup>2</sup>. Using Terzaghis Ultimate bearing capacity equation and assuming a 1m deep foundation and 690mm wide strip footing, the ultimate bearing capacity of the soil is 622kN/m<sup>2</sup>. Applying a Factor of safety of two the safe bearing capacity is 311kN/m<sup>2</sup>.

From the DCP test it was observed that most areas had a Penetration index of more than 20mm/blow (approx CBR of 10). This indicates that basically the surface at Mkwichi CDSS is weak, foundations need to be placed at a depth of more than 1.5m to reach firm ground which has been evidenced by observations and triaxial test results on samples from trial pits. The water penetration results gave an average percolation value of 3.55mm/min which is quite good for soakaways.

### **2.2 Edingeni CDSS**

Six trial pits for sample collection and testing were dug at and around Edingeni CDSS. Water penetration test failed because the pits could not hold water, i.e the permeability was high. 60 points were selected for DCP testing.

Observations on trial pits at 2m depth and classification tests indicated that the soils were basically dark red firm clayey sand soils. Only pit 5 shows a presence of a slightly decomposed rock at 2m depth.

From the triaxial test, the worst case scenario was observed on Pit no. 4 which gave an angle of friction of 10.4 degrees and cohesion intercept of 55kN/m<sup>2</sup>. Using Terzaghis Ultimate bearing capacity equation and assuming a 1m deep foundation and 690mm wide strip footing, the ultimate bearing capacity of the soil is 526kN/m<sup>2</sup>. Applying a Factor of safety of two the safe bearing capacity is 263kN/m<sup>2</sup>.

From the DCP test it was observed that most areas had a Penetration index of more than 20mm/blow (approx CBR of 10). This indicates that basically the surface at Edingeni CDSS is weak, foundations need to be placed at a depth of more than 1.5m to reach firm ground which has been evidenced by observations and triaxial test results from trial pits.

### **2.3 Ezondweni CDSS**

Six trial pits for sample collection and testing were dug at and around Mkwichi CDSS. In addition three more pits were dug for Water penetration test. Furthermore 50 points were selected for DCP testing.

Observations on trial pits at 2m depth and classification tests indicated that the soils were basically dark brown firm clays of high plasticity with traces of sand size.

From the triaxial test, the worst case scenario was observed on Pit no. 5 which gave an angle of friction of 11.3 degrees and cohesion intercept of 54kN/m<sup>2</sup>. Using Terzaghis Ultimate bearing capacity equation and assuming a 1m deep foundation and 690mm wide strip footing, the ultimate bearing capacity of the soil is 540kN/m<sup>2</sup>. Applying a Factor of safety of two the safe bearing capacity is 270kN/m<sup>2</sup>.

From the DCP test it was observed that most areas had a Penetration index of more than 20mm/blow (approx CBR of 10). This indicates that basically the surface at Ezondweni CDSS is weak, foundations need to be placed at a depth of more than 1.5m to reach firm ground which has been evidenced by observations and triaxial test results on samples from trial pits.

The water penetration results gave an average percolation value of 2.25mm/min which is adequate for soakaways.

### **2.4 Zolozolo CDSS**

Six trial pits for sample collection and testing were dug at and around Zolozolo CDSS. Water penetration test failed because the pits could not hold water, i.e. the permeability was high. 50 points were selected for DCP testing.

Observations on trial pits at 2m depth and classification tests indicated that the soils were basically light grey loose sands with occasional silt size particles. The soils were basically non-plastic.

Triaxial test was not carried out because of the nature of the soil. From observation and literature, a safe bearing capacity of  $100\text{kN/m}^2$  can be adopted for 690mm footing. Nevertheless the foundation trench should be treated by putting a well compacted gravel layer of at least 200mm thick before placing the foundation concrete. The gravel layer should be compacted to at least 95%MDD.

## **2.5 Mpamba CDSS**

Six trial pits for sample collection and testing were dug at and around Mpamba CDSS. In addition three more pits were dug for Water penetration test. Furthermore 60 points were selected for DCP testing.

Observations on trial pits at 2m depth and classification tests indicated that the soils were basically reddish loose sandy silt soils. The soils were basically very plastic.

Triaxial test was not carried out because of the nature of the soil. From observation and literature, a safe bearing capacity of  $100\text{kN/m}^2$  can be adopted for 690mm footing. Nevertheless the foundation trench should be treated by putting a well compacted gravel layer of at least 200mm thick before placing the foundation concrete. The gravel layer should be compacted to at least 95%MDD.

The water penetration results gave an average percolation value of 1.23mm/min which is quite low indicating that the soils are of low permeability.

## **2.6 Liwaladzi CDSS**

Six trial pits for sample collection and testing were dug at and around Liwaladzi CDSS. Water Penetration test was not possible because the area was basically water logged. Furthermore 50 points were selected for DCP testing.

Observations on trial pits at 2m depth and classification tests indicated that the soils were basically dark brown firm clays of high plasticity with traces of sand size.

