

2. BOREHOLE DRILLING AND CONSTRUCTION

A Direct Air Drilling and circulatory mud method was applied. Borehole construction materials used for drilling were temporary casings, plain casing, slotted casing and gravel packing. The details of each site boreholes are separated below.

1. MUHASUWA C. D. S. S (R1)

At Muhasuwa CDSS water was found on the first drilling attempt made. The details of the borehole results are as below

1.1 DETAILS OF THE BOREHOLE AT MUHASUWA CDSS (R1 – No. 1)

Date of Drilling: 29/11/2013

Borehole Depth: 67m (Drilled 67m)

Result: WET

DEPTH (m)	LITHOLOGY
0 – 1	Top Brown Soil
2 – 4	Gravel
5 – 6	Soft Yellowish Rock
7 – 11	Soft Brown rock
11 – 20	Soft Greyish rock
21 – 26	Soft Black Rock
27 – 45	Yellowish gray granite
46 – 67	Grey weathered granite rock

The details of the borehole which includes lithology and borehole design are as shown in the figure below.

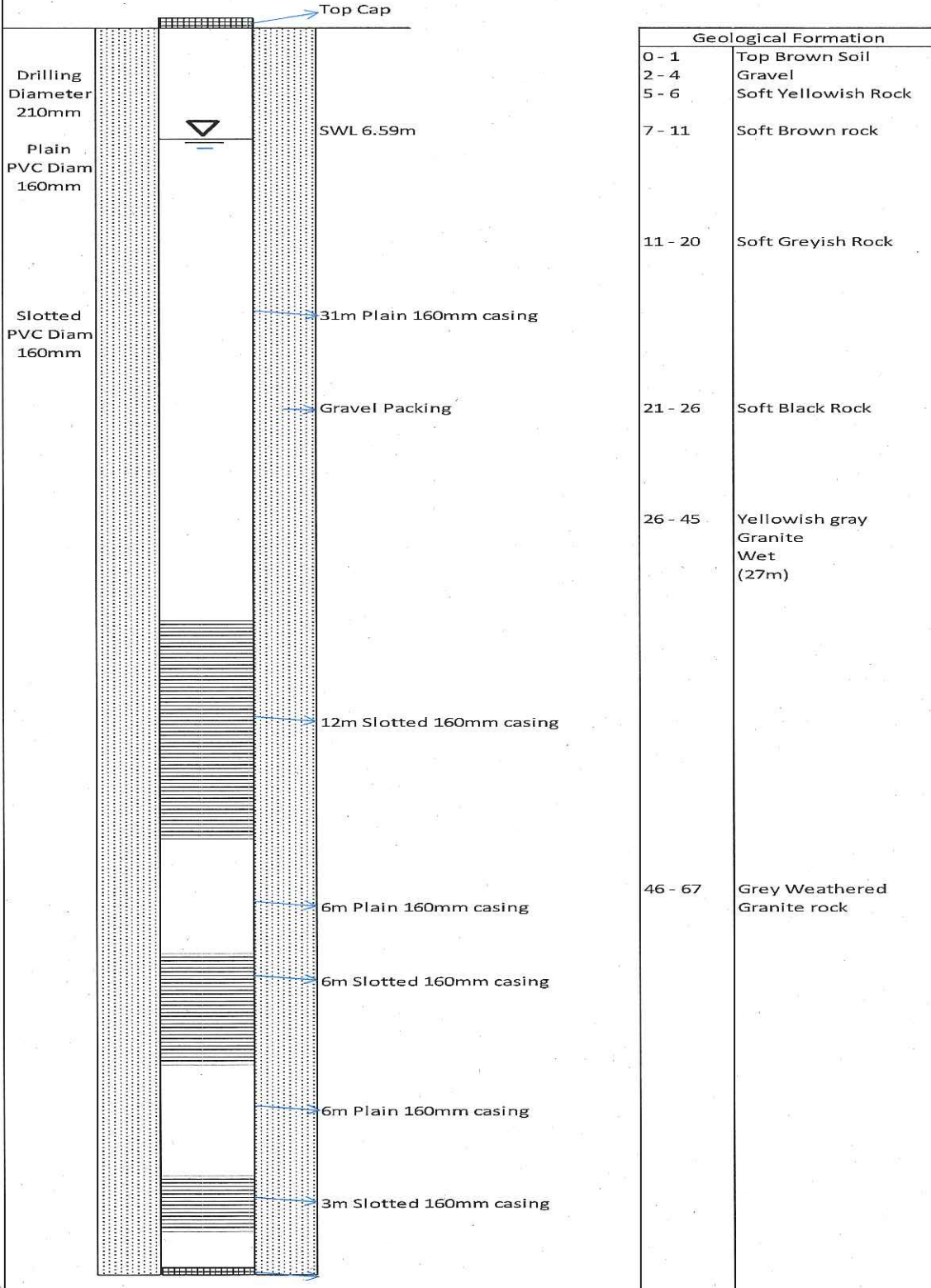
1.2 BOREHOLE DEVELOPMENT AND PUMPING TEST

There were 3 types of Pumping test carried out namely Step Draw Down, Constant Discharge and Recovery test. The pump was set at a Depth of 45m. Before the pumping test the borehole was developed by AIR LIFTING method for a period of 4 hours.

BOREHOLE STRUCTURE - WET

Project Name: C. D. S. S Phase III
 Site Name: MUHASUWA C. D. S. S
 Borehole No.: No. R1 - No1
 Starting Date: 29th November 2013
 Completion Date: 29th November 2013

Drilling Depth 67 m
 Casing Depth 67 m
 Casing Diam 160mm



Geological Formation	
0 - 1	Top Brown Soil
2 - 4	Gravel
5 - 6	Soft Yellowish Rock
7 - 11	Soft Brown rock
11 - 20	Soft Greyish Rock
21 - 26	Soft Black Rock
26 - 45	Yellowish gray Granite Wet (27m)
46 - 67	Grey Weathered Granite rock

Drilling depth 67m

MUHASUWA CDSS BOREHOLE

1.3 PUMPING TEST AT MUHASUWA CDSS

Pumping test of the borehole at Muhasuwa CDSS was done in 4 Step Drawn test of 120 minutes. The four steps tests were set at 0.3l/s, 0.5l/s, 0.8l/s and 1.0l/s. The pump was set at a depth of 45m. This was followed by Constant Discharge Pumping test for 24 hours at the yield of 1.0l/s and followed by Recovery test. The below table shows the Step Draw down Test and Constant Pump Test results at Muhasuwa CDSS

Step No.	Duration (Min)	Discharge	Drawdown (m)	Water Cleanliness
1	120	0.3 L/s	4.66	Clean
2	120	0.5 L/s	10.21	Clean
3	120	0.8 L/s	22.26	Clean
4	120	1.0 L/s	31.56	Clean

STEP DRAW DOWN PUMPING TEST RECORD

MUHASUWA C. D. S. S

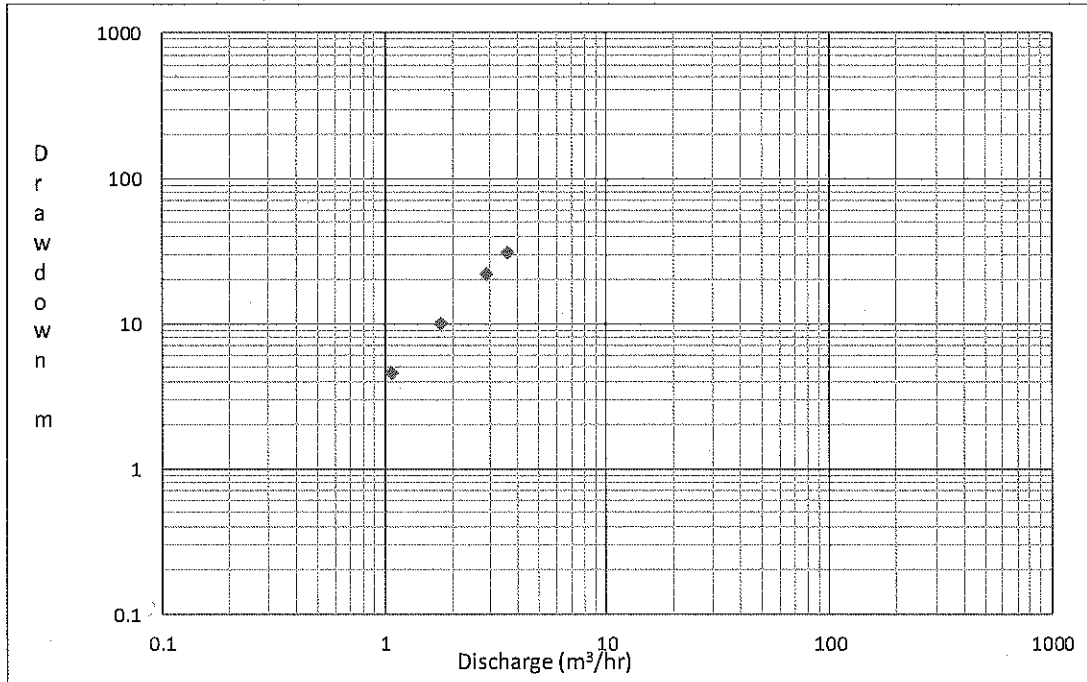
	1 st Step	2 nd Step	3 rd Step	4 th Step
Discharge (l/s)	0.3l/s	0.5l/s	0.8l/s	1l/s
Duration	120	120	120	120

Date	1/12/2013
Static Water Level	6.59 M
Borehole Depth	67M
Pump Set	45m

Time (Min)	1 st Step		2 nd Step		3 rd Step		4 th Step	
	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)
0	6.59	0	11.25	4.66	16.8	10.21	28.85	22.26
1	7.15	0.56	13.14	6.55	17.85	11.26	28.92	22.33
2	8.04	1.45	14.08	7.49	16.65	10.06	29.07	22.48
3	8.48	1.89	14.55	7.96	19.4	12.81	29.57	22.98
4	8.7	2.11	14.79	8.2	19.92	13.33	30.04	23.45
5	8.81	2.22	14.9	8.31	20.41	13.82	30.46	23.87
6	8.93	2.34	14.96	8.37	20.93	14.34	30.77	24.18
7	9.04	2.45	14.99	8.4	21.39	14.8	31.16	24.57
8	9.3	2.71	15.01	8.42	21.75	15.16	31.62	25.03
9	9.45	2.86	15.02	8.43	22.13	15.54	31.83	25.24
10	9.46	2.87	15.02	8.43	22.45	15.86	32.1	25.51
12	9.48	2.89	15.03	8.44	23.11	16.52	32.67	26.08
14	10	3.41	15.14	8.55	23.57	16.98	33.25	26.66
16	10.12	3.53	15.2	8.61	24.02	17.43	33.62	27.03
18	10.25	3.66	15.33	8.74	24.44	17.85	33.98	27.39
20	10.29	3.7	15.43	8.84	24.93	18.34	34.22	27.63
25	10.39	3.8	15.63	9.04	25.72	19.13	34.9	28.31
30	10.48	3.89	15.84	9.25	26.42	19.83	35.32	28.73
35	10.54	3.95	15.96	9.37	26.93	20.34	35.58	28.99
40	10.62	4.03	16.02	9.43	27.25	20.66	35.83	29.24
45	10.66	4.07	16.13	9.54	27.46	20.87	36.08	29.49
50	10.66	4.07	16.2	9.61	27.63	21.04	36.24	29.65
55	10.66	4.07	16.29	9.7	27.81	21.22	36.43	29.84
60	10.67	4.08	16.33	9.74	28	21.41	36.69	30.1
75	10.68	4.09	16.5	9.91	28.21	21.62	37.25	30.66
90	11.01	4.42	16.62	10.03	28.38	21.79	37.67	31.08
105	11.13	4.54	16.71	10.12	28.64	22.05	37.95	31.36
120	11.25	4.66	16.8	10.21	28.85	22.26	38.15	31.56

STEP DRAWDOWN TEST

Project Name	C. D. S. S PHASE III		
Borehole No	R1 - No 1	Static Water Level	6.59 M
Site	MUHASUWA C. D. S. S	Date	01/12/2013



Step	Discharge (m3/hr)	Dynamic Level (m)	Drawdown (m)
First (1st)	1.08	11.25	4.66
Second (2nd)	1.8	16.8	10.21
Third (3rd)	2.88	28.85	22.26
Forth (4th)	3.6	38.15	31.56

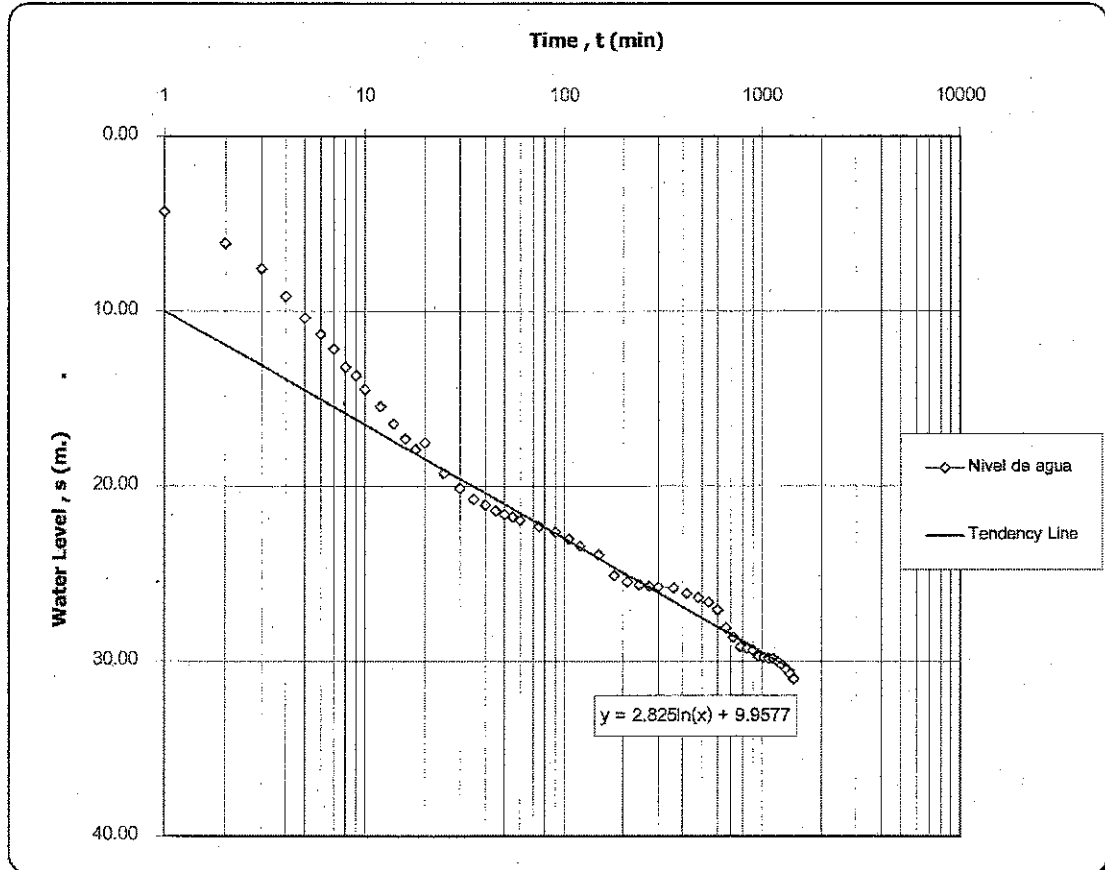
CONSTANT DISCHARGE TEST

Name of Project	C. D. S. S PHASE III		
Borehole No.	R1 - No 1	Depth	67M
Name of Location	MUHASUWA C. D. S. S	Casing Depth	67m
District	CHIRADZULU	Static Water Level	6.59 M
		Dynamic Water Level	37.6 M
Date	02/12/2013	Pump Set Depth	45m

Actual Time (Hours:Minutes)	Time (Min)	Yield (Lit/Sec)	Dynamic Water Level (M)	Drawn Down (M)	Remarks
7:04	0	1L/s	6.59	0.00	
7:05	0:01	1L/s	10.88	4.29	
7:06	0:02	1L/s	12.70	6.11	
7:07	0:03	1L/s	14.15	7.56	
7:08	0:04	1L/s	15.74	9.15	
7:09	0:05	1L/s	16.97	10.38	
7:10	0:06	1L/s	17.90	11.31	
7:11	0:07	1L/s	18.75	12.16	
7:12	0:08	1L/s	19.76	13.17	
7:13	0:09	1L/s	20.26	13.67	
7:14	0:10	1L/s	21.05	14.46	
7:16	0:12	1L/s	22.03	15.44	
7:18	0:14	1L/s	23.02	16.43	
7:20	0:16	1L/s	23.87	17.28	
7:22	0:18	1L/s	24.48	17.89	
7:24	0:20	1L/s	24.10	17.51	
7:29	0:25	1L/s	25.85	19.26	
7:34	0:30	1L/s	26.70	20.11	
7:39	0:35	1L/s	27.33	20.74	
7:44	0:40	1L/s	27.65	21.06	
7:49	0:45	1L/s	28.00	21.41	
7:54	0:50	1L/s	28.20	21.61	
7:59	0:55	1L/s	28.33	21.74	
8:04	1:00	1L/s	28.53	21.94	
8:19	1:15	1L/s	28.89	22.30	
8:34	1:30	1L/s	29.21	22.62	
8:49	1:45	1L/s	29.60	23.01	
9:04	2:00	1L/s	30.00	23.41	
9:34	2:30	1L/s	30.50	23.91	
10:04	3:00	1L/s	31.70	25.11	
10:34	3:30	1L/s	32.05	25.46	
11:04	4:00	1L/s	32.22	25.63	
11:34	4:30	1L/s	32.31	25.72	
12:04	5:00	1L/s	32.35	25.76	
13:04	6:00	1L/s	32.40	25.81	
14:04	7:00	1L/s	32.72	26.13	
15:04	8:00	1L/s	32.96	26.37	
16:04	9:00	1L/s	33.20	26.61	
17:04	10:00	1L/s	33.65	27.06	
18:04	11:00	1L/s	34.69	28.10	
19:04	12:00	1L/s	35.21	28.62	
20:04	13:00	1L/s	35.74	29.15	
21:04	14:00	1L/s	35.85	29.26	
22:04	15:00	1L/s	35.95	29.36	
23:04	16:00	1L/s	36.30	29.71	
0:04	17:00	1L/s	36.37	29.78	
1:04	18:00	1L/s	36.41	29.82	
1:04	18:00	1L/s	36.46	29.87	
3:04	20:00	1L/s	36.62	30.03	
4:04	21:00	1L/s	36.79	30.20	
5:04	22:00	1L/s	37.05	30.46	
6:04	23:00	1L/s	37.31	30.72	
7:04	0:00	1L/s	37.60	31.01	

CONSTANT DISCHARGE TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R1 No.1	STATIC WATER LEVEL	6.59 m.
SITE	Muhasuwa CDSS	DATE	02/12/13



DESCRIPTION	
Discharge, Q (m ³ /hr.)	3.60 m ³ /hr.
water Level ,ΔS (m.)	6.67 m. ←
Transmissivity , T (m ² /hr.)	
$T = (2.30 Q)/(4\pi\Delta S)$	0.099 m ² /hr. ←
Screen Length , b (m.)	21.00 m. ←
Hydraulic Gradient , K (m./hr.)	
$K = T/b$	4.704E-03 m./hr.

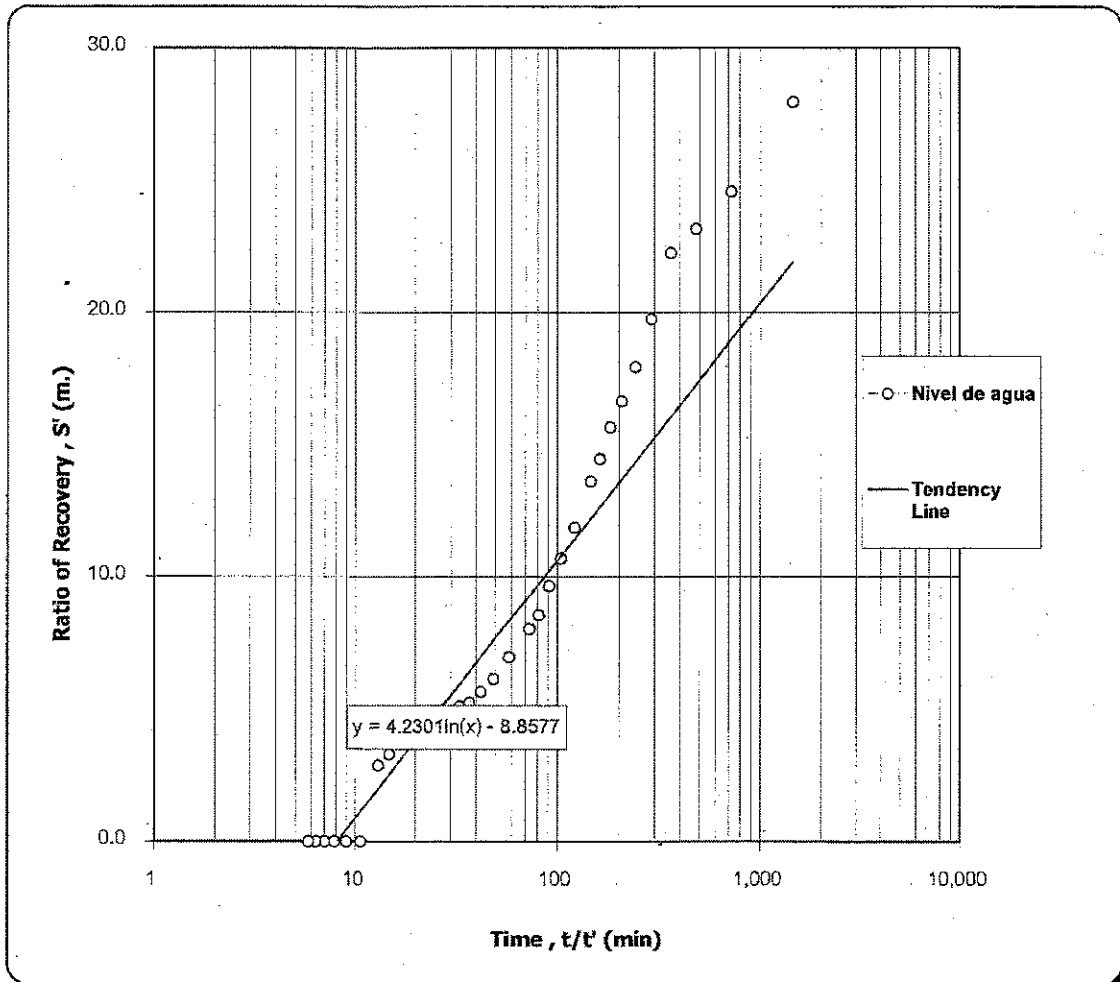
CONSTANT DISCHARGE TEST (RECOVERY)

Name of Project	C. D. S. S PHASE III		
Borehole No.	R1 - No 1	Depth	67M
Name of Location	MUHASUWA C. D. S. S	Casing Depth	67m
District	CHIRADZULU	Static Water Level	6.59 M
		Dynamic Water Level	37.6 M
Date	03/12/2013	Pump Set Depth	45m

Actual Time (Hours:Minutes)	Time (Min)	Accumulated time (Min)	Water Level (M)	Recovery (m)	Remarks
7:04	0:00	1440	37.6	31.01	
7:05	0:01	1441	34.55	27.96	
7:06	0:02	1442	31.17	24.58	
7:07	0:03	1443	29.75	23.16	
7:08	0:04	1444	28.85	22.26	
7:09	0:05	1445	26.34	19.75	
7:10	0:06	1446	24.53	17.94	
7:11	0:07	1447	23.24	16.65	
7:12	0:08	1448	22.25	15.66	
7:13	0:09	1449	21.05	14.46	
7:14	0:10	1450	20.2	13.61	
7:16	0:12	1452	18.45	11.86	
7:18	0:14	1454	17.3	10.71	
7:20	0:16	1456	16.25	9.66	
7:22	0:18	1458	15.15	8.56	
7:24	0:20	1460	14.63	8.04	
7:29	0:25	1465	13.57	6.98	
7:34	0:30	1470	12.74	6.15	
7:39	0:35	1475	12.25	5.66	
7:44	0:40	1480	11.85	5.26	
7:49	0:45	1485	11.7	5.11	
7:54	0:50	1490	11.45	4.86	
7:59	0:55	1495	11.29	4.70	
8:04	1:00	1500	11.15	4.56	
8:19	1:15	1515	10.75	4.16	
8:34	1:30	1530	10.31	3.72	
8:49	1:45	1545	9.89	3.30	
9:04	2:00	1560	9.47	2.88	

WATER LEVEL RECOVERY TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R1 No.1	STATIC WATER LEVEL	6.59 m.
SITE	Muhasuwa CDSS	DATE	03/12/13



DESCRIPTION	
Discharge, Q ($m^3/hr.$)	3.60 $m^3/hr.$
Water Level, ΔS (m.)	9.50 m.
Transmissivity, T ($m^2/hr.$)	
$T = (2.30 Q)/(4\pi\Delta S)$	0.07 $m^2/hr.$
Screen Length, b (m.)	21.00 m.
Hydraulic Gradient, K (m./hr.)	
$K = T/b$	3.303E-03 m./hr.

2. MWATIBU C. D. S. S (R2)

At Mwatibu CDSS water was found on the first drilling attempt made. The details of the borehole results are as below

2.1 DETAILS OF THE BOREHOLE AT MWATIBU CDSS (R2 – No. 1)

Date of Drilling: 14/10/2013

Borehole Depth: 60m (Drilled 61m)

Result: WET

DEPTH (m)	LITHOLOGY
0 – 2	Dark Brown Clay Soil
3 – 6	Inter-changing of color brownish to darkish brown
7 – 8	Soft brown Rock
9 – 17	Grey rock
18 – 61	Hard granite grey rock

The details of the borehole which includes lithology and borehole design are as shown in the figure below.

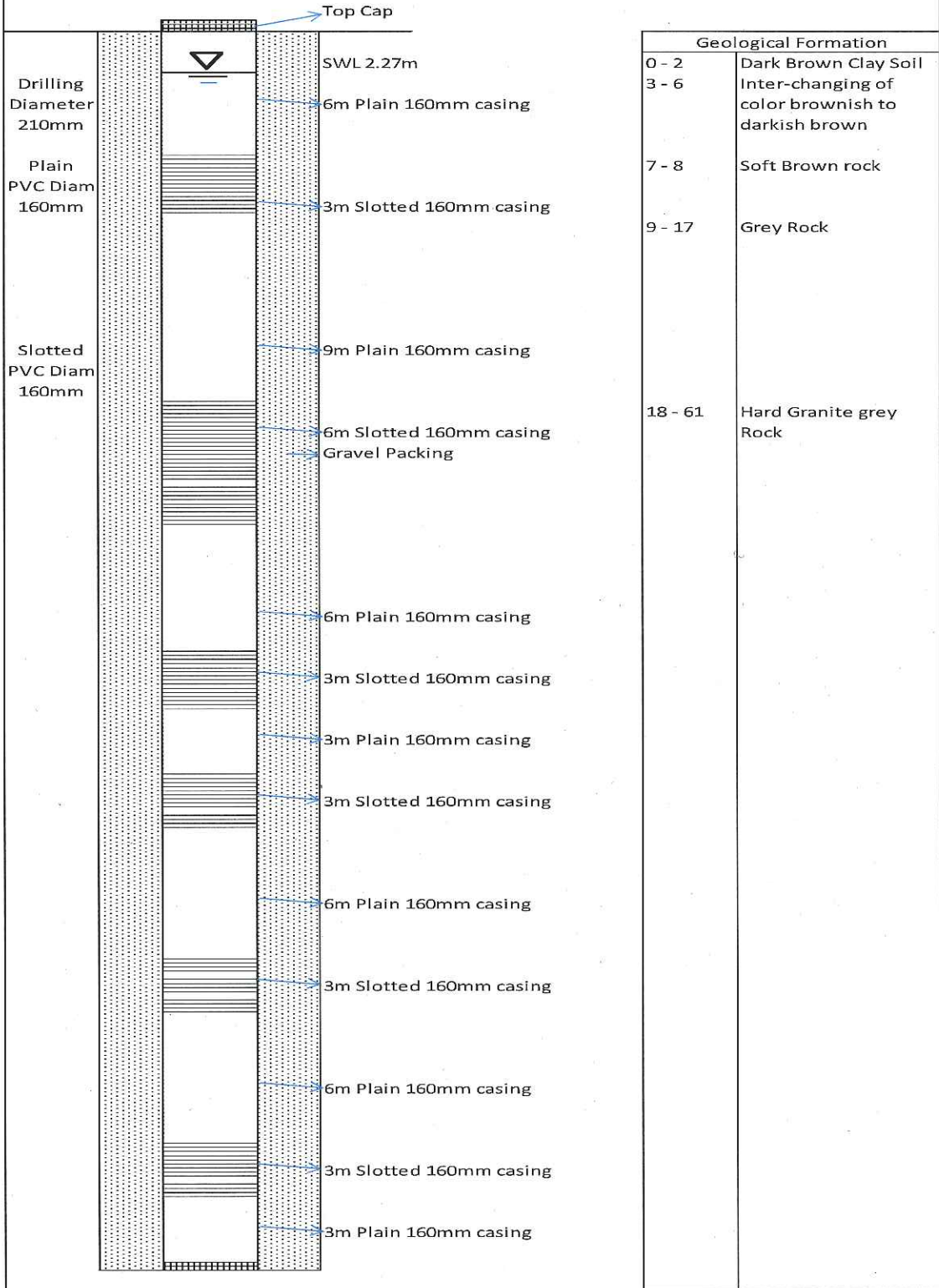
2.2 BOREHOLE DEVELOPMENT AND PUMPING TEST

There were 3 types of Pumping test carried out namely Step Draw Down, Constant Discharge and Recovery test. The pump was set at a Depth of 42m. Before the pumping test the borehole was developed by AIR LIFTING method for a period of 3¹/₂ hours.

BOREHOLE STRUCTURE - WET

Project Name: C. D. S. S Phase III
 Site Name: MWATIBU C. D. S. S
 Borehole No.: R2 - No. 1
 Starting Date: 14th October 2012
 Completion Date: 15th October 2013

Drilling Depth 61 m
 Casing Depth 60 m
 Casing Diam 160mm



Drilling depth 61m

MWATIBU CDSS BOREHOLE

2.3 PUMPING TEST AT MWATIBU CDSS

Pumping test of the borehole at Mwatibu CDSS was done in 4 Step Drawn test of 120 minutes. The four steps tests were set at 0.3l/s, 0.5l/s, 0.8l/s and 1.0l/s. The pump was set at a depth of 42m. This was followed by Constant Discharge Pumping test for 24 hours at the yield of 1.11l/s and followed by Recovery test. The below table shows the Step Draw down Test and Constant Pump Test results at Mwatibu CDSS

Step No.	Duration (Min)	Discharge	Drawdown (m)	Water Cleanliness
1	120	0.3 L/s	0.66	Clean
2	120	0.5 L/s	1.23	Clean
3	120	0.8 L/s	3.29	Clean
4	120	1.0 L/s	7.07	Clean

STEP DRAW DOWN PUMPING TEST RECORD

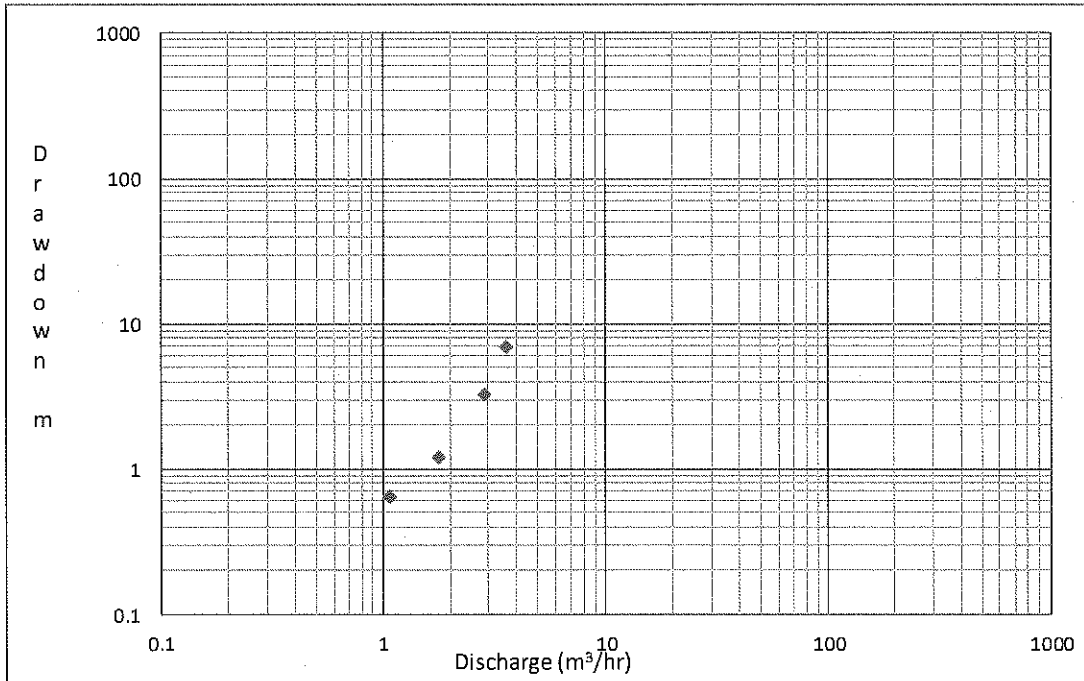
MWATIBU C. D. S. S

	1 st Step	2 nd Step	3 rd Step	4 th Step		Date	17/10/2013
Discharge (l/s)	0.3L/s	0.5L/s	0.8L/s	1L/s		Static Water Level	2.27M
Duration	120	120	120	120		Borehole Depth	61M
						Pump Set	42m

Time (Min)	1 st Step		2 nd Step		3 rd Step		4 th Step	
	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)
0	2.27	0.00	2.93	0.66	3.50	1.23	5.56	3.29
1	3.50	1.23	3.38	1.11	4.53	2.26	6.06	3.79
2	3.20	0.93	3.40	1.13	4.82	2.55	6.25	3.98
3	3.00	0.73	3.42	1.15	4.94	2.67	6.56	4.29
4	2.95	0.68	3.44	1.17	5.05	2.78	6.76	4.49
5	2.93	0.66	3.45	1.18	5.08	2.81	6.88	4.61
6	2.93	0.66	3.46	1.19	5.12	2.85	6.97	4.70
7	2.93	0.66	3.47	1.20	5.16	2.89	7.09	4.82
8	2.93	0.66	3.48	1.21	5.19	2.92	7.13	4.86
9	2.93	0.66	3.49	1.22	5.21	2.94	7.16	4.89
10	2.93	0.66	3.50	1.23	5.24	2.97	7.23	4.96
12	2.93	0.66	3.50	1.23	5.25	2.98	7.35	5.08
14	2.93	0.66	3.50	1.23	5.26	2.99	7.46	5.19
16	2.93	0.66	3.50	1.23	5.27	3.00	7.54	5.27
18	2.93	0.66	3.50	1.23	5.30	3.03	7.63	5.36
20	2.93	0.66	3.50	1.23	5.36	3.09	7.72	5.45
25	2.93	0.66	3.50	1.23	5.44	3.17	7.85	5.58
30	2.93	0.66	3.50	1.23	5.52	3.25	7.96	5.69
35	2.93	0.66	3.50	1.23	5.55	3.28	8.10	5.83
40	2.93	0.66	3.50	1.23	5.56	3.29	8.27	6.00
45	2.93	0.66	3.50	1.23	5.56	3.29	8.45	6.18
50	2.93	0.66	3.50	1.23	5.56	3.29	8.63	6.36
55	2.93	0.66	3.50	1.23	5.56	3.29	8.79	6.52
60	2.93	0.66	3.50	1.23	5.56	3.29	8.84	6.57
75	2.93	0.66	3.50	1.23	5.56	3.29	9.00	6.73
90	2.93	0.66	3.50	1.23	5.56	3.29	9.12	6.85
105	2.93	0.66	3.50	1.23	5.56	3.29	9.23	6.96
120	2.93	0.66	3.50	1.23	5.56	3.29	9.34	7.07

STEP DRAWDOWN TEST

Project Name	C. D. S. S PHASE III		
Borehole No	R2 - No. 1	Static Water Level	2.27 M
Site	MWATIBU C. D. S. S	Date	17/10/2013