From the triaxial test, the worst case scenario was observed on Pit no. 5 which gave an angle of friction of 9.5 degrees and cohesion intercept of  $33\text{kN/m}^2$ . Using Terzaghis Ultimate bearing capacity equation and assuming a 1m deep foundation and 690mm wide strip footing, the ultimate bearing capacity of the soil is  $310\text{kN/m}^2$ . Applying a Factor of safety of two the safe bearing capacity is  $155\text{kN/m}^2$ .

From the DCP test it was observed that most areas had a Penetration index of more than 20mm/blow (approx CBR of 10). This indicates that basically the surface at Liwaladzi CDSS

is weak , foundations need to be placed at a depth of more than 1.5m to reach firm ground which has been evidenced by observations and triaxial test results on samples from trial pits.

## **2.7 Matenje CDSS**

Six trial pits for sample collection and testing were dug at and around Matenje CDSS. Water Penetration test was carried out on three pits. Furthermore 50 points were selected for DCP testing.

Observations on trial pits at 2m depth and classification tests indicated that the soils were basically dark brown firm clays of high plasticity with traces of sand size.

From the triaxial test, the worst case scenario was observed on Pit no. 5 which gave an angle of friction of 14.6 degrees and cohesion intercept of 57kN/m<sup>2</sup>. Using Terzaghis Ultimate bearing capacity equation and assuming a 1m deep foundation and 690mm wide strip footing, the ultimate bearing capacity of the soil is 648kN/m<sup>2</sup>. Applying a Factor of safety of two the safe bearing capacity is 324kN/m<sup>2</sup>.

From the DCP test it was observed that not many areas had a Penetration index of more than 20mm/blow (approx CBR of 10). This indicates that basically the surface at Liwaladzi CDSS is stable for normal strip footing.

The water penetration results gave an average percolation value of 3.8mm/min which is adequate for soakaways.

### **3 RECOMMENDATIONS**

The soil conditions at the proposed CDSS are adequate for Mkwichi CDSS, Edingeni CDSS, Ezondweni CDSS, Liwaladzi CDSS and Matenje CDSS (safe bearing capacity for a strip footing of 690mm greater than 150kN/m<sup>2</sup>). For Zolozolo CDSS and Mpamba CDSS the foundation trench should be treated by laying at least a 200mm layer of well compacted gravel to 95% MDD.

### **4 References**

1. Soil mechanics by R.F. Graig
2. Elements of Soil mechanics by G.N. Smith

### **5 Appendices**

1. Site Location
2. Summary report on Geotechnical Investigation
3. Triaxial Test Results
4. DCP Test results

# **Appendices**

## 1. Site Location

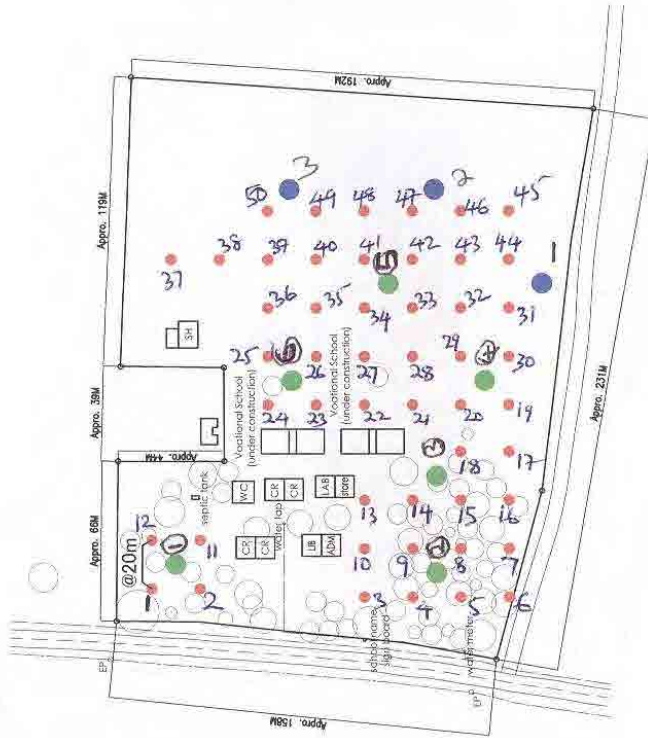


Appendix 2



Legend (Geotechnical Survey)

- Dynamic Cone Penetrometer Test Points (50 No. @20m)
- Water Penetration Test Points (3 No.)
- Lab. Sample (6 No.)