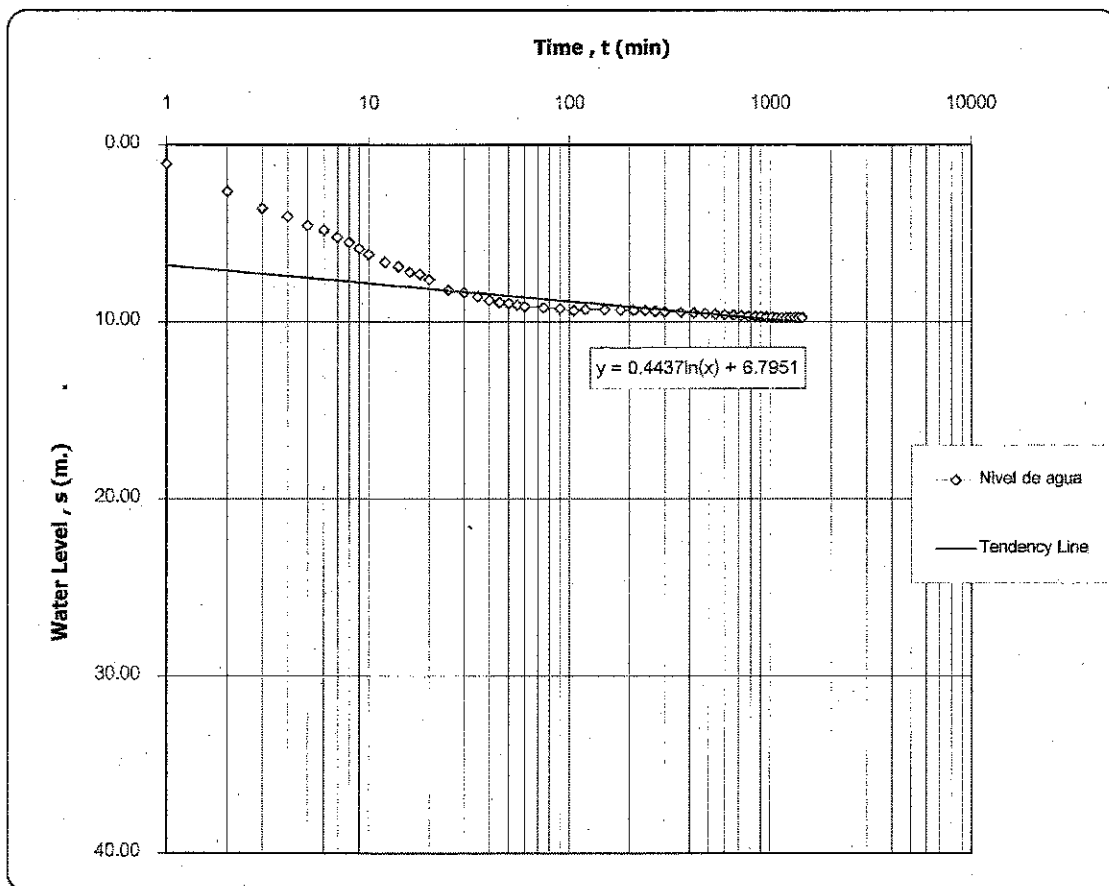
Step	Discharge (m ³ /hr)	Dynamic Level (m)	Drawdown (m)
First (1st)	1.08	2.93	0.66
Second (2nd)	1.8	3.5	1.23
Third (3rd)	2.88	5.56	3.29
Forth (4th)	3.6	9.34	7.07

CONSTANT DISCHARGE TEST

Name of Project	C. D. S. S PHASE III				
Borehole No.	R2 - No. 1	Depth	61M		
Name of Location	MWATIBU C. D. S. S	Casing Depth	60M		
District	LILONGWE	Static Water Level	2.27 M		
		Dynamic Water Level	12.03 M		
Date	18/10/2013	Pump Set Depth	42m		
Actual Time (Hours:Minutes)	Time (Min)	Yield (Lit/Sec)	Dynamic Water Level (M)	Drawn Down (M)	Remarks
5:00	0	1.11L/s	2.27	0	
5:01	0:01	1.11L/s	3.34	1.07	
5:02	0:02	1.11L/s	4.90	2.63	
5:03	0:03	1.11L/s	5.85	3.58	
5:04	0:04	1.11L/s	6.32	4.05	
5:05	0:05	1.11L/s	6.84	4.57	
5:06	0:06	1.11L/s	7.10	4.83	
5:07	0:07	1.11L/s	7.49	5.22	
5:08	0:08	1.11L/s	7.77	5.5	
5:09	0:09	1.11L/s	8.13	5.86	
5:10	0:10	1.11L/s	8.45	6.18	
5:12	0:12	1.11L/s	8.89	6.62	
5:14	0:14	1.11L/s	9.13	6.86	
5:16	0:16	1.11L/s	9.46	7.19	
5:18	0:18	1.11L/s	9.57	7.3	
5:20	0:20	1.11L/s	9.89	7.62	
5:25	0:25	1.11L/s	10.45	8.18	
5:30	0:30	1.11L/s	10.62	8.35	
5:35	0:35	1.11L/s	10.83	8.56	
5:40	0:40	1.11L/s	11.04	8.77	
5:45	0:45	1.11L/s	11.16	8.89	
5:50	0:50	1.11L/s	11.22	8.95	
5:55	0:55	1.11L/s	11.31	9.04	
6:00	1:00	1.11L/s	11.40	9.13	
6:15	1:15	1.11L/s	11.46	9.19	
6:30	1:30	1.11L/s	11.51	9.24	
6:45	1:45	1.11L/s	11.64	9.37	
7:00	2:00	1.11L/s	11.57	9.3	
7:30	2:30	1.11L/s	11.58	9.31	
8:00	3:00	1.11L/s	11.59	9.32	
8:30	3:30	1.11L/s	11.61	9.34	
9:00	4:00	1.11L/s	11.63	9.36	
9:30	4:30	1.11L/s	11.66	9.39	
10:00	5:00	1.11L/s	11.69	9.42	
11:00	6:00	1.11L/s	11.73	9.46	
12:00	7:00	1.11L/s	11.77	9.5	
13:00	8:00	1.11L/s	11.80	9.53	
14:00	9:00	1.11L/s	11.84	9.57	
15:00	10:00	1.11L/s	11.87	9.6	
16:00	11:00	1.11L/s	11.90	9.63	
17:00	12:00	1.11L/s	11.93	9.66	
18:00	13:00	1.11L/s	11.95	9.68	
19:00	14:00	1.11L/s	11.97	9.7	
20:00	15:00	1.11L/s	11.99	9.72	
21:00	16:00	1.11L/s	12.01	9.74	
22:00	17:00	1.11L/s	12.02	9.75	
23:00	18:00	1.11L/s	12.03	9.76	
23:00	18:00	1.11L/s	12.03	9.76	
1:00	20:00	1.11L/s	12.03	9.76	
2:00	21:00	1.11L/s	12.03	9.76	
3:00	22:00	1.11L/s	12.03	9.76	
4:00	23:00	1.11L/s	12.03	9.76	
5:00	0:00	1.11L/s	12.03	9.76	

CONSTANT DISCHARGE TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R2 No.1	STATIC WATER LEVEL	2.27 m.
SITE	Mwatibu CDSS	DATE	18/10/13



DESCRIPTION	
Discharge, Q (m ³ /hr.)	3.96 m ³ /hr.
water Level ,ΔS (m.)	1.10 m.
Transmissivity , T (m ² /hr.)	
$T = (2.30 Q) / (4\pi\Delta S)$	0.659 m ² /hr.
Screen Length , b (m.)	21.00 m.
Hydraulic Gradient , K (m./hr.)	
$K = T/b$	3.138E-02 m./hr.

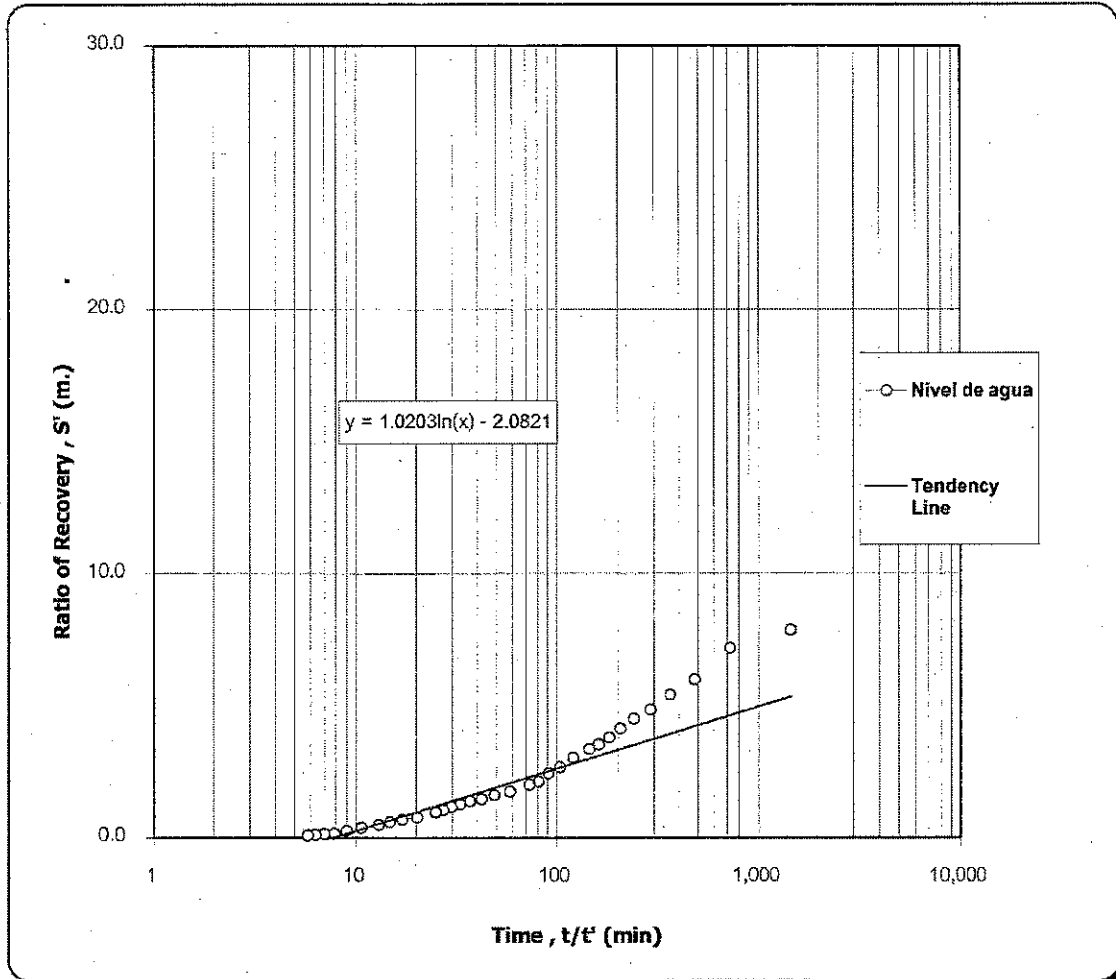
CONSTANT DISCHARGE TEST (RECOVERY)

Name of Project	C. D. S. S PHASE III		
Borehole No.	R2 - No. 1	Depth	61M
Name of Location	MWATIBU C. D. S. S	Casing Depth	60M
District	LILONGWE	Static Water Level	2.27 M
		Dynamic Water Level	12.03 M
Date	19/10/2013	Pump Set Depth	42m

Actual Time (Hours:Minutes)	Time (Min)	Accumulated time (Min)	Water Level (M)	Recovery (m)	Remarks
5:00	0:00	1440	12.03	9.76	
5:01	0:01	1441	10.14	7.87	
5:02	0:02	1442	9.46	7.19	
5:03	0:03	1443	8.27	6.00	
5:04	0:04	1444	7.69	5.42	
5:05	0:05	1445	7.13	4.86	
5:06	0:06	1446	6.78	4.51	
5:07	0:07	1447	6.41	4.14	
5:08	0:08	1448	6.07	3.80	
5:09	0:09	1449	5.81	3.54	
5:10	0:10	1450	5.63	3.36	
5:12	0:12	1452	5.32	3.05	
5:14	0:14	1454	4.96	2.69	
5:16	0:16	1456	4.72	2.45	
5:18	0:18	1458	4.4	2.13	
5:20	0:20	1460	4.29	2.02	
5:25	0:25	1465	4.03	1.76	
5:30	0:30	1470	3.89	1.62	
5:35	0:35	1475	3.74	1.47	
5:40	0:40	1480	3.66	1.39	
5:45	0:45	1485	3.55	1.28	
5:50	0:50	1490	3.45	1.18	
5:55	0:55	1495	3.33	1.06	
6:00	1:00	1500	3.24	0.97	
6:15	1:15	1515	3.05	0.78	
6:30	1:30	1530	2.97	0.70	

WATER LEVEL RECOVERY TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R2 no.1	STATIC WATER LEVEL	2.27 m.
SITE	Mwatibu CDSS	DATE	19/10/13



DESCRIPTION	
Discharge, Q (m ³ /hr.)	3.96 m ³ /hr.
Water Level, ΔS (m.)	2.27 m.
Transmissivity, T (m ² /hr.)	
$T = (2.30 Q) / (4\pi\Delta S)$	0.32 m ² /hr.
Screen Length, b (m.)	21.00 m.
Hydraulic Gradient, K (m./hr.)	
$K = T/b$	1.520E-02 m./hr.

3. CHIMWALIRA C. D. S. S (R3)

At Chimwalira CDSS water was found on the first drilling attempt made. The details of the borehole results are as below

3.1 DETAILS OF THE BOREHOLE AT CHIMWALIRA CDSS (R3 – No. 1)

Date of Drilling: 01/12/2013

Borehole Depth: 51m (Drilled 51m)

Result: WET

DEPTH (m)	LITHOLOGY
0 – 1	Top Loam soil
2 – 3	Gravel Brown color
4 – 5	Soft brown weathered rock
6 – 21	Inter-changing of color brown to grey
22 – 40	Grey hard granite
41 – 51	Gneiss pure dark grey hard basement

The details of the borehole which includes lithology and borehole design are as shown in the figure below.

3.2 BOREHOLE DEVELOPMENT AND PUMPING TEST

There were 3 types of Pumping test carried out namely Step Draw Down, Constant Discharge and Recovery test. The pump was set at a Depth of 38m. Before the pumping test the borehole was developed by AIR LIFTING method for a period of 3 hours.

BOREHOLE STRUCTURE - WET

Project Name: C. D. S. S Phase III

Site Name: CHIMWALIRA C. D. S. S

Borehole No.: R3 - No 1

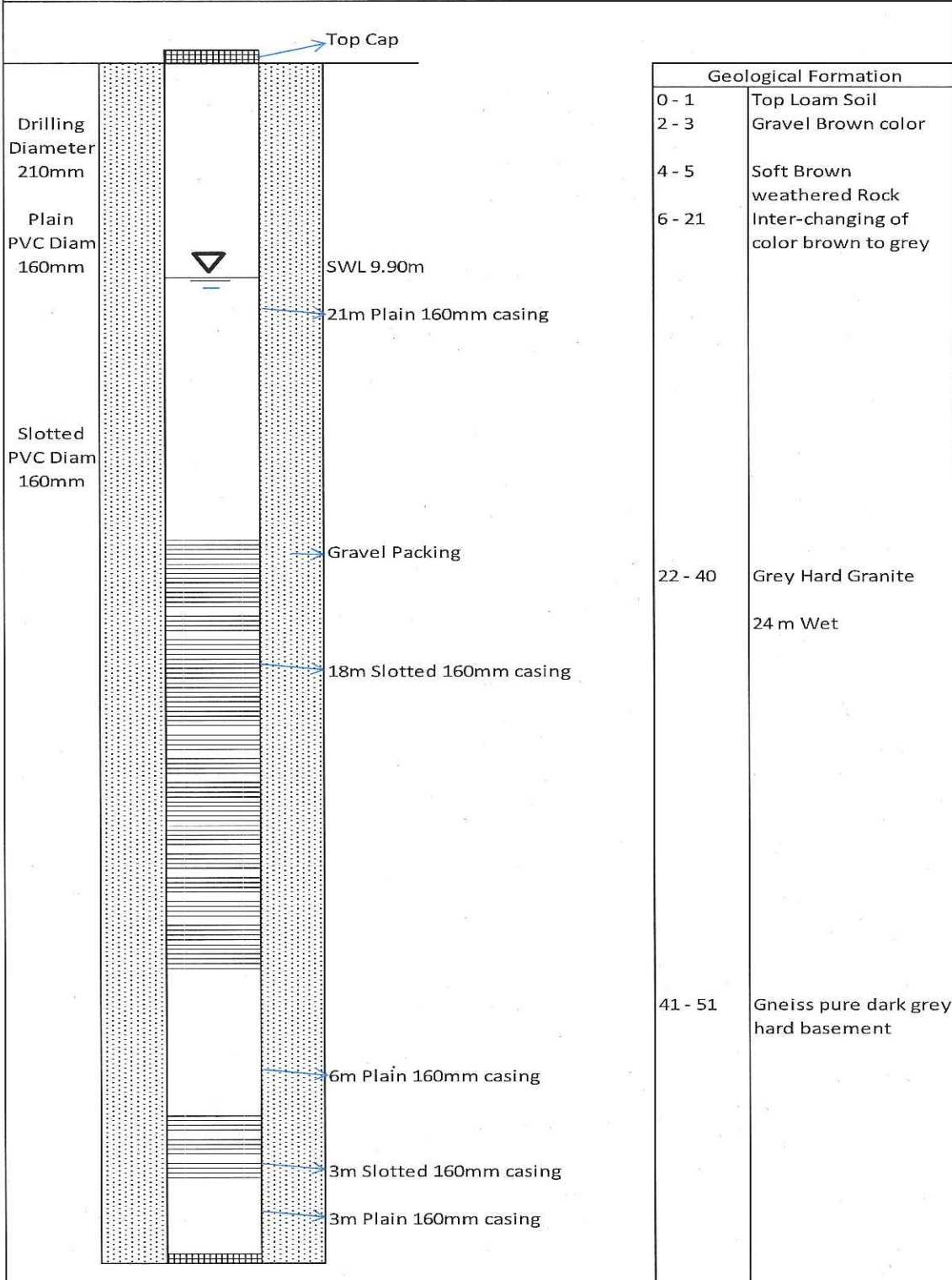
Starting Date: 1st December 2012

Completion Date: 1st December 2013

Drilling Depth 51 m

Casing Depth 51 m

Casing Diam 160mm



Drilling depth 51m

CHIMWALIRA CDSS BOREHOLE

3.3 PUMPING TEST AT CHIMWALIRA CDSS

Pumping test of the borehole at Chimwalira CDSS was done in 4 Step Drawn test of 120 minutes. The four steps tests were set at 0.3l/s, 0.5l/s, 0.8l/s and 1.0l/s. The pump was set at a depth of 38m. This was followed by Constant Discharge Pumping test for 24 hours at the yield of 1.0l/s and followed by Recovery test. The below table shows the Step Draw down Test and Constant Pump Test results at Chimwalira CDSS

Step No.	Duration (Min)	Discharge	Drawdown (m)	Water Cleanliness
1	120	0.3 L/s	3.72	Clean
2	120	0.5 L/s	6.58	Clean
3	120	0.8 L/s	11.20	Clean
4	120	1.0 L/s	13.74	Clean

STEP DRAW DOWN PUMPING TEST RECORD

CHIMWALIRA C. D. S. S

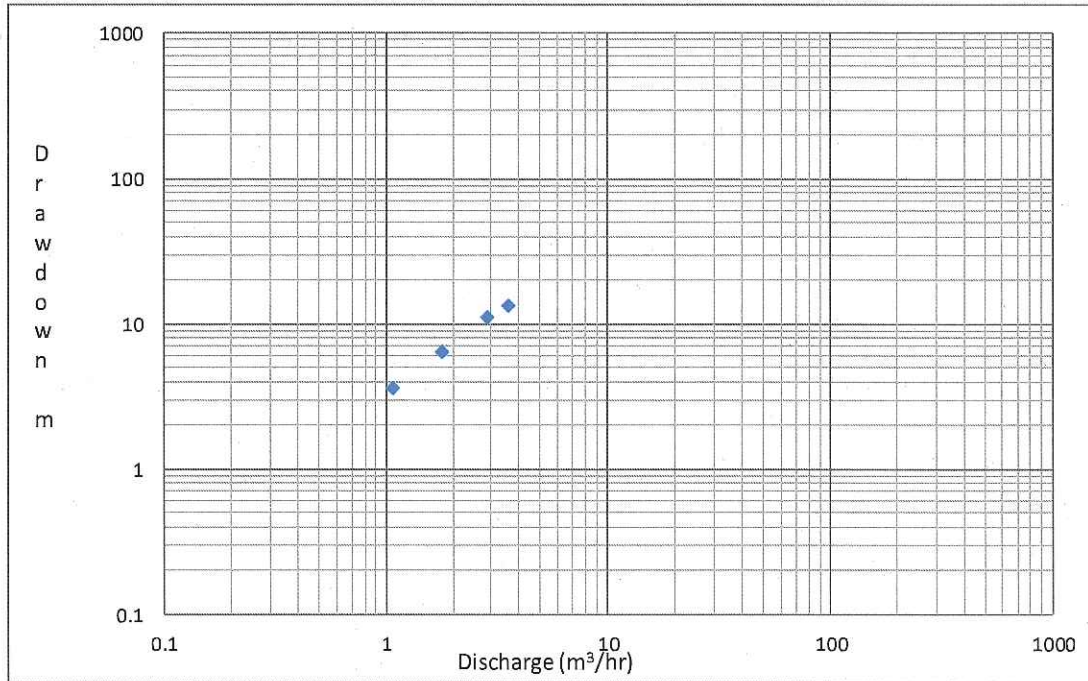
	1 st Step	2 nd Step	3 rd Step	4 th Step
Discharge (l/s)	0.3L/s	0.5L/s	0.8L/s	1L/s
Duration	120	120	120	120

Date	2/12/2013
Static Water Level	9.9 M
Borehole Depth	51M
Pump Set	38M

Time (Min)	1 st Step		2 nd Step		3 rd Step		4 th Step	
	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)
0	9.90	0.00	13.62	3.72	16.48	6.58	21.10	11.20
1	10.34	0.44	14.30	4.40	16.80	6.90	21.26	11.36
2	10.86	0.96	14.38	4.48	17.30	7.40	21.38	11.48
3	11.16	1.26	14.69	4.79	17.57	7.67	21.55	11.65
4	11.33	1.43	14.75	4.85	17.95	8.05	21.68	11.78
5	11.59	1.69	14.81	4.91	18.24	8.34	21.77	11.87
6	11.70	1.80	14.89	4.99	18.55	8.65	21.90	12.00
7	11.88	1.98	14.96	5.06	19.16	9.26	22.02	12.12
8	12.03	2.13	15.03	5.13	19.50	9.60	22.13	12.23
9	12.29	2.39	15.17	5.27	19.68	9.78	22.26	12.36
10	12.50	2.60	15.24	5.34	19.85	9.95	22.34	12.44
12	12.94	3.04	15.42	5.52	20.03	10.13	22.50	12.60
14	13.19	3.29	15.61	5.71	20.15	10.25	22.61	12.71
16	13.25	3.35	15.68	5.78	20.24	10.34	22.75	12.85
18	13.27	3.37	16.04	6.14	20.36	10.46	22.89	12.99
20	13.30	3.40	16.23	6.33	20.45	10.55	22.97	13.07
25	13.33	3.43	16.26	6.36	20.62	10.72	23.20	13.30
30	13.35	3.45	16.32	6.42	20.78	10.88	23.41	13.51
35	13.35	3.45	16.40	6.50	20.89	10.99	23.44	13.54
40	13.40	3.50	16.45	6.55	20.94	11.04	23.47	13.57
45	13.42	3.52	16.46	6.56	20.99	11.09	23.49	13.59
50	13.45	3.55	16.47	6.57	21.03	11.13	23.51	13.61
55	13.48	3.58	16.48	6.58	21.06	11.16	23.54	13.64
60	13.50	3.60	16.48	6.58	21.08	11.18	23.57	13.67
75	13.53	3.63	16.48	6.58	21.09	11.19	23.60	13.70
90	13.56	3.66	16.48	6.58	21.10	11.20	23.62	13.72
105	13.58	3.68	16.48	6.58	21.10	11.20	23.63	13.73
120	13.62	3.72	16.48	6.58	21.10	11.20	23.64	13.74

STEP DRAWDOWN TEST

Project Name	C. D. S. S PHASE III		
Borehole No	R3 - No 1	Static Water Level	9.9 M
Site	CHIMWALIRA C. D. S. S	Date	02/12/2013



Step	Discharge (m ³ /hr)	Dynamic Level (m)	Drawdown (m)
First (1st)	1.08	13.62	3.72
Second (2nd)	1.8	16.48	6.58
Third (3rd)	2.88	21.1	11.2
Forth (4th)	3.6	23.64	13.74

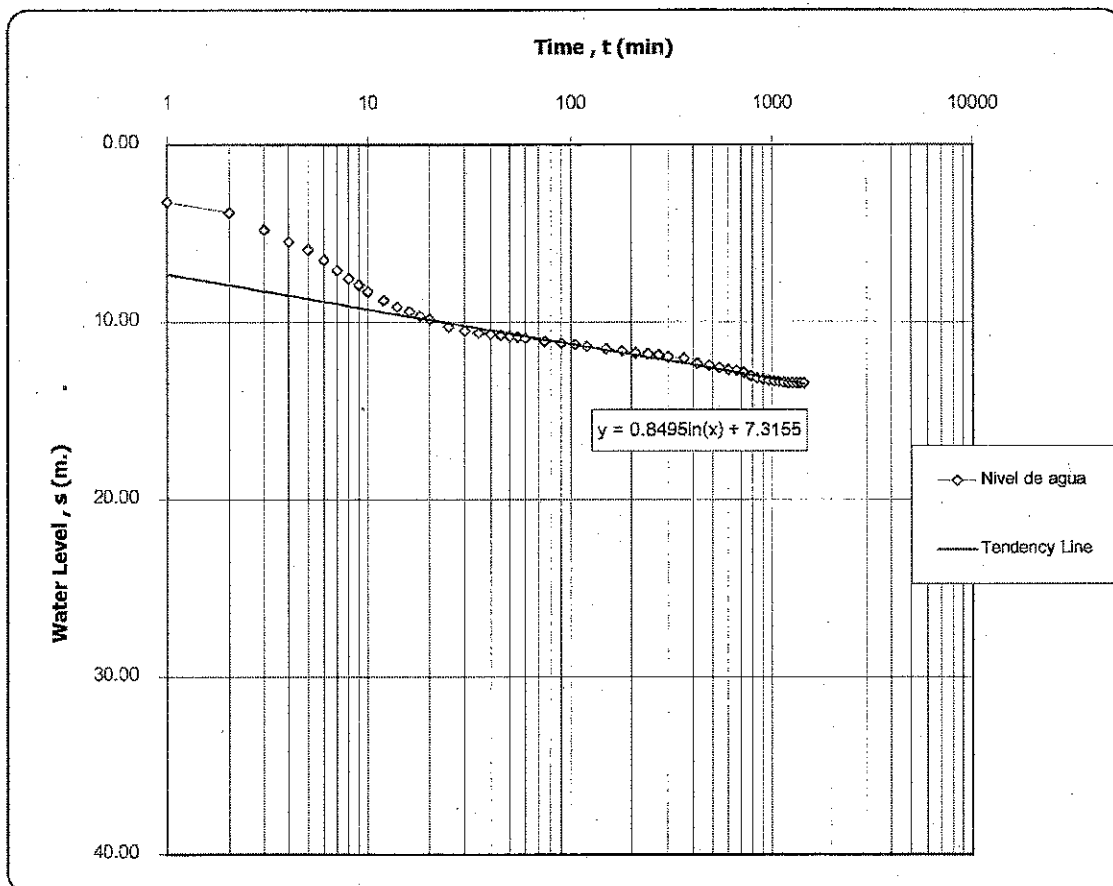
CONSTANT DISCHARGE TEST

Name of Project	C. D. S. S PHASE III		
Borehole No.	R3 - No 1	Depth	51M
Name of Location	CHIMWALIRA C. D. S. S	Casing Depth	51M
District	ZOMBA	Static Water Level	9.9 M
		Dynamic Water Level	23.34 M
Date	03/12/2013	Pump Set Depth	38M

Actual Time (Hours:Minutes)	Time (Min)	Yield (Lit/Sec)	Dynamic Water Level (M)	Drawn Down (M)	Remarks
10:15	0	1L/s	9.90	0.00	
10:16	0:01	1L/s	13.14	3.24	
10:17	0:02	1L/s	13.73	3.83	
10:18	0:03	1L/s	14.70	4.80	
10:19	0:04	1L/s	15.38	5.48	
10:20	0:05	1L/s	15.81	5.91	
10:21	0:06	1L/s	16.40	6.50	
10:22	0:07	1L/s	16.98	7.08	
10:23	0:08	1L/s	17.43	7.53	
10:24	0:09	1L/s	17.78	7.88	
10:25	0:10	1L/s	18.16	8.26	
10:27	0:12	1L/s	18.67	8.77	
10:29	0:14	1L/s	19.04	9.14	
10:31	0:16	1L/s	19.30	9.40	
10:33	0:18	1L/s	19.55	9.65	
10:35	0:20	1L/s	19.73	9.83	
10:40	0:25	1L/s	20.17	10.27	
10:45	0:30	1L/s	20.37	10.47	
10:50	0:35	1L/s	20.51	10.61	
10:55	0:40	1L/s	20.57	10.67	
11:00	0:45	1L/s	20.64	10.74	
11:05	0:50	1L/s	20.70	10.80	
11:10	0:55	1L/s	20.75	10.85	
11:15	1:00	1L/s	20.80	10.90	
11:30	1:15	1L/s	20.98	11.08	
11:45	1:30	1L/s	21.08	11.18	
12:00	1:45	1L/s	21.16	11.26	
12:15	2:00	1L/s	21.25	11.35	
12:45	2:30	1L/s	21.40	11.50	
13:15	3:00	1L/s	21.52	11.62	
13:45	3:30	1L/s	21.63	11.73	
14:15	4:00	1L/s	21.69	11.79	
14:45	4:30	1L/s	21.76	11.86	
15:15	5:00	1L/s	21.87	11.97	
16:15	6:00	1L/s	21.95	12.05	
17:15	7:00	1L/s	22.23	12.33	
18:15	8:00	1L/s	22.34	12.44	
19:15	9:00	1L/s	22.47	12.57	
20:15	10:00	1L/s	22.58	12.68	
21:15	11:00	1L/s	22.63	12.73	
22:15	12:00	1L/s	22.74	12.84	
23:15	13:00	1L/s	22.92	13.02	
0:15	14:00	1L/s	23.06	13.16	
1:15	15:00	1L/s	23.11	13.21	
2:15	16:00	1L/s	23.18	13.28	
3:15	17:00	1L/s	23.23	13.33	
4:15	18:00	1L/s	23.27	13.37	
4:15	18:00	1L/s	23.31	13.41	
6:15	20:00	1L/s	23.33	13.43	
7:15	21:00	1L/s	23.34	13.44	
8:15	22:00	1L/s	23.34	13.44	
9:15	23:00	1L/s	23.34	13.44	
10:15	0:00	1L/s	23.34	13.44	

CONSTANT DISCHARGE TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R3 No.1	STATIC WATER LEVEL	9.90 m.
SITE	Chimwalira CDSS	DATE	03/12/13



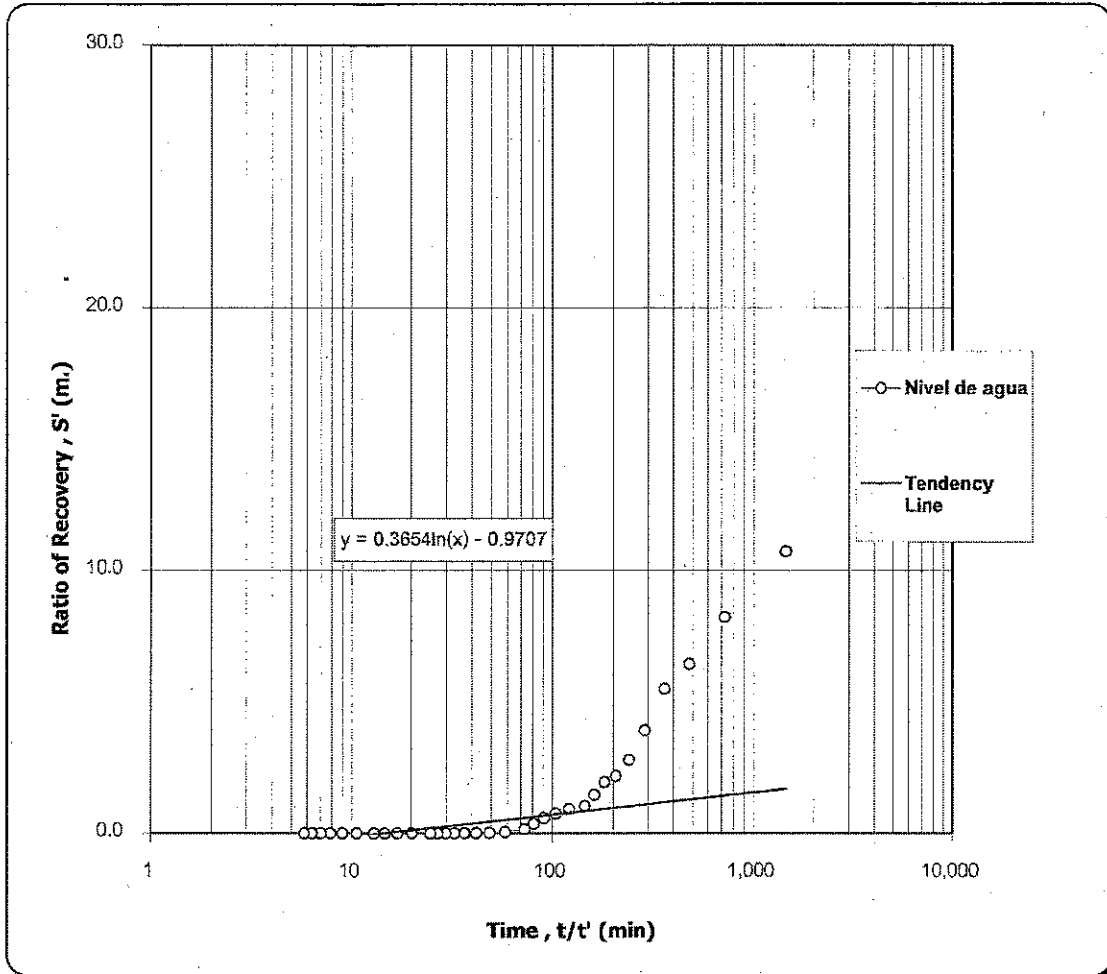
DESCRIPTION	
Discharge, Q (m ³ /hr.)	3.60 m ³ /hr.
water Level, ΔS (m.)	2.10 m.
Transmissivity, T (m ² /hr.)	
$T = (2.30 Q) / (4\pi\Delta S)$	0.314 m ² /hr.
Screen Length, b (m.)	21.00 m.
Hydraulic Gradient, K (m./hr.)	
$K = T/b$	1.494E-02 m./hr.

CONSTANT DISCHARGE TEST (RECOVERY)

Name of Project	C. D. S. S PHASE III				
Borehole No.	R3 - No 1	Depth	51M		
Name of Location	CHIMWALIRA C. D. S. S	Casing Depth	51M		
District	ZOMBA	Static Water Level	9.9 M		
		Dynamic Water Level	23.34 M		
Date	04/12/2013	Pump Set Depth	38M		
Actual Time (Hours:Minutes)	Time (Min)	Accumulated time (Min)	Water Level (M)	Recovery (m)	Remarks
10:15	0:00	1440	23.34	13.44	
10:16	0:01	1441	20.63	10.73	
10:17	0:02	1442	18.14	8.24	
10:18	0:03	1443	16.35	6.45	
10:19	0:04	1444	15.4	5.50	
10:20	0:05	1445	13.82	3.92	
10:21	0:06	1446	12.7	2.80	
10:22	0:07	1447	12.09	2.19	
10:23	0:08	1448	11.86	1.96	
10:24	0:09	1449	11.38	1.48	
10:25	0:10	1450	10.96	1.06	
10:27	0:12	1452	10.84	0.94	
10:29	0:14	1454	10.66	0.76	
10:31	0:16	1456	10.49	0.59	
10:33	0:18	1458	10.27	0.37	
10:35	0:20	1460	10.06	0.16	
10:40	0:25	1465	9.96	0.06	
10:45	0:30	1470	9.93	0.03	

WATER LEVEL RECOVERY TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R3 No.1	STATIC WATER LEVEL	9.90 m.
SITE	Chimwalira CDSS	DATE	04/12/13



DESCRIPTION	
Discharge, Q (m ³ /hr.)	3.60 m ³ /hr.
Water Level ,ΔS (m.)	0.85 m.
Transmissivity , T (m ² /hr.)	
$T = (2.30 Q)/(4\pi\Delta S)$	0.78 m ² /hr.
Screen Length , b (m.)	21.00 m.
Hydraulic Gradient , K (m./hr.)	
$K = T/b$	3.691E-02 m./hr.