SCALE 1/2500  
 Mkwichi CDSS  
 Apprx. 3.8ha

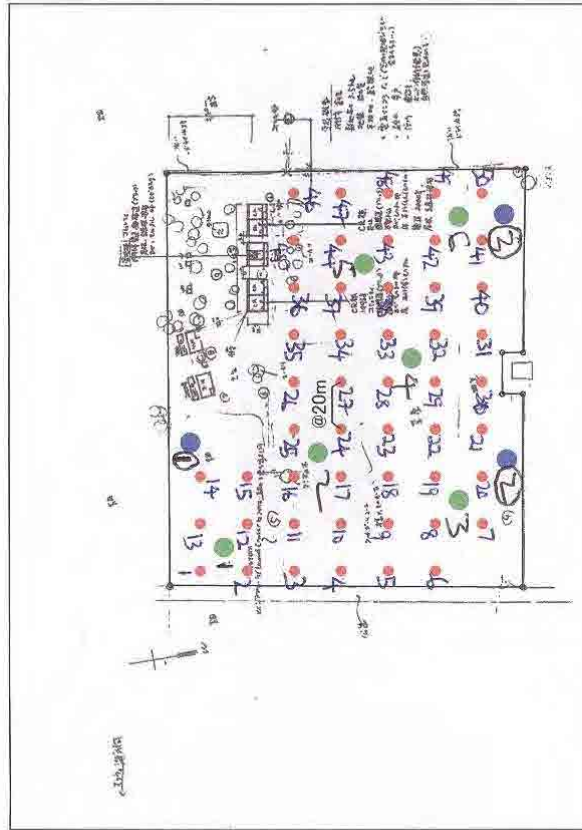
Handwritten mark resembling the number '5'.

Handwritten signature or initials.



Legend (Geotechnical Survey)

- Dynamic Cone Penetrometer Test Points (50 No. @20m)
- Water Penetration Test Points (3 No.)
- Lab. Sample (6 No.)

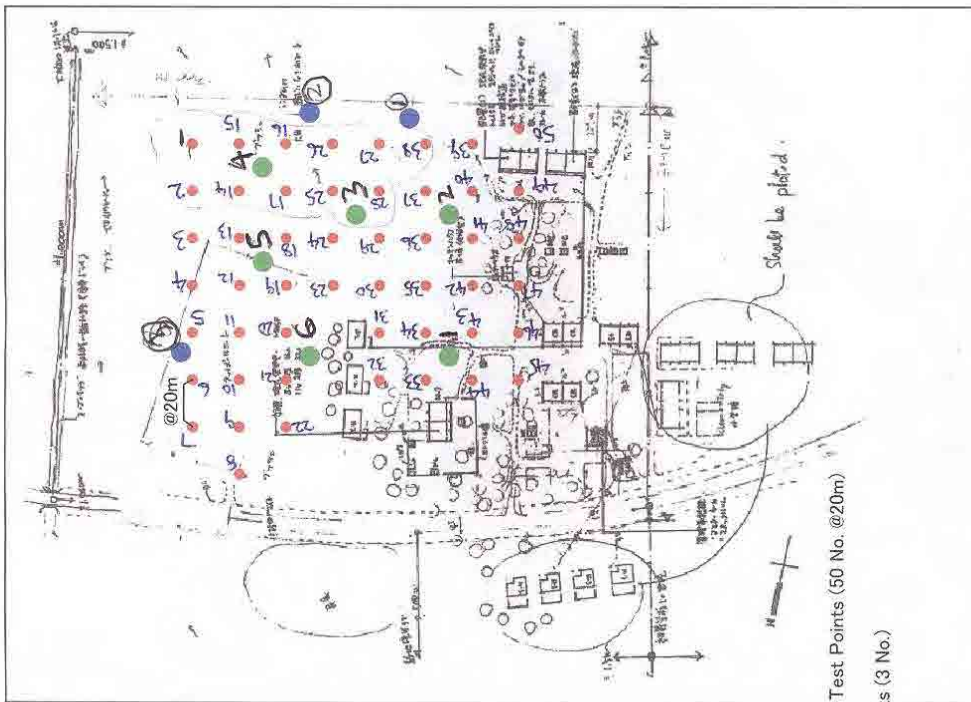


SCALE 1/2500

Liwaladzi CDSS  
 Appro. 3.0ha

Handwritten mark resembling a stylized '2' or 'J'.

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Legend (Geotechnical Survey)

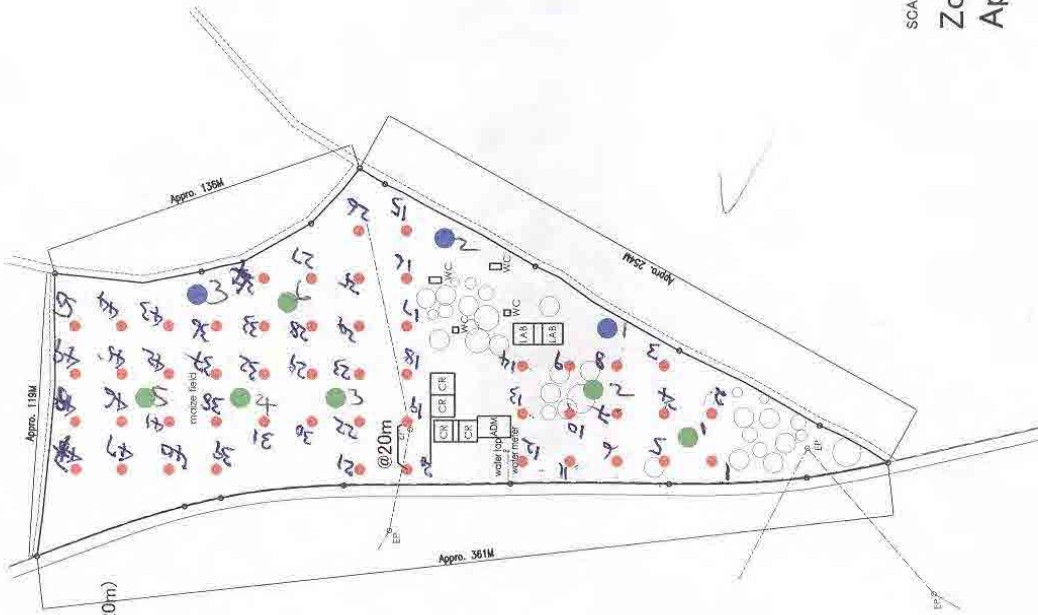
- Dynamic Cone Penetrometer Test Points (50 No. @20m)
- Water Penetration Test Points (3 No.)
- Lab. Sample (6 No.)