4. KABEKERE C. D. S. S (R4)

At Kabekere CDSS water was found on the third drilling attempt made. The details of the borehole results are as below

4.1 DETAILS OF THE BOREHOLE AT KABEKERE CDSS (R4 – No. 1, No. 2 and No. 3)

Date of Drilling: 21/11/2013

Borehole Depth: 51m (Drilled 51m)

Result: DRY (R4 – No. 1)

DEPTH (m)	LITHOLOGY
0 – 1	Top Loam soil
2 – 3	Soft brown material
4 – 10	Color changing at intervals brown to blackish
11 – 51	Hard black basement

Date of Drilling: 22/11/2013

Borehole Depth: 61m (Drilled 61m)

Result: DRY (R4 – No. 2)

DEPTH (m)	LITHOLOGY
0 – 1	Top Loam soil
2 – 9	Soft brown rock
10 – 16	Color changing at intervals darkish to blackish
17 – 22	Gneiss dark rock
23 – 36	Soft Greyish rock
37 – 44	Hard whitish and powdered rock
45 – 59	Hard greyish rock
60 – 61	Hard dark gneiss rock

Date of Drilling: 24/11/2013

Borehole Depth: 51m (Drilled 51m)

Result: WET (R4 – No. 3)

DEPTH (m)	LITHOLOGY
0 – 1	Dark Brown clay soil
2 – 4	Soft brown material
5 – 15	Inter-changing of color brown to darkish
16 – 20	Boulder OD 2-4mm
21 – 30	Brown gneiss soft rock
31 – 38	Grey granite soft rock
39 – 51	Dark grey gneiss rocky formation

The details of the borehole which includes lithology and borehole design are as shown in the figure below.

4.2 BOREHOLE DEVELOPMENT AND PUMPING TEST

There were 3 types of Pumping test carried out namely Step Draw Down, Constant Discharge and Recovery test. The pump was set at a Depth of 47m. Before the pumping test the borehole was developed by AIR LIFTING method for a period of 3 hours.

BOREHOLE STRUCTURE - DRY

Project Name: C. D. S. S Phase III

Site Name: KABEKERE C. D. S. S

Borehole No.: R4 - No. 1

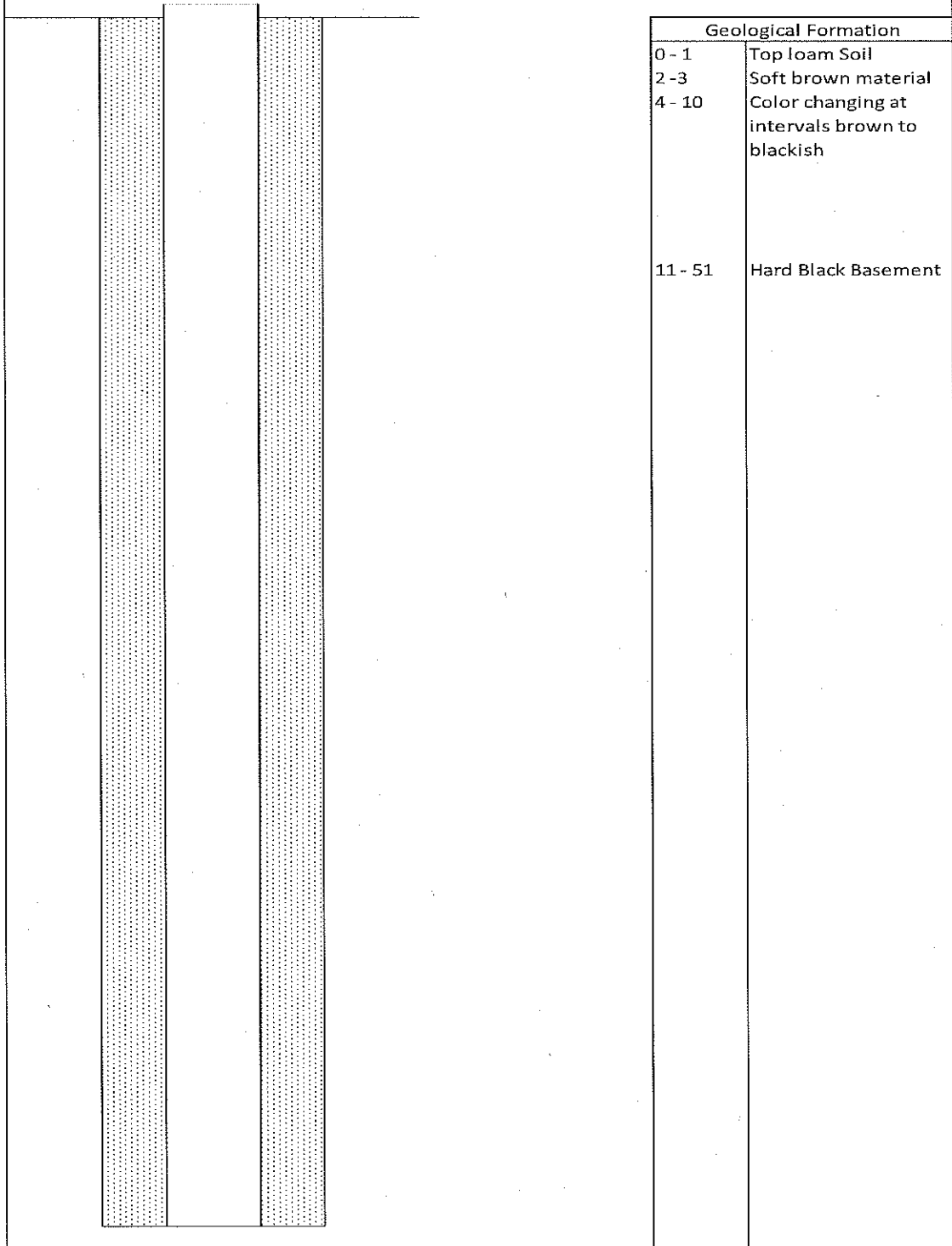
Starting Date: 21st November 2013

Completion Date: 22nd November 2013

Drilling Depth 51 m

Casing Depth Dry

Casing Diam 160mm



Drilling depth 51m

KABEKERE CDSS BOREHOLE

BOREHOLE STRUCTURE - DRY

Project Name: C. D. S. S Phase III

Site Name: KABEKERE C. D. S. S

Borehole No.: R4 - No 2

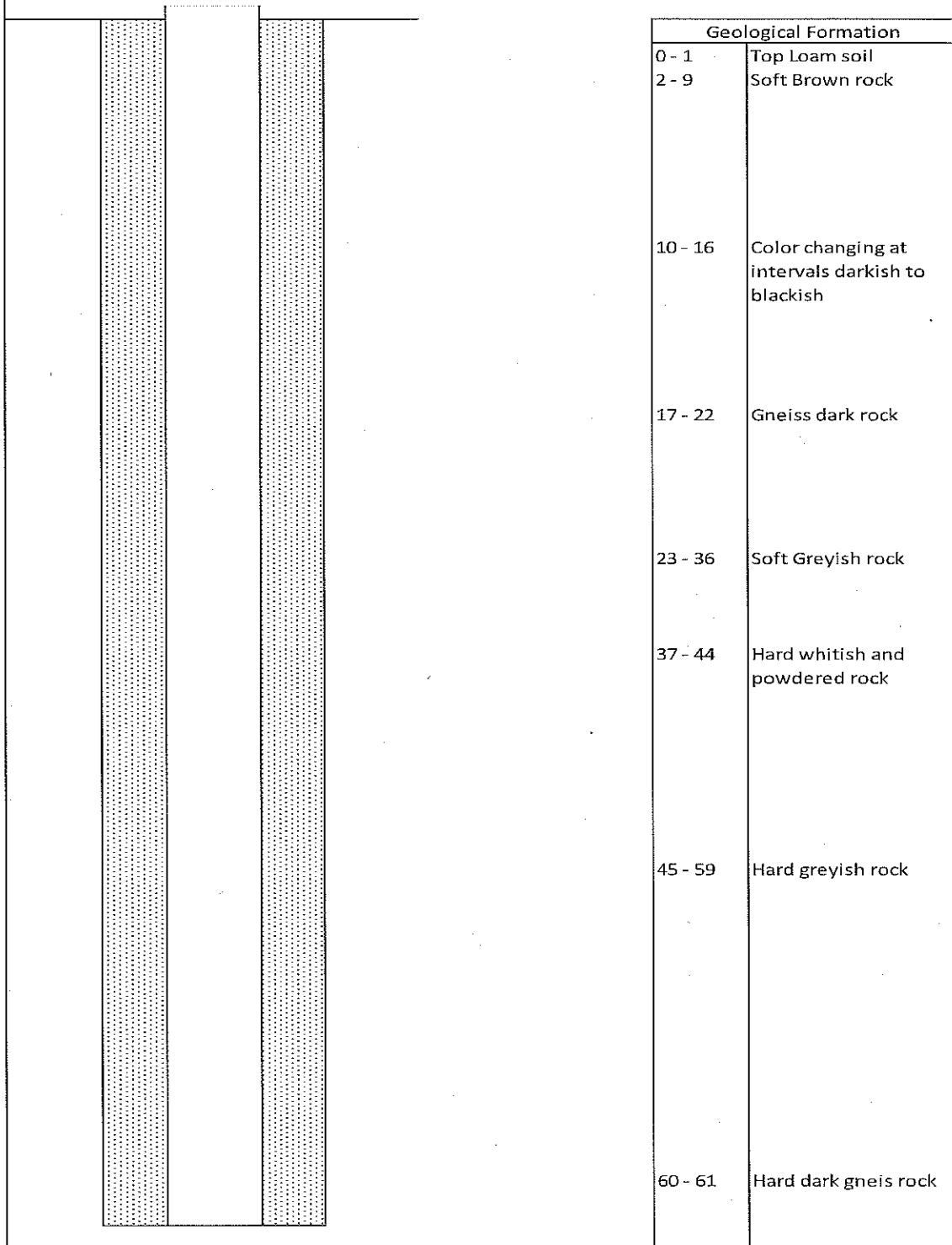
Starting Date: 22nd November 2013

Completion Date: 23rd November 2013

Drilling Depth 61 m

Casing Depth Dry

Casing Diam 160mm



Drilling depth 61m

KABEKERE CDSS BOREHOLE

BOREHOLE STRUCTURE - WET

Project Name: C. D. S. S Phase III

Site Name: KABEKERE C. D. S. S

Borehole No.: R4 - No. 3

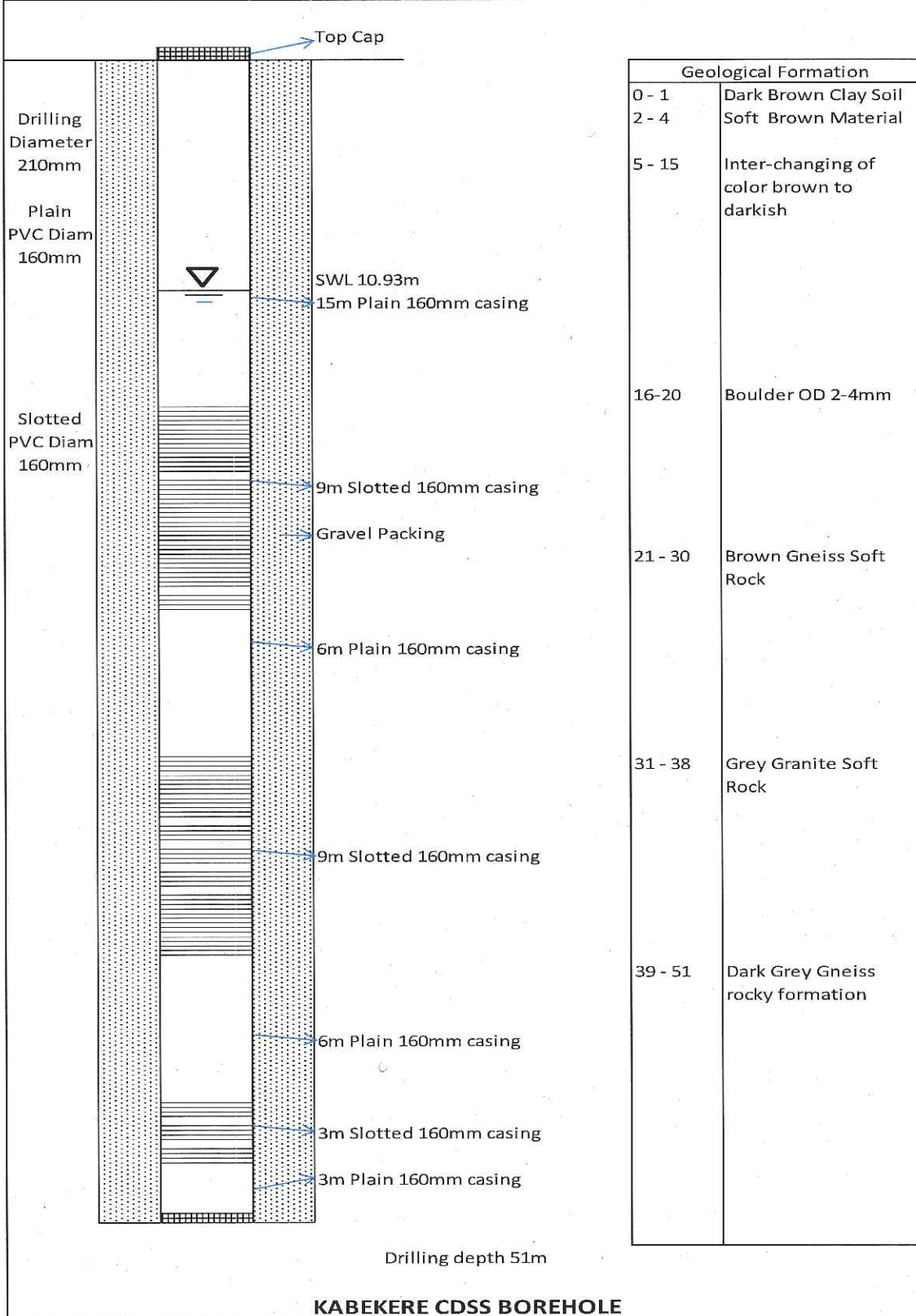
Starting Date: 24th November 2013

Completion Date: 25th November 2013

Drilling Depth 51 m

Casing Depth 51 m

Casing Diam 160mm



4.3 PUMPING TEST AT KABEKERE CDSS

Pumping test of the borehole at Kabekere CDSS was done in 4 Step Drawn test of 120 minutes. The four steps tests were set at 0.3l/s, 0.5l/s, 0.8l/s and 1.0l/s. The pump was set at a depth of 47m. This was followed by Constant Discharge Pumping test for 24 hours at the yield of 1.0l/s and followed by Recovery test. The below table shows the Step Draw down Test and Constant Pump Test results at Kabekere CDSS

Step No.	Duration (Min)	Discharge	Drawdown (m)	Water Cleanliness
1	120	0.3 L/s	1.62	Clean
2	120	0.5 L/s	2.55	Clean
3	120	0.8 L/s	3.73	Clean
4	120	1.0 L/s	4.29	Clean

STEP DRAW DOWN PUMPING TEST RECORD

KABEKERE C. D. S. S

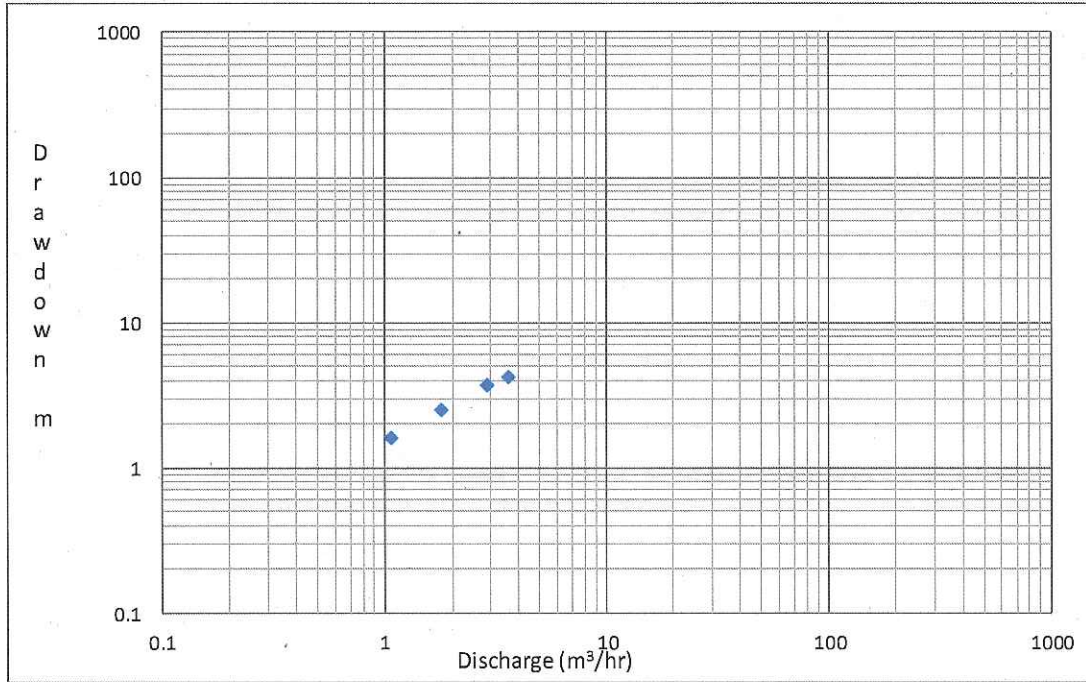
	1 st Step	2 nd Step	3 rd Step	4 th Step
Discharge (l/s)	0.3L/s	0.5L/s	0.8L/s	1L/s
Duration	120	120	120	120

Date	26/11/2013
Static Water Level	10.93 M
Borehole Depth	51M
Pump Set	47M

Time (Min)	1 st Step		2 nd Step		3 rd Step		4 th Step	
	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)
0	10.93	0.00	12.55	1.62	13.48	2.55	14.66	3.73
1	12.09	1.16	12.70	1.77	14.09	3.16	14.75	3.82
2	12.10	1.17	12.94	2.01	14.13	3.20	14.76	3.83
3	12.12	1.19	13.02	2.09	14.19	3.26	14.77	3.84
4	12.13	1.20	13.09	2.16	14.22	3.29	14.78	3.85
5	12.14	1.21	13.10	2.17	14.25	3.32	14.79	3.86
6	12.15	1.22	13.11	2.18	14.27	3.34	14.80	3.87
7	12.16	1.23	13.12	2.19	14.31	3.38	14.81	3.88
8	12.17	1.24	13.13	2.20	14.36	3.43	14.82	3.89
9	12.19	1.26	13.14	2.21	14.39	3.46	14.83	3.90
10	12.20	1.27	13.15	2.22	14.42	3.49	14.84	3.91
12	12.22	1.29	13.18	2.25	14.43	3.50	14.85	3.92
14	12.23	1.30	13.20	2.27	14.44	3.51	14.86	3.93
16	12.24	1.31	13.22	2.29	14.45	3.52	14.88	3.95
18	12.25	1.32	13.23	2.30	14.45	3.52	14.90	3.97
20	12.26	1.33	13.24	2.31	14.47	3.54	14.92	3.99
25	12.27	1.34	13.25	2.32	14.52	3.59	14.94	4.01
30	12.28	1.35	13.26	2.33	14.55	3.62	14.96	4.03
35	12.29	1.36	13.27	2.34	14.58	3.65	14.98	4.05
40	12.30	1.37	13.29	2.36	14.61	3.68	15.00	4.07
45	12.32	1.39	13.32	2.39	14.63	3.70	15.02	4.09
50	12.33	1.40	13.34	2.41	14.65	3.72	15.04	4.11
55	12.34	1.41	13.35	2.42	14.66	3.73	15.06	4.13
60	12.35	1.42	13.36	2.43	14.66	3.73	15.08	4.15
75	12.49	1.56	13.40	2.47	14.66	3.73	15.12	4.19
90	12.55	1.62	13.43	2.50	14.66	3.73	15.16	4.23
105	12.55	1.62	13.45	2.52	14.66	3.73	15.20	4.27
120	12.55	1.62	13.48	2.55	14.66	3.73	15.22	4.29

STEP DRAWDOWN TEST

Project Name	C. D. S. S PHASE III		
Borehole No	R4 - No 3	Static Water Level	10.93 M
Site	KABEKERE C. D. S. S	Date	26/11/2013



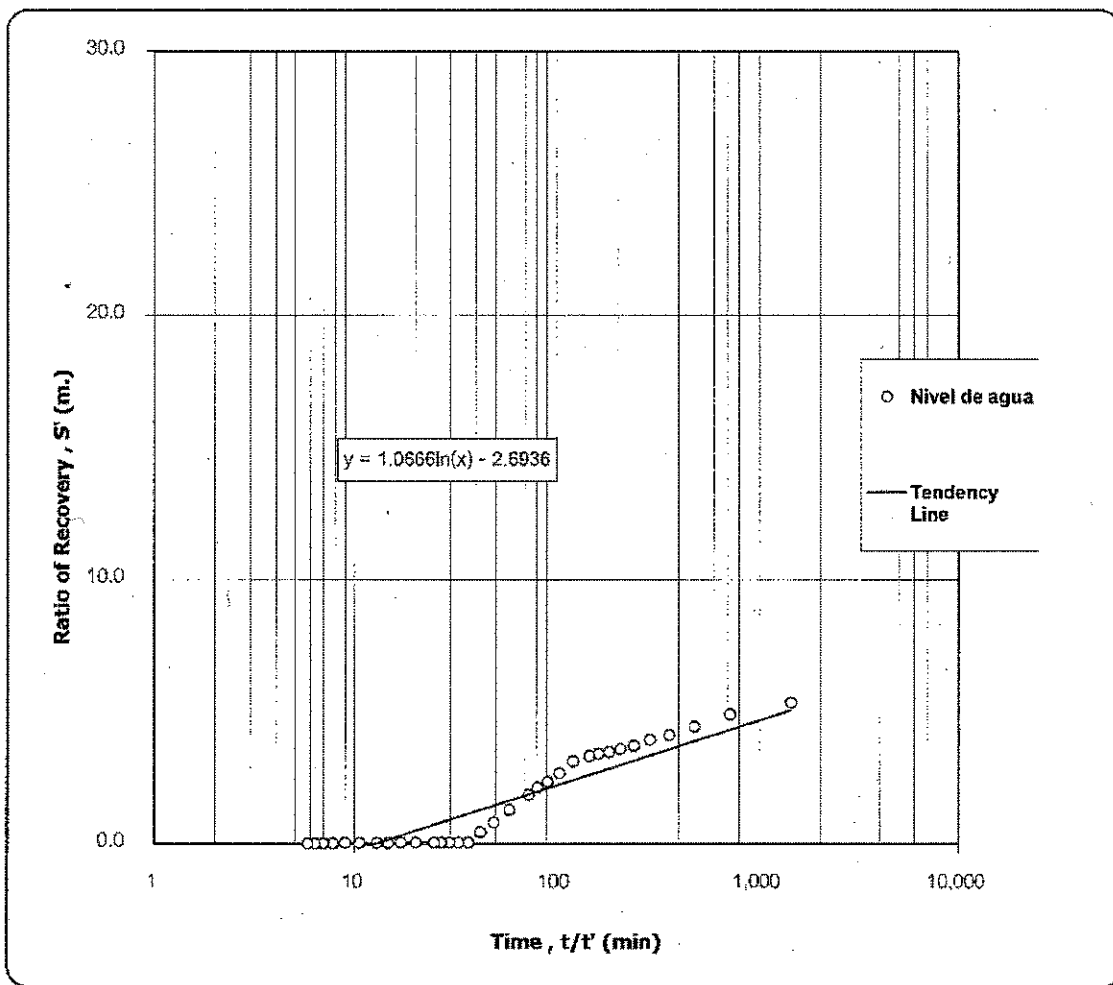
Step	Discharge (m3/hr)	Dynamic Level (m)	Drawdown (m)
First (1st)	1.08	12.55	1.62
Second (2nd)	1.8	13.48	2.55
Third (3rd)	2.88	14.66	3.73
Forth (4th)	3.6	15.22	4.29

CONSTANT DISCHARGE TEST

Name of Project	C. D. S. S PHASE III				
Borehole No.	R4 - No 3	Depth	51M		
Name of Location	KABEKERE C. D. S. S	Casing Depth	51M		
District	NTCHEU	Static Level	10.93 M		
		Dynamic Water Level	18.01 M		
Date	27/11/2013	Pump Set Depth	47M		
Actual Time (Hours:Minutes)	Time (Min)	Yield (Lit/Sec)	Dynamic Water Level (M)	Drawn Down (M)	Remarks
7:30	0	1L/s	10.93	0.00	
7:31	0:01	1L/s	12.05	1.12	
7:32	0:02	1L/s	12.58	1.65	
7:33	0:03	1L/s	12.83	1.90	
7:34	0:04	1L/s	13.06	2.13	
7:35	0:05	1L/s	13.18	2.25	
7:36	0:06	1L/s	13.37	2.44	
7:37	0:07	1L/s	13.64	2.71	
7:38	0:08	1L/s	13.87	2.94	
7:39	0:09	1L/s	14.05	3.12	
7:40	0:10	1L/s	14.19	3.26	
7:42	0:12	1L/s	14.43	3.50	
7:44	0:14	1L/s	14.54	3.61	
7:46	0:16	1L/s	14.60	3.67	
7:48	0:18	1L/s	14.68	3.75	
7:50	0:20	1L/s	14.72	3.79	
7:55	0:25	1L/s	14.78	3.85	
8:00	0:30	1L/s	14.85	3.92	
8:05	0:35	1L/s	14.92	3.99	
8:10	0:40	1L/s	14.97	4.04	
8:15	0:45	1L/s	15.03	4.10	
8:20	0:50	1L/s	15.07	4.14	
8:25	0:55	1L/s	15.11	4.18	
8:30	1:00	1L/s	15.15	4.22	
8:45	1:15	1L/s	15.33	4.40	
9:00	1:30	1L/s	15.43	4.50	
9:15	1:45	1L/s	15.50	4.57	
9:30	2:00	1L/s	15.69	4.76	
10:00	2:30	1L/s	15.81	4.88	
10:30	3:00	1L/s	16.04	5.11	
11:00	3:30	1L/s	16.39	5.46	
11:30	4:00	1L/s	16.54	5.61	
12:00	4:30	1L/s	16.68	5.75	
12:30	5:00	1L/s	16.73	5.80	
13:30	6:00	1L/s	16.87	5.94	
14:30	7:00	1L/s	17.04	6.11	
15:30	8:00	1L/s	17.16	6.23	
16:30	9:00	1L/s	17.28	6.35	
17:30	10:00	1L/s	17.40	6.47	
18:30	11:00	1L/s	17.56	6.63	
19:30	12:00	1L/s	17.61	6.68	
20:30	13:00	1L/s	17.69	6.76	
21:30	14:00	1L/s	17.83	6.90	
22:30	15:00	1L/s	17.87	6.94	
23:30	16:00	1L/s	17.91	6.98	
0:30	17:00	1L/s	17.93	7.00	
1:30	18:00	1L/s	17.96	7.03	
1:30	18:00	1L/s	17.98	7.05	
3:30	20:00	1L/s	17.99	7.06	
4:30	21:00	1L/s	18.01	7.08	
5:30	22:00	1L/s	18.01	7.08	
6:30	23:00	1L/s	18.01	7.08	
7:30	0:00	1L/s	18.01	7.08	

WATER LEVEL RECOVERY TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R4 No.3	STATIC WATER LEVEL	10.93 m.
SITE	Kabekere CDSS	DATE	28/11/13



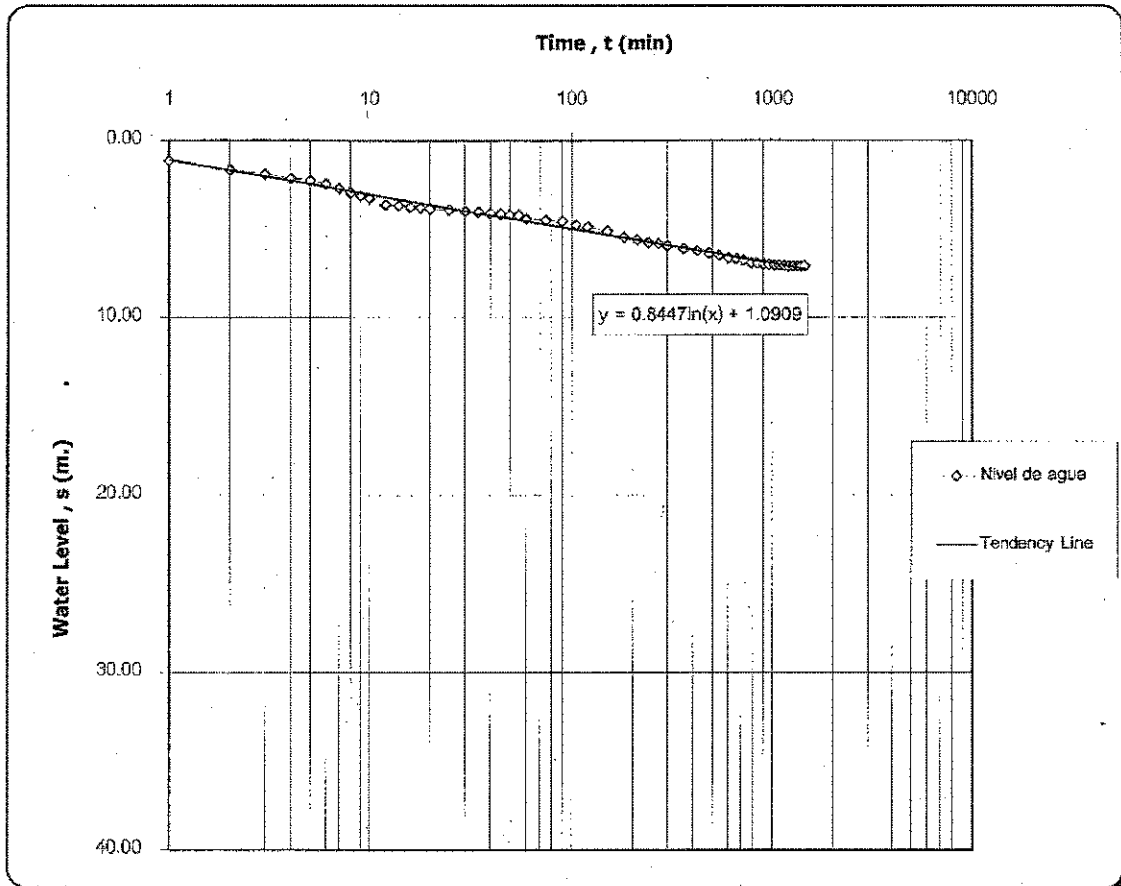
DESCRIPTION	
Discharge, Q (m ³ /hr.)	3.60 m ³ /hr.
Water Level, ΔS (m.)	2.38 m.
Transmissivity, T (m ² /hr.)	0.28 m ² /hr.
$T = (2.30 Q) / (4\pi \Delta S)$	0.28 m ² /hr.
Screen Length, b (m.)	21.00 m.
Hydraulic Gradient, K (m./hr.)	1.318E-02 m./hr.
$K = T/b$	1.318E-02 m./hr.

CONSTANT DISCHARGE TEST (RECOVERY)

Name of Project	C. D. S. S PHASE III				
Borehole No.	R4 - No 3	Depth	51M		
Name of Location	KABEKERE C. D. S. S	Casing Depth	51M		
District	NTCHEU	Static Level	10.93 M		
		Dynamic Water Level	18.01 M		
Date	28/11/2013	Pump Set Depth	47M		
Actual Time (Hours:Minutes)	Time (Min)	Accumulated time (Min)	Water Level (M)	Recovery (m)	Remarks
7:30	0:00	1440	18.01	7.08	
7:31	0:01	1441	16.29	5.36	
7:32	0:02	1442	15.84	4.91	
7:33	0:03	1443	15.38	4.45	
7:34	0:04	1444	15.06	4.13	
7:35	0:05	1445	14.88	3.95	
7:36	0:06	1446	14.66	3.73	
7:37	0:07	1447	14.54	3.61	
7:38	0:08	1448	14.42	3.49	
7:39	0:09	1449	14.35	3.42	
7:40	0:10	1450	14.26	3.33	
7:42	0:12	1452	14.07	3.14	
7:44	0:14	1454	13.63	2.70	
7:46	0:16	1456	13.29	2.36	
7:48	0:18	1458	13.07	2.14	
7:50	0:20	1460	12.81	1.88	
7:55	0:25	1465	12.24	1.31	
8:00	0:30	1470	11.76	0.83	
8:05	0:35	1475	11.39	0.46	
8:10	0:40	1480	11.03	0.10	

CONSTANT DISCHARGE TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R4 No.3	STATIC WATER LEVEL	10.93 m.
SITE	Kabekere CDSS	DATE	27/11/13



DESCRIPTION	
Discharge, Q (m ³ /hr.)	3.60 m ³ /hr.
water Level ,ΔS (m.)	2.18 m. ←
Transmissivity , T (m ² /hr.)	
$T = (2.30 Q)/(4\pi\Delta S)$	0.302 m ² /hr.
Screen Length , b (m.)	21.00 m. ←
Hydraulic Gradient , K (m./hr.)	
$K = T/b$	1.439E-02 m./hr.

5. MWALAWANYENJE C. D. S. S (R5)

At Mwalawanyenje CDSS water was found on the first drilling attempt made. The details of the borehole results are as below

5.1 DETAILS OF THE BOREHOLE AT MWALAWANYENJE CDSS (R5 – No. 1)

Date of Drilling: 26/10/2013

Borehole Depth: 54m (Drilled 56m)

Result: WET

DEPTH (m)	LITHOLOGY
0 – 1	Top loam soil
2 – 3	Inter-changing of color brown to darkish
4 – 11	Soft brown rock
12 – 26	Granite hard rock
27 – 31	Grey granite hard rock
32 – 51	White brown granite hard rock
52 – 56	Dark grey granite basement

The details of the borehole which includes lithology and borehole design are as shown in the figure below.

5.2 BOREHOLE DEVELOPMENT AND PUMPING TEST

There were 3 types of Pumping test carried out namely Step Draw Down, Constant Discharge and Recovery test. The pump was set at a Depth of 47m. Before the pumping test the borehole was developed by AIR LIFTING method for a period of 3 hours.

BOREHOLE STRUCTURE - WET

Project Name: C. D. S. S Phase III

Site Name: MWALAWANYENJE C. D. S. S

Borehole No.: R5 - No 1

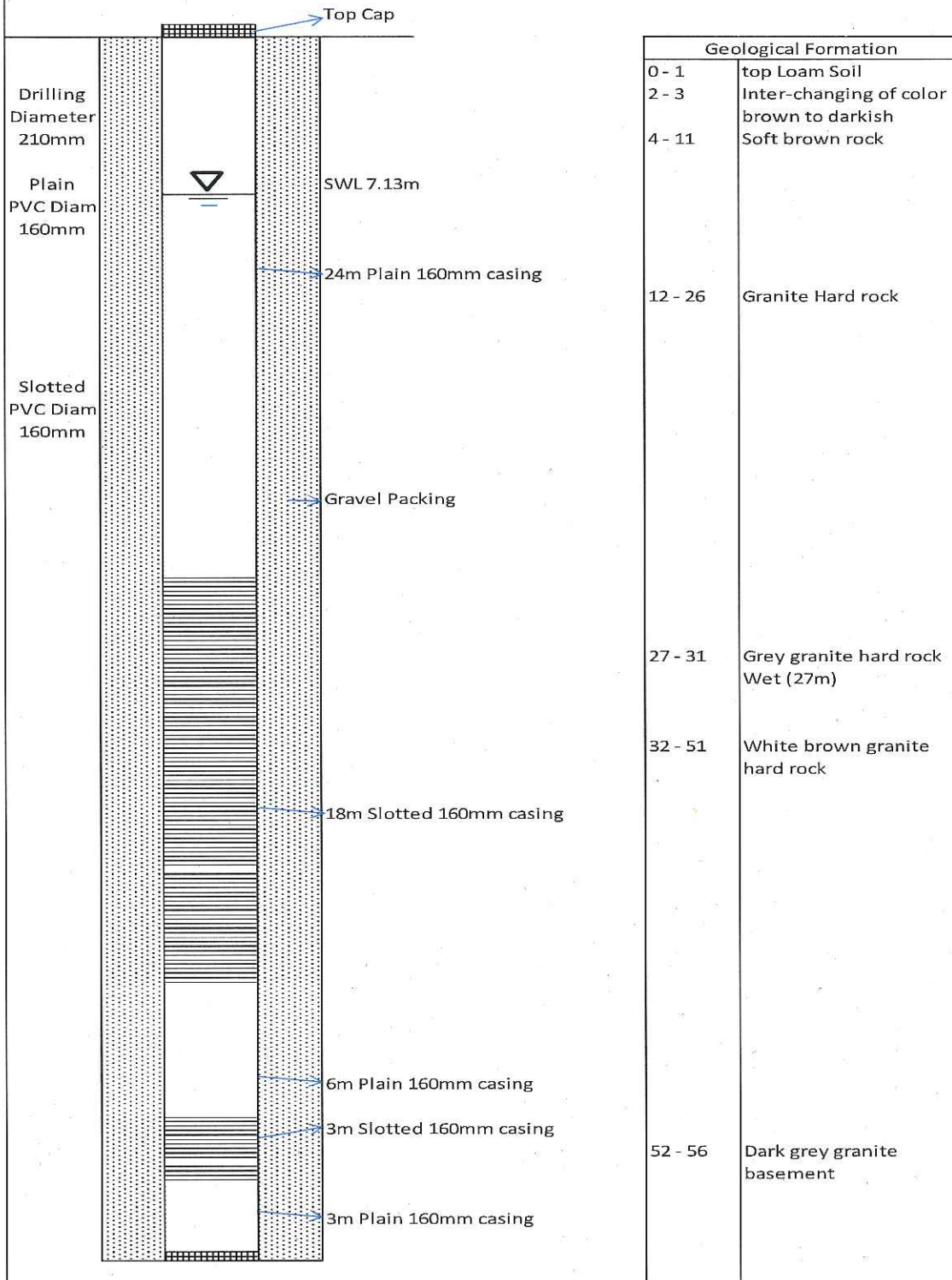
Starting Date: 26th October 2013

Completion Date: 27th October 2013

Drilling Depth 56 M

Casing Depth 54 M

Casing Diam 160mm



Drilling depth 56m

MWALAWANYENJE CDSS BOREHOLE

5.3 PUMPING TEST AT MWALAWANYENJE CDSS

Pumping test of the borehole at Mwalawanyenje CDSS was done in 2 Step Drawn test of 120 minutes and 3rd Step Drawn test of 8 minutes. The three steps tests were set at 0.3l/s, 0.4l/s and 0.5l/s. The pump was set at a depth of 47m. This was followed by Constant Discharge Pumping test for 24 hours at the yield of 0.36l/s and followed by Recovery test. The below table shows the Step Draw down Test and Constant Pump Test results at Mwalawanyenje CDSS