SCALE 1/2500  
 Matenje CDSS  
 Apprx. 4.0ha

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Handwritten signature or initials.

Appendix 2



SCALE 1/2500  
 Zolozolo CDSS  
 Appro. 2.9ha

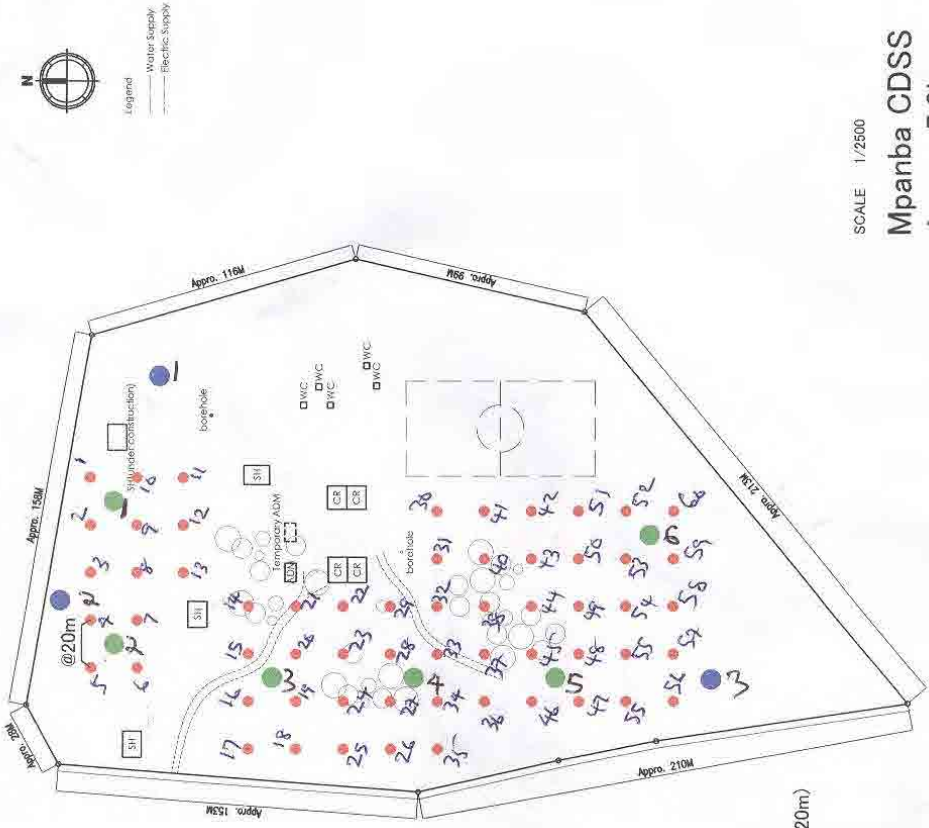
Legend (Geotechnical Survey)

- Dynamic Cone Penetrometer Test Points (50 No. @20m)
- Water Penetration Test Points (3 No.)
- Lab. Sample (6 No.)

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*Handwritten signature*

Appendix 2



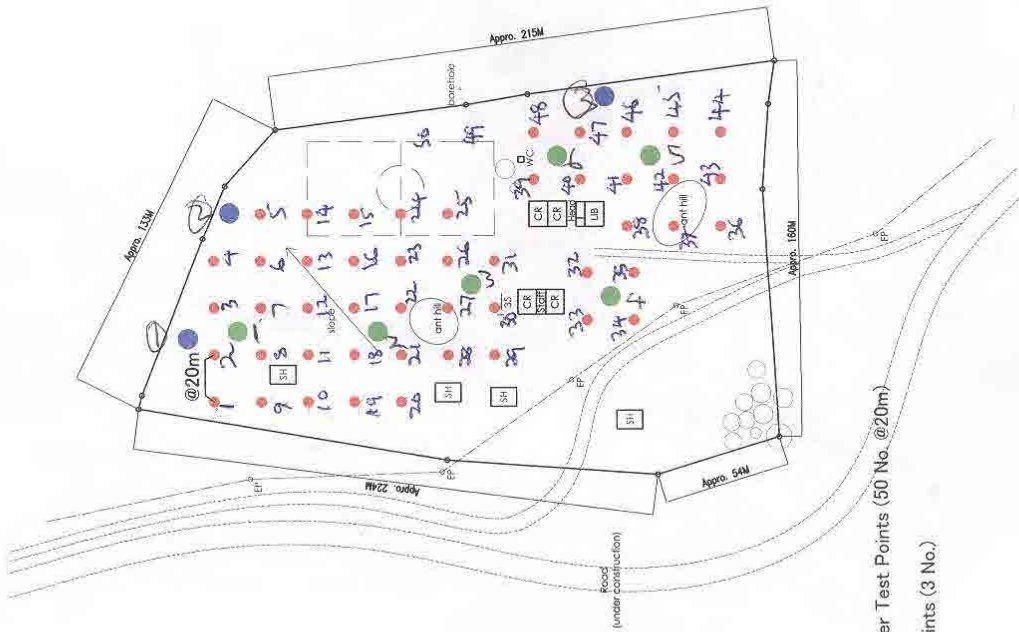
SCALE 1/2500  
**Mpanba CDSS**  
 Appro. 5.9ha