Step No.	Duration (Min)	Discharge	Drawdown (m)	Water Cleanliness
1	120	0.3 L/s	10.83	Clean
2	120	0.4 L/s	27.54	Clean
3	8	0.5 L/s	38.61	Clean
4		0 L/s		

STEP DRAW DOWN PUMPING TEST RECORD

MWALAWANYENJE C. D. S. S

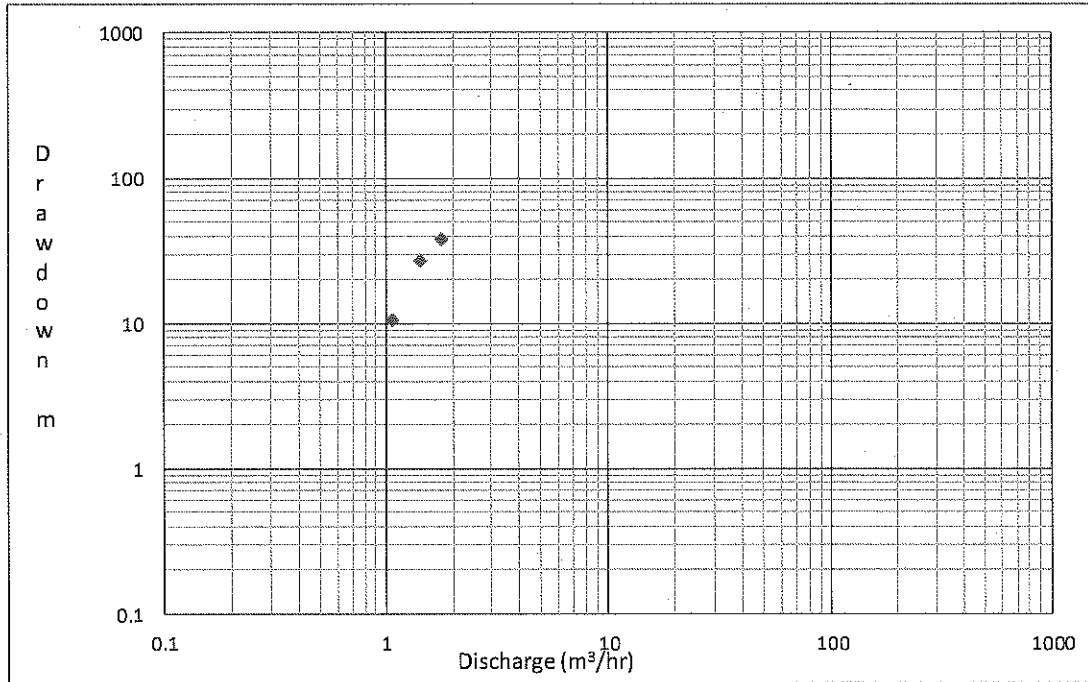
	1 st Step	2 nd Step	3 rd Step	4 th Step
Discharge (l/s)	0.3L/s	0.4 L/s	0.5 L/s	0
Duration	120	120	8	0

Date	28/10/2013
Static Water Level	7.13 M
Borehole Depth	54 M
Pump Set	47M

Time (Min)	1 st Step		2 nd Step		3 rd Step		4 th Step	
	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)
0	7.13	0.00	17.96	10.83	34.67	27.54	0.00	0.00
1	12.28	5.15	18.51	11.38	36.83	29.70	0.00	0.00
2	13.37	6.24	19.10	11.97	39.24	32.11	0.00	0.00
3	13.90	6.77	19.85	12.72	41.38	34.25	0.00	0.00
4	14.24	7.11	20.53	13.40	43.17	36.04	0.00	0.00
5	14.48	7.35	21.04	13.91	44.63	37.50	0.00	0.00
6	14.64	7.51	21.61	14.48	44.91	37.78	0.00	0.00
7	14.90	7.77	22.23	15.10	45.16	38.03	0.00	0.00
8	15.09	7.96	22.55	15.42	45.74	38.61	0.00	0.00
9	15.24	8.11	23.08	15.95	0.00	0.00	0.00	0.00
10	15.41	8.28	23.52	16.39	0.00	0.00	0.00	0.00
12	15.62	8.49	24.11	16.98	0.00	0.00	0.00	0.00
14	15.88	8.75	24.93	17.80	0.00	0.00	0.00	0.00
16	16.06	8.93	25.74	18.61	0.00	0.00	0.00	0.00
18	16.21	9.08	26.20	19.07	0.00	0.00	0.00	0.00
20	16.35	9.22	27.65	20.52	0.00	0.00	0.00	0.00
25	16.67	9.54	28.43	21.30	0.00	0.00	0.00	0.00
30	17.00	9.87	29.66	22.53	0.00	0.00	0.00	0.00
35	17.17	10.04	30.27	23.14	0.00	0.00	0.00	0.00
40	17.29	10.16	30.88	23.75	0.00	0.00	0.00	0.00
45	17.41	10.28	31.35	24.22	0.00	0.00	0.00	0.00
50	17.50	10.37	31.80	24.67	0.00	0.00	0.00	0.00
55	17.55	10.42	32.25	25.12	0.00	0.00	0.00	0.00
60	17.62	10.49	32.68	25.55	0.00	0.00	0.00	0.00
75	17.70	10.57	33.04	25.91	0.00	0.00	0.00	0.00
90	17.78	10.65	33.50	26.37	0.00	0.00	0.00	0.00
105	17.87	10.74	34.29	27.16	0.00	0.00	0.00	0.00
120	17.96	10.83	34.67	27.54	0.00	0.00	0.00	0.00

STEP DRAWDOWN TEST

Project Name	C. D. S. S PHASE III		
Borehole No	R5 - No 1	Static Water Level	7.13 M
Site	MWALAWANYENJE C. D. S. S	Date	28/10/2013



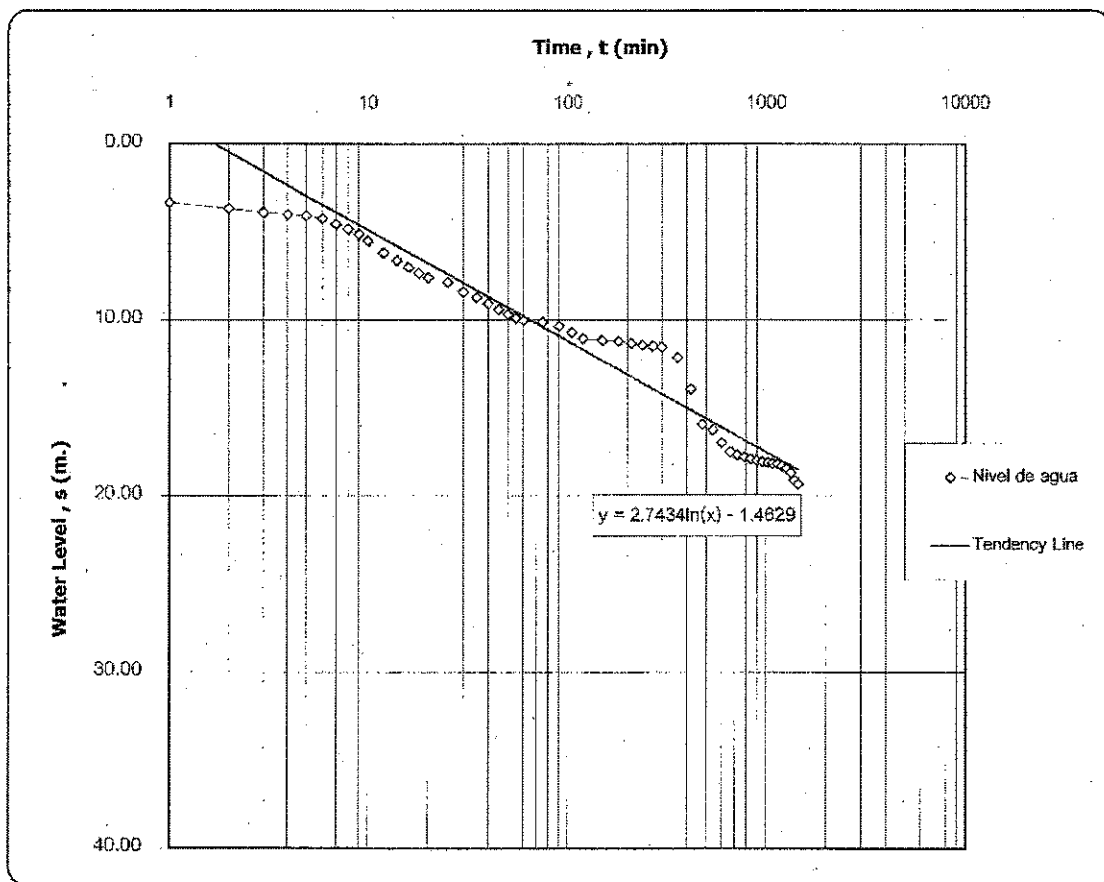
Step	Discharge (m ³ /hr)	Dynamic Level (m)	Drawdown (m)
First (1st)	1.08	17.96	10.83
Second (2nd)	1.44	34.67	27.54
Third (3rd)	1.8	45.74	38.61
Forth (4th)	3.6	0	0

CONSTANT DISCHARGE TEST

CONSTANT DISCHARGE TEST					
Name of Project	C. D. S. S PHASE III				
Borehole No.	R5 - No 1	Depth	56 M		
Name of Location	MWALAWANYENJE C. D. S. S	Casing Depth	54 M		
District	KASUNGU	Static Water Level	7.13 M		
		Dynamic Water Level	26.42 M		
Date	29/10/2013	Pump Set Depth	47M		
Actual Time (Hours:Minutes)	Time (Min)	Yield (Lit/Sec)	Dynamic Water Level (M)	Drawn Down (M)	Remarks
9:30	0	0.5L/S	7.13	0.00	
9:31	0:01	0.5L/S	10.46	3.33	
9:32	0:02	0.5L/S	10.80	3.67	
9:33	0:03	0.5L/S	11.02	3.89	
9:34	0:04	0.5L/S	11.11	3.98	
9:35	0:05	0.5L/S	11.20	4.07	
9:36	0:06	0.4L/S	11.36	4.23	
9:37	0:07	0.4L/S	11.67	4.54	
9:38	0:08	0.4L/S	11.95	4.82	
9:39	0:09	0.4L/S	12.24	5.11	
9:40	0:10	0.4L/S	12.63	5.50	
9:42	0:12	0.4L/S	13.30	6.17	
9:44	0:14	0.36L/S	13.75	6.62	
9:46	0:16	0.36L/S	14.12	6.99	
9:48	0:18	0.36L/S	14.44	7.31	
9:50	0:20	0.36L/S	14.70	7.57	
9:55	0:25	0.36L/S	14.98	7.85	
10:00	0:30	0.36L/S	15.52	8.39	
10:05	0:35	0.36L/S	15.85	8.72	
10:10	0:40	0.36L/S	16.19	9.06	
10:15	0:45	0.36L/S	16.51	9.38	
10:20	0:50	0.36L/S	16.80	9.67	
10:25	0:55	0.34L/S	17.00	9.87	
10:30	1:00	0.34L/S	17.16	10.03	
10:45	1:15	0.34L/S	17.24	10.11	
11:00	1:30	0.34L/S	17.46	10.33	
11:15	1:45	0.34L/S	17.83	10.70	
11:30	2:00	0.36L/S	18.18	11.05	
12:00	2:30	0.36L/S	18.26	11.13	
12:30	3:00	0.36L/S	18.32	11.19	
13:00	3:30	0.34L/S	18.44	11.31	
13:30	4:00	0.34L/S	18.55	11.42	
14:00	4:30	0.34L/S	18.60	11.47	
14:30	5:00	0.34L/S	18.65	11.52	
15:30	6:00	0.36L/S	19.26	12.13	
16:30	7:00	0.36L/S	21.04	13.91	
17:30	8:00	0.36L/S	23.05	15.92	
18:30	9:00	0.36L/S	23.37	16.24	
19:30	10:00	0.36L/S	24.10	16.97	
20:30	11:00	0.36L/S	24.60	17.47	
21:30	12:00	0.36L/S	24.80	17.67	
22:30	13:00	0.36L/S	24.90	17.77	
23:30	14:00	0.34L/S	25.01	17.88	
0:30	15:00	0.34L/S	25.11	17.98	
1:30	16:00	0.34L/S	25.17	18.04	
2:30	17:00	0.34L/S	25.21	18.08	
3:30	18:00	0.34L/S	25.25	18.12	
3:30	18:00	0.34L/S	25.29	18.16	
5:30	20:00	0.36L/S	25.42	18.29	
6:30	21:00	0.36L/S	25.57	18.44	
7:30	22:00	0.36L/S	25.80	18.67	
8:30	23:00	0.36L/S	26.23	19.10	
9:30	0:00	0.36L/S	26.42	19.29	

CONSTANT DISCHARGE TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R5 No.1	STATIC WATER LEVEL	7.13 m.
SITE	Mwalawanyenje CDSS	DATE	29/10/13

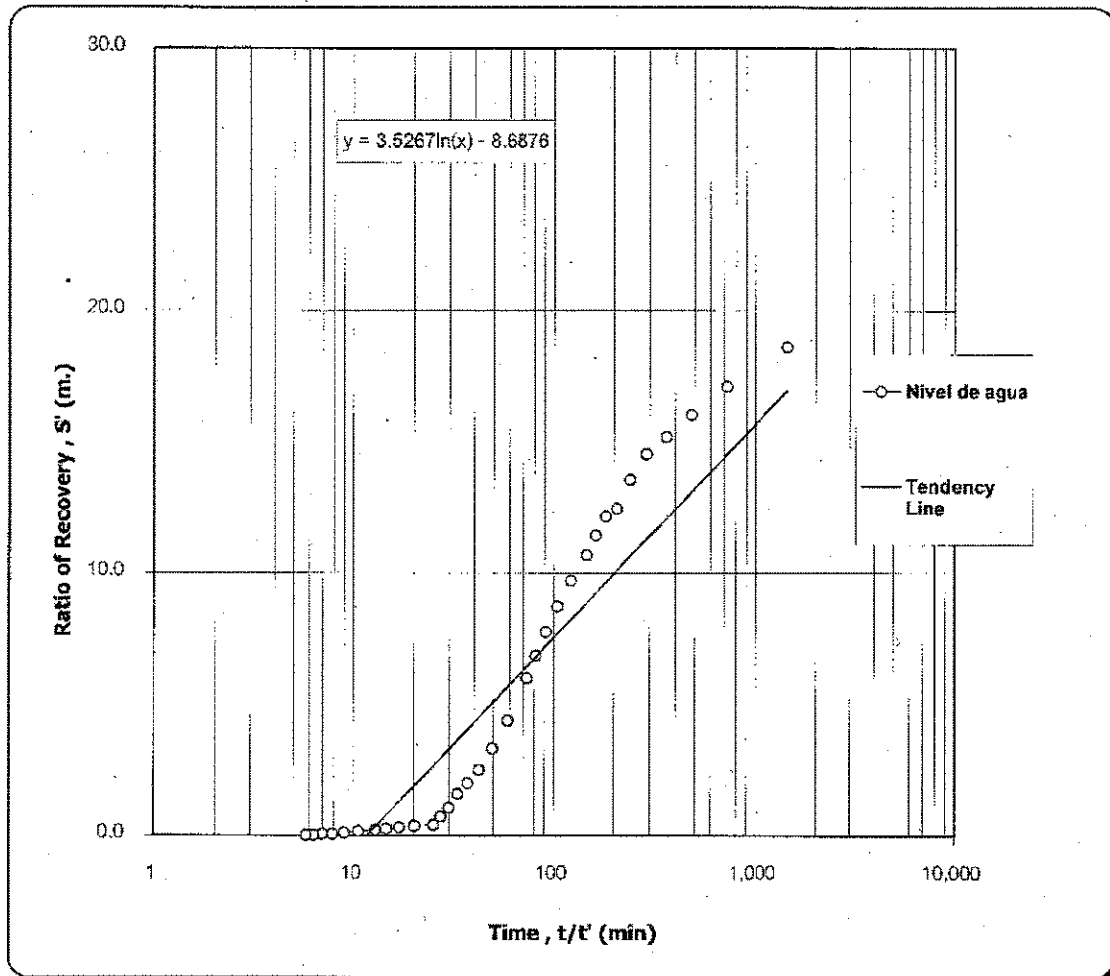


DESCRIPTION	
Discharge, Q (m ³ /hr.)	1.30 m ³ /hr.
water Level ΔS (m.)	6.36 m.
Transmissivity, T (m ² /hr.)	
$T = (2.30 Q) / (4\pi\Delta S)$	0.037 m ² /hr.
Screen Length, b (m.)	21.00 m.
Hydraulic Gradient, K (m./hr.)	
$K = T/b$	1.776E-03 m./hr.