- Legend (Geotechnical Survey)
- Dynamic Cone Penetrometer Test Points (60 No. @20m)
  - Water Penetration Test Points (3 No.)
  - Lab. Sample (6 No.)

*M. M. M.*



Legend  
 - Water Supply  
 - Electric Supply



SCALE 1/2500  
**Ezondwezi CDSS**  
 Appro. 3.7ha

Legend (Geotechnical Survey)

- Dynamic Cone Penetrometer Test Points (50 No. @20m)
- Water Penetration Test Points (3 No.)
- Lab. Sample (6 No.)

25

P3M02

# **Appendices**

## 2. Summary report on Geotechnical Investigation



## UNIVERSITY OF MALAWI

**PRINCIPAL**  
Grant Kululanga, PhD. Eng., MSc. Eng., BSc. Eng., MASCE

Our Ref.:

Your Ref:

Date: **15th June, 2011**

Please address all correspondence to the Principal

**The Malawi Polytechnic**  
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Chichiri  
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MALAWI

Tel: (265) 01 870 411  
Fax: (265) 01 870 578  
E-Mail: principal@poly.ac.mw

**ATT: Matsuda International Consultants**

### SUMMARY REPORT ON GEOTECHNICAL INVESTIGATIONS

SITE	SOIL TYPE	PENETRATION RATE OF WATER (mm/min)	DCP PENETRATION INDEX	APPROXIMATE COMPARATIVE CBR	DEGREE OF COMPACTION	COMMENTS & RECOMMENDATIONS
MKWICHI CDSS	Dark brown firm sandy clay with traces of gravel size material	3.55 (good for soakaways)	>20 mm/blow	10	SOFT Weak surface	Foundations need to be placed at a depth of more than 1.5m to reach firm ground.
EDINGENI CDSS	Dark red firm clayey sandy soil	High Permeability (pit not hold water)	>20 mm/blow	10	VERY SOFT	Foundation trench to be treated by putting a well compacted to at least 95% MDD gravel layer of at least 200mm thick before placing the foundation concrete.
EZONDWENI CDSS	Dark brown firm clay of high plasticity with traces of sand	2.25 (good for soakaways)	>20 mm/blow	10	SOFT	Foundations need to be placed at a depth of more than 1.5m to reach firm ground.
ZOLOZOLO CDSS	Light grey loose sand with silt size particles of non-plastic	High Permeability (pit not hold water)	>20 mm/blow	10	VERY SOFT	Foundation trench to be treated by putting a well compacted to at least 95% MDD gravel layer of at least 200mm thick before placing the foundation concrete.
MPAMBA CDSS	Reddish loose sandy silt soil with high plastic	1.23 (Low Permeability)	>20 mm/blow	10	SOFT	Foundations need to be placed at a depth of more than 1.5m to reach firm ground.
LIWALADZI CDSS	Dark brown firm clay of high PI	Waterlogged (test not possible)	>20 mm/blow	10	FIRM Weak surface	Foundations need to be placed at a depth of more than 1.5m to reach firm ground.
MATENJE CDSS	Dark brown firm clay of high PI	3.8 (good for soakaways)	<20 mm/blow	10	FIRM Basically stable surface for normal Strip Footing.	Can ably accommodate normal foundation loads from buildings & >20mm/blow points to be recompacted to improve bearing capacity or be avoided.

D.B.KASIMPHA



# **Appendices**

## 3. Triaxial Test Results

**UNIVERSITY OF MALAWI – THE POLYTECHNIC**  
**DEPARTMENT OF CIVIL ENGINEERING**

DATE : 03rd May,2011

SUMMARY OF RESULTS FOR SOIL INVESTIGATIONS – MATSUDA INTERNATIONAL CONSULTANTS

SITE	PIT NO	GRADING	ATTERBERG LIMITS			TRIAIAL TEST	
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	COHENSION INTERCEPT (C')	ANGLE OF SHEARING ( $\phi$ )
MKWICHI (LILONGWE)	1	DONE	NP	NP	NP	Decomposed Rock	
	2	DONE	41.7	21.7	20.0	69 kN/m <sup>2</sup>	11.3°
	3	DONE	NP	NP	NP	Decomposed Rock	
	4	DONE	NP	NP	NP	Decomposed Rock	
	5	DONE	46.0	27.7	18.3	67 kN/m <sup>2</sup>	10.2°
	6	DONE	47.0	25.3	21.7	63 kN/m <sup>2</sup>	11.6°
EDINGENI (MZIMBA)	1	DONE	32.3	13.9	18.4	80 kN/m <sup>2</sup>	8.3°
	2	DONE	28.5	16.2	12.3	85 kN/m <sup>2</sup>	8.8°
	3	DONE	31.8	13.3	18.5	55 kN/m <sup>2</sup>	10.4°
	4	DONE	36.3	19.4	17.0	63 kN/m <sup>2</sup>	10.2°
	5	DONE	NP	NP	NP	Slightly Decomposed Rock	
	6	DONE	37.5	19.8	17.7	60 kN/m <sup>2</sup>	11.3°
EZONDWENI (MZIMBA)	1	DONE	30.2	17.8	12.4	125 kN/m <sup>2</sup>	7.5°
	2	DONE	31.0	15.9	15.1	69 kN/m <sup>2</sup>	8.7°
	3	DONE	30.5	19.1	11.4	115 kN/m <sup>2</sup>	9.0°
	4	DONE	29.8	17.7	12.1	129 kN/m <sup>2</sup>	7.3°
	5	DONE	34.5	15.3	19.2	54 kN/m <sup>2</sup>	11.3°
	6	DONE	35.0	20.0	15.0	66 kN/m <sup>2</sup>	8.5°
ZOLOZOLO (MZUZU)	1	DONE	NP	NP	NP	Sandy Soil	
	2	DONE	NP	NP	NP	Sandy Soil	
	3	DONE	NP	NP	NP	Sandy Soil	
	4	DONE	NP	NP	NP	Sandy Soil	
	5	DONE	NP	NP	NP	Sandy Soil	
	6	DONE	NP	NP	NP	Sandy Soil	
MPAMBA (NKHATABAY)	1	DONE	49.0	25.7	23.3	Loose Soft Material	
	2	DONE	38.9	22.1	16.8	Loose Soft Material	
	3	DONE	40.1	24.1	16.0	Loose Soft Material	
	4	DONE	40.3	21.6	18.7	Loose Soft Material	
	5	DONE	47.5	27.2	20.3	Loose Soft Material	
	6	DONE	46.9	21.1	25.8	Loose Soft Material	
LIWALADZI (NRHOTAKOTA)	1	DONE	NP	NP	NP	Slightly Decomposed Rock	
	2	DONE	38.2	20.6	17.6	38 kN/m <sup>2</sup>	4.6°
	3	DONE	38.0	17.0	21.0	35 kN/m <sup>2</sup>	7.8°
	4	DONE	35.0	18.7	16.3	42 kN/m <sup>2</sup>	5.5°
	5	DONE	38.3	17.6	20.7	33 kN/m <sup>2</sup>	9.5°

	6	DONE	34.3	18.3	16.0	44 kN/m <sup>2</sup>	5.9 <sup>o</sup>
MATENJE (SALIMA)	1	DONE	35.0	12.4	22.6	74 kN/m <sup>2</sup>	22.8 <sup>o</sup>
	2	DONE	33.8	13.5	20.3	79 kN/m <sup>2</sup>	21.8 <sup>o</sup>
	3	DONE	46.3	28.3	18.0	103 kN/m <sup>2</sup>	18.5 <sup>o</sup>
	4	DONE	45.7	24.8	20.9	112 kN/m <sup>2</sup>	18.6 <sup>o</sup>
	5	DONE	45.0	22.9	22.1	57 kN/m <sup>2</sup>	14.6 <sup>o</sup>
	6	DONE	45.4	18.2	27.2	89 kN/m <sup>2</sup>	13.8 <sup>o</sup>

COMPILED BY : Ishmael Ng'oma

CHECKED BY : D.B.Kasimpha

# **Appendices**

## 4. DCP Test results



## UNIVERSITY OF MALAWI

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### DCP TEST RESULTS FOR MKWICHI CDSS IN LILONGWE

POINT	TOTAL NO OF BLOWS	PENETRATION (mm)	DCP NUMBER (mm/blow)	IN SITU CBR
1	180	2000	11	20
2	100	2000	20	9
3	180	2000	11	20
4	70	2000	29	6
5	60	2000	33	5
6	220	2000	9	25
7	180	2000	11	20
8	28	2000	71	2
9	200	2000	10	22
10	50	2000	40	4
11	100	2000	20	9
12	44	2000	45	4
13	48	2000	42	4
14	60	2000	33	5
15	49	2000	41	4
16	60	2000	33	5
17	140	2000	14	15
18	180	2000	11	20
19	100	2000	20	9
20	185	2000	11	20
21	70	2000	29	6
22	160	2000	13	16
23	86	2000	23	8
24	50	2000	40	4
25	100	2000	20	9
26	210	2000	10	22
27	200	2000	10	22
28	30	2000	67	2

29	36	2000	56	2
30	40	2000	50	3
31	60	2000	33	5
32	60	2000	33	5
33	200	2000	10	22
34	75	2000	27	6
35	180	2000	11	20
36	70	2000	29	6
37	37	2000	54	2
38	35	2000	57	2
39	45	2000	44	3
40	65	2000	31	5
41	50	2000	40	4
42	100	2000	20	9
43	38	2000	53	3
44	40	2000	50	3
45	100	2000	20	9
46	115	2000	17	12
47	105	2000	19	10
48	65	2000	31	5
49	104	2000	19	10
50	100	2000	20	9

**LEGEND:**

- \*DCP NUMBER (mm/blow) : Is found by dividing **total penetration (2000mm)** by **total number of blows**.
- \* BLOW(S) : Counting the freely falling force applied to the DCP to attain penetration.
- \* IN SITU CBR : Comparative values with the DCP NUMBER found on the chart provided by the suppliers of the DCP machine.

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**DCP TEST RESULTS FOR EZONDWENI CDSS IN MZIMBA**

<b>POINT</b>	<b>TOTAL NO OF BLOWS</b>	<b>PENETRATION (mm)</b>	<b>DCP NUMBER (mm/blow)</b>	<b>IN SITU CBR</b>
1	36	2000	56	2
2	37	2000	54	2
3	40	2000	50	3
4	37	2000	54	2
5	58	2000	34	5
6	63	2000	32	5
7	66	2000	30	6
8	69	2000	29	6
9	60	2000	33	5
10	55	2000	36	4
11	46	2000	43	4
12	49	2000	41	4
13	40	2000	50	3
14	38	2000	53	3
15	51	2000	39	4
16	49	2000	41	4
17	59	2000	34	5
18	63	2000	32	5
19	65	2000	31	5
20	63	2000	32	5
21	60	2000	33	5
22	61	2000	33	5
23	65	2000	31	5
24	60	2000	33	5
25	53	2000	38	4
26	52	2000	38	4
27	63	2000	32	5

28	60	2000	33	5
29	60	2000	31	5
30	66	2000	30	6
31	63	2000	32	5
32	67	2000	30	6
33	60	2000	33	5
34	54	2000	37	4
35	52	2000	38	4
36	50	2000	40	4
37	56	2000	36	4
38	53	2000	38	4
39	51	2000	39	4
40	56	2000	36	4
41	54	2000	37	4
42	53	2000	38	4
43	52	2000	38	4
44	56	2000	36	4
45	50	2000	40	4
46	59	2000	41	4
47	51	2000	39	4
48	48	2000	42	4
49	51	2000	39	4
50	52	2000	38	4

**LEGEND:**

\*DCP NUMBER (mm/blow) : Is found by dividing total penetration (2000mm) by total number of blows.

\* BLOW(S) : Counting the freely falling force applied to the DCP to attain penetration.

\* IN SITU CBR : Comparative values with the DCP NUMBER found on the chart provided by the suppliers of the DCP machine.

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### DCP TEST RESULTS FOR MATENJE CDSS IN SALIMA

POINT	TOTAL NO OF BLOWS	PENETRATION (mm)	DCP NUMBER (mm/blow)	IN SITU CBR
1	160	2000	13	16
2	158	2000	13	16
3	155	2000	13	16
4	120	2000	17	12
5	82	2000	24	7
6	73	2000	27	6
7	75	2000	27	6
8	82	2000	24	7
9	77	2000	26	7
10	79	2000	25	7
11	76	2000	26	7
12	101	2000	20	9
13	129	2000	16	13
14	160	2000	13	16
15	162	2000	12	18
16	175	2000	11	20
17	168	2000	12	18
18	140	2000	14	15
19	115	2000	17	12
20	86	2000	23	8
21	81	2000	25	7
22	80	2000	25	7
23	112	2000	18	11
24	135	2000	15	14
25	146	2000	14	15
26	174	2000	11	20
27	102	2000	20	9
28	110	2000	18	11

29	115	2000	17	12
30	113	2000	18	11
31	89	2000	22	8
32	82	2000	24	7
33	84	2000	24	7
34	80	2000	25	7
35	100	2000	20	9
36	120	2000	17	12
37	125	2000	16	13
38	111	2000	18	11
39	86	2000	23	8
40	100	2000	20	9
41	102	2000	20	9
42	88	2000	22	8
43	75	2000	27	6
44	55	2000	36	4
45	58	2000	34	5
46	51	2000	39	4
47	89	2000	22	8
48	95	2000	21	9
49	97	2000	21	9
50	87	2000	23	8

**LEGEND:**

- \*DCP NUMBER (mm/blow) : Is found by dividing **total penetration (2000mm)** by **total number of blows**.
- \* BLOW(S) : Counting the freely falling force applied to the DCP to attain penetration.
- \* IN SITU CBR : Comparative values with the DCP NUMBER found on the chart provided by the suppliers of the DCP machine.

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### DCP TEST RESULTS FOR ZOLOZOLO CDSS IN MZUZU

POINT	TOTAL NO OF BLOWS	PENETRATION (mm)	DCP NUMBER (mm/blow)	IN SITU CBR
1	37	2000	57	3
2	41	2000	49	3
3	39	2000	51	3
4	33	2000	61	2
5	45	2000	44	4
6	33	2000	61	2
7	29	2000	69	2
8	36	2000	56	3
9	37	2000	54	3
10	45	2000	44	4
11	38	2000	53	3
12	43	2000	47	3
13	39	2000	51	3
14	40	2000	50	3
15	46	2000	43	4
16	66	2000	30	6
17	69	2000	29	6
18	70	2000	29	6
19	65	2000	31	6
20	71	2000	28	6
21	73	2000	27	6
22	69	2000	29	6
23	73	2000	27	6
24	71	2000	28	6
25	72	2000	28	6
26	55	2000	36	4
27	59	2000	34	5
28	70	2000	29	6

29	71	2000	28	6
30	68	2000	29	6
31	68	2000	29	6
32	70	2000	29	6
33	65	2000	31	6
34	64	2000	31	6
35	67	2000	30	6
36	65	2000	31	6
37	66	2000	30	6
38	73	2000	27	6
39	64	2000	31	6
40	66	2000	30	6
41	64	2000	31	6
42	65	2000	31	6
43	76	2000	26	7
44	74	2000	27	6
45	67	2000	30	6
46	71	2000	28	6
47	66	2000	30	6
48	69	2000	29	6
49	66	2000	30	6
50	59	2000	34	5

**LEGEND:**

- \*DCP NUMBER (mm/blow) : Is found by dividing **total penetration (2000mm)** by **total number of blows**.
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### **DCP TEST RESULTS FOR MPAMBA CDSS IN NKHATABAY**

<b>POINT</b>	<b>TOTAL NO OF BLOWS</b>	<b>PENETRATION (mm)</b>	<b>DCP NUMBER (mm/blow)</b>	<b>IN SITU CBR</b>
1	29	2000	69	2
2	35	2000	57	3
3	30	2000	67	2
4	30	2000	67	2
5	25	2000	80	1
6	28	2000	71	2
7	29	2000	69	2
8	31	2000	65	2
9	30	2000	67	2
10	26	2000	77	2
11	26	2000	77	2
12	29	2000	69	2
13	31	2000	65	2
14	55	2000	36	4
15	33	2000	61	2
16	38	2000	53	3
17	23	2000	87	1
18	27	2000	74	2
19	34	2000	59	3
20	32	2000	63	2
21	33	2000	61	2
22	36	2000	56	3
23	28	2000	71	2
24	28	2000	71	2
25	29	2000	69	2
26	37	2000	54	3
27	31	2000	65	2
28	25	2000	80	1

29	24	2000	83	1
30	26	2000	77	2
31	35	2000	57	3
32	37	2000	54	3
33	35	2000	57	3
34	40	2000	50	3
35	36	2000	56	3
36	36	2000	56	3
37	27	2000	74	2
38	29	2000	69	2
39	32	2000	63	2
40	31	2000	65	2
41	32	2000	63	2
42	24	2000	83	1
43	37	2000	54	3
44	33	2000	61	2
45	32	2000	63	2
46	33	2000	61	2
47	30	2000	67	2
48	34	2000	59	3
49	32	2000	63	2
50	27	2000	74	2
51	30	2000	67	2
52	26	2000	77	2
53	27	2000	74	2
54	28	2000	71	2
55	24	2000	83	1
56	28	2000	71	2
57	31	2000	65	2
58	33	2000	61	2
59	35	2000	57	3
60	37	2000	54	3

**LEGEND:**

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POINT	TOTAL NO OF BLOWS	PENETRATION (mm)	DCP NUMBER (mm/blow)	IN SITU CBR
1	152	2000	13	16
2	149	2000	13	16
3	166	2000	13	16
4	90	2000	22	8
5	95	2000	21	9
6	97	2000	21	9
7	158	2000	13	16
8	151	2000	13	16
9	155	2000	13	16
10	153	2000	13	16
11	159	2000	13	16
12	160	2000	13	16
13	101	2000	20	9
14	100	2000	20	9
15	95	2000	21	9
16	87	2000	23	8
17	68	2000	29	6
18	57	2000	35	5
19	120	2000	17	12
20	119	2000	17	12
21	89	2000	22	8
22	90	2000	22	8
23	93	2000	22	8
24	98	2000	20	9
25	86	2000	23	8
26	56	2000	35	5
27	67	2000	32	5
28	70	2000	29	6

29	73	2000	27	6
30	81	2000	25	7
31	86	2000	23	8
32	140	2000	14	15
33	152	2000	13	16
34	135	2000	15	14
35	140	2000	14	15
36	159	2000	13	16
37	146	2000	14	15
38	141	2000	14	15
39	85	2000	23	8
40	67	2000	30	6
41	53	2000	38	4
42	60	2000	33	5
43	90	2000	22	8
44	66	2000	30	6
45	69	2000	29	6
46	57	2000	35	5
47	67	2000	30	6
48	76	2000	26	7
49	80	2000	25	7
50	86	2000	23	8

**LEGEND:**

- \*DCP NUMBER (mm/blow) : Is found by dividing **total penetration (2000mm)** by **total number of blows**.
- \* BLOW(S) : Counting the freely falling force applied to the DCP to attain penetration.
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