CONSTANT DISCHARGE TEST (RECOVERY)					
Name of Project	C. D. S. S PHASE III				
Borehole No.	R5 - No 1	Depth	56 M		
Name of Location	MWALAWANYENJE C. D. S. S	Casing Depth	54 M		
District	KASUNGU	Static Water Level	7.13 M		
		Dynamic Water Level	26.42 M		
Date	30/10/2013	Pump Set Depth	47M		
Actual Time (Hours:Minutes)	Time (Min)	Accumulated time (Min)	Water Level (M)	Recovery (m)	Remarks
9:30	0:00	1440	26.42	19.29	
9:31	0:01	1441	25.75	18.62	
9:32	0:02	1442	24.25	17.12	
9:33	0:03	1443	23.17	16.04	
9:34	0:04	1444	22.32	15.19	
9:35	0:05	1445	21.68	14.55	
9:36	0:06	1446	20.70	13.57	
9:37	0:07	1447	19.58	12.45	
9:38	0:08	1448	19.30	12.17	
9:39	0:09	1449	18.57	11.44	
9:40	0:10	1450	17.83	10.70	
9:42	0:12	1452	16.85	9.72	
9:44	0:14	1454	15.87	8.74	
9:46	0:16	1456	14.90	7.77	
9:48	0:18	1458	14.00	6.87	
9:50	0:20	1460	13.14	6.01	
9:55	0:25	1465	11.52	4.39	
10:00	0:30	1470	10.45	3.32	
10:05	0:35	1475	9.65	2.52	
10:10	0:40	1480	9.13	2.00	
10:15	0:45	1485	8.72	1.59	
10:20	0:50	1490	8.20	1.07	
10:25	0:55	1495	7.86	0.73	
10:30	1:00	1500	7.54	0.41	

WATER LEVEL RECOVERY TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R5 No.1	STATIC WATER LEVEL	7.13 m.
SITE	Mwalawanyenje CDSS	DATE	30/10/13



DESCRIPTION	
Discharge, Q (m ³ /hr.)	1.30 m ³ /hr.
Water Level, ΔS (m.)	9.38 m.
Transmissivity, T (m ² /hr.)	
$T = (2.30 Q) / (4\pi \Delta S)$	0.03 m ² /hr.
Screen Length, b (m.)	21.00 m.
Hydraulic Gradient, K (m./hr.)	
$K = T/b$	1.205E-03 m./hr.

6. MZOMA C. D. S. S (R6)

At Mzoma CDSS water was found on the first drilling attempt made. The details of the borehole results are as below

6.1 DETAILS OF THE BOREHOLE AT MZOMA CDSS (R6 – No. 1 and No. 2)

Date of Drilling: 22/10/2013

Borehole Depth: 52m (Drilled 52m)

Result: DRY (R6 – No. 1)

DEPTH (m)	LITHOLOGY
0 – 3	Top loam soil
4 – 7	Gravel
8 – 19	Soft whitish material
20 – 21	Weathered soft blackish rock
22 – 42	Quartz material (collapsing)
42 – 52	Granite rock

Date of Drilling: 13/11/2013

Borehole Depth: 52m (Drilled 56m)

Result: WET (R6 – No. 2)

DEPTH (m)	LITHOLOGY
0 – 1	Dark brown clay
2 – 3	Top red soil with gravel
4 – 6	Soft brown material
7 – 17	Inter-changing of color brownish to greyish
18 – 19	Quartz materials highly collapsed
20 – 32	Granite soft rock blocky in form
33 – 41	White brown quartz materials
42 – 56	Grey granite soft rock

The details of the borehole which includes lithology and borehole design are as shown in the figure below.

6.2 BOREHOLE DEVELOPMENT AND PUMPING TEST

There were 3 types of Pumping test carried out namely Step Draw Down, Constant Discharge and Recovery test. The pump was set at a Depth of 47m. Before the pumping test the borehole was developed by AIR LIFTING method for a period of 3 hours.

BOREHOLE STRUCTURE - DRY

Project Name: C. D. S. S Phase III

Site Name: MZOMA C. D. S. S

Borehole No.: R6 - No 1

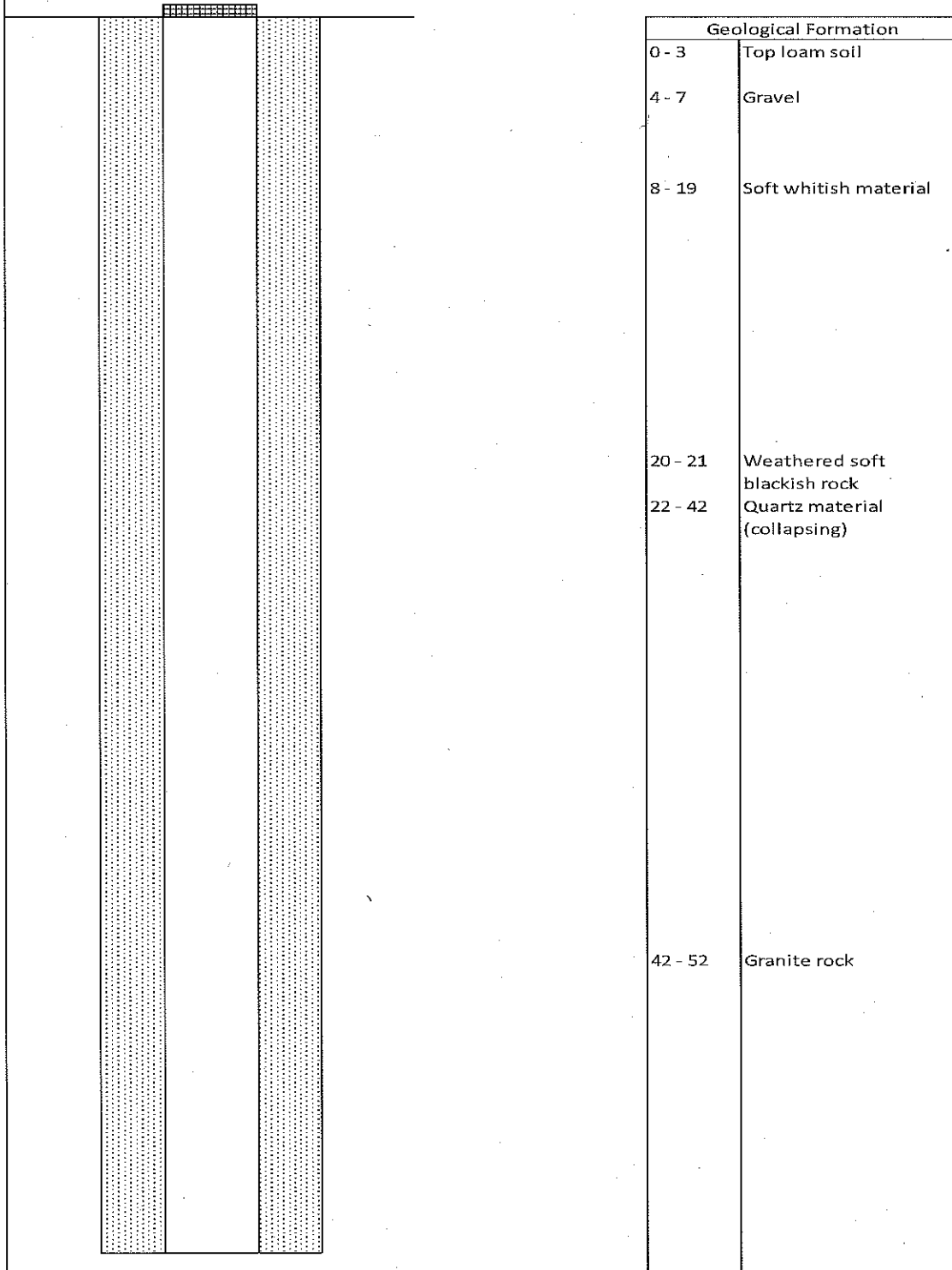
Starting Date: 22nd October 2013

Completion Date: 24th October 2013

Drilling Depth 52 M

Casing Depth Dry

Casing Diam 160mm



Drilling depth 52m

MZOMA CDSS BOREHOLE

BOREHOLE STRUCTURE - WET

Project Name: C. D. S. S Phase III

Site Name: MZOMA C. D. S. S

Borehole No.: R6 - No 2

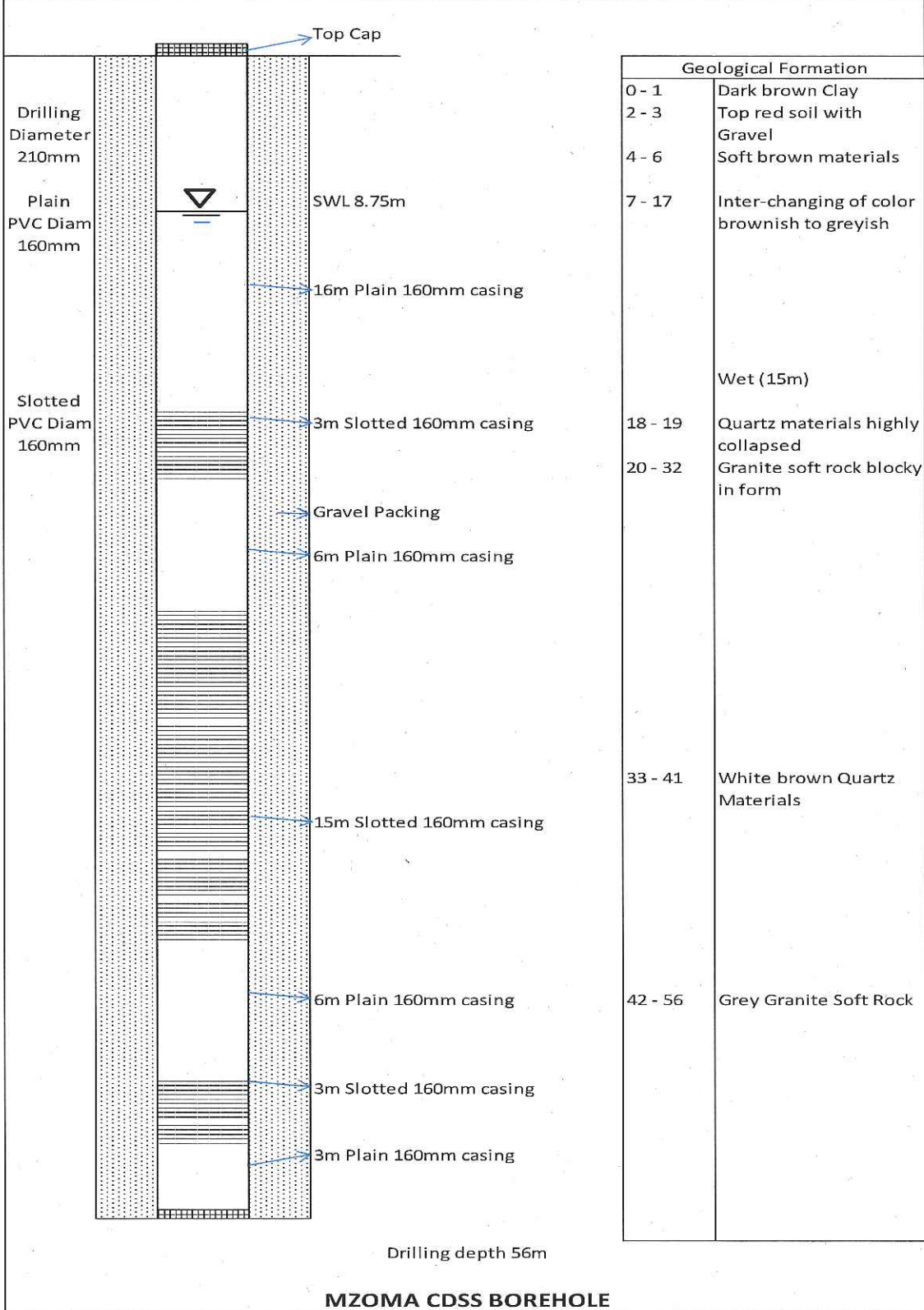
Starting Date: 13th November 2013

Completion Date: 13th November 2013

Drilling Depth 56 M

Casing Depth 52 M

Casing Diam 160mm



6.3 PUMPING TEST AT Mzoma CDSS

Pumping test of the borehole at Mzoma CDSS was done in 4 Step Drawn test of 120 minutes. The four steps tests were set at 0.3l/s, 0.4l/s, 0.5l/s and 1.0l/s. The pump was set at a depth of 47m. This was followed by Constant Discharge Pumping test for 24 hours at the yield of 1.0l/s and followed by Recovery test. The below table shows the Step Draw down Test and Constant Pump Test results at Mzoma CDSS

Step No.	Duration (Min)	Discharge	Drawdown (m)	Water Cleanliness
1	120	0.3 L/s	2.47	Clean
2	120	0.5 L/s	4.10	Clean
3	120	0.8 L/s	10.05	Clean
4	120	1.0 L/s	12.38	Clean

STEP DRAW DOWN PUMPING TEST RECORD

MZOMA C. D. S. S

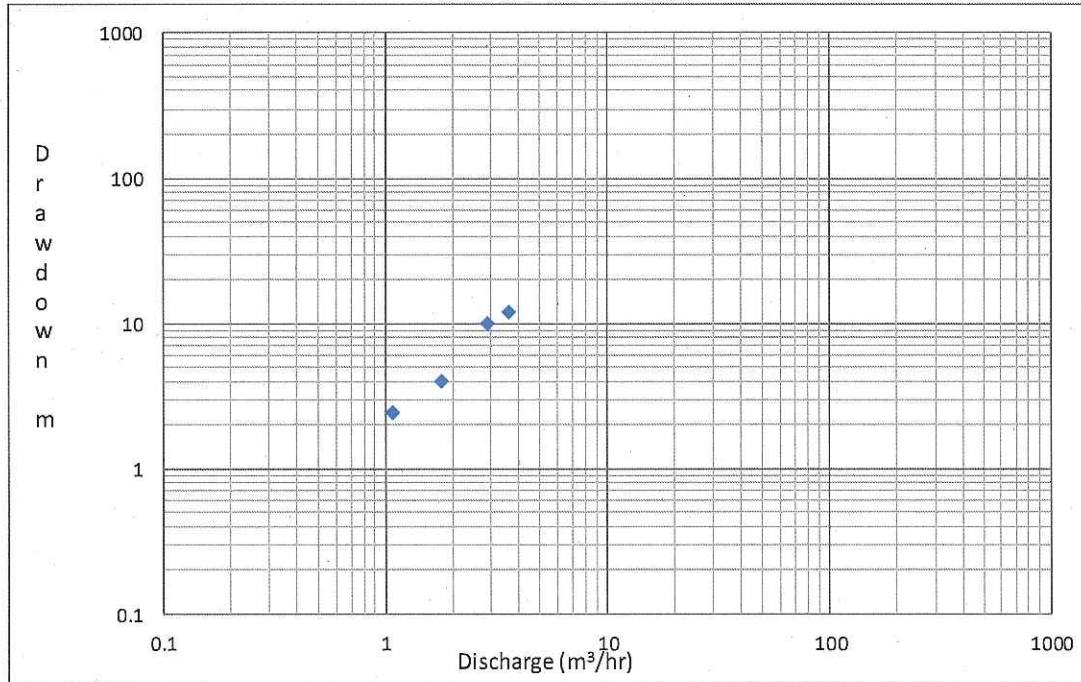
	1 st Step	2 nd Step	3 rd Step	4 th Step
Discharge (l/s)	0.3L/s	0.5L/s	0.8L/s	1 L/S
Duration	120	120	120	120

Date	16/11/2013
Static Water Level	8.75 M
Borehole Depth	56 M
Pump Set	47M

Time (Min)	1 st Step		2 nd Step		3 rd Step		4 th Step	
	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)	DWL (m)	Drawdown (m)
0	8.75	0.00	11.22	2.47	12.85	4.10	18.80	10.05
1	9.80	1.05	11.96	3.21	13.40	4.65	19.23	10.48
2	10.10	1.35	12.06	3.31	13.98	5.23	19.46	10.71
3	10.20	1.45	12.19	3.44	14.39	5.64	19.62	10.87
4	10.21	1.46	12.25	3.50	14.65	5.90	19.85	11.10
5	10.45	1.70	12.38	3.63	15.36	6.61	20.04	11.29
6	10.60	1.85	12.42	3.67	15.58	6.83	20.15	11.40
7	10.74	1.99	12.45	3.70	15.86	7.11	20.24	11.49
8	10.76	2.01	12.50	3.75	16.06	7.31	20.32	11.57
9	10.79	2.04	12.53	3.78	16.60	7.85	20.43	11.68
10	10.80	2.05	12.55	3.80	17.04	8.29	20.50	11.75
12	10.89	2.14	12.57	3.82	17.37	8.62	20.60	11.85
14	10.92	2.17	12.60	3.85	17.52	8.77	20.66	11.91
16	10.95	2.20	12.63	3.88	17.68	8.93	20.74	11.99
18	10.97	2.22	12.65	3.90	18.00	9.25	20.79	12.04
20	11.01	2.26	12.67	3.92	18.10	9.35	20.85	12.10
25	11.06	2.31	12.71	3.96	18.36	9.61	20.90	12.15
30	11.09	2.34	12.72	3.97	18.40	9.65	20.98	12.23
35	11.11	2.36	12.73	3.98	18.47	9.72	21.02	12.27
40	11.13	2.38	12.74	3.99	18.51	9.76	21.05	12.30
45	11.15	2.40	12.75	4.00	18.56	9.81	21.08	12.33
50	11.19	2.44	12.76	4.01	18.62	9.87	21.09	12.34
55	11.20	2.45	12.77	4.02	18.65	9.90	21.10	12.35
60	11.21	2.46	12.78	4.03	18.67	9.92	21.10	12.35
75	11.22	2.47	12.79	4.04	18.76	10.01	21.12	12.37
90	11.22	2.47	12.83	4.08	18.80	10.05	21.13	12.38
105	11.22	2.47	12.85	4.10	18.80	10.05	21.13	12.38
120	11.22	2.47	12.85	4.10	18.80	10.05	21.13	12.38

STEP DRAWDOWN TEST

Project Name	C. D. S. S PHASE III		
Borehole No	R6 - No 2	Static Water Level	8.75 M
Site	MZOMA C. D. S. S	Date	16/11/2013



Step	Discharge (m3/hr)	Dynamic Level (m)	Drawdown (m)
First (1st)	1.08	11.22	2.47
Second (2nd)	1.8	12.85	4.1
Third (3rd)	2.88	18.8	10.05
Forth (4th)	3.6	21.13	12.38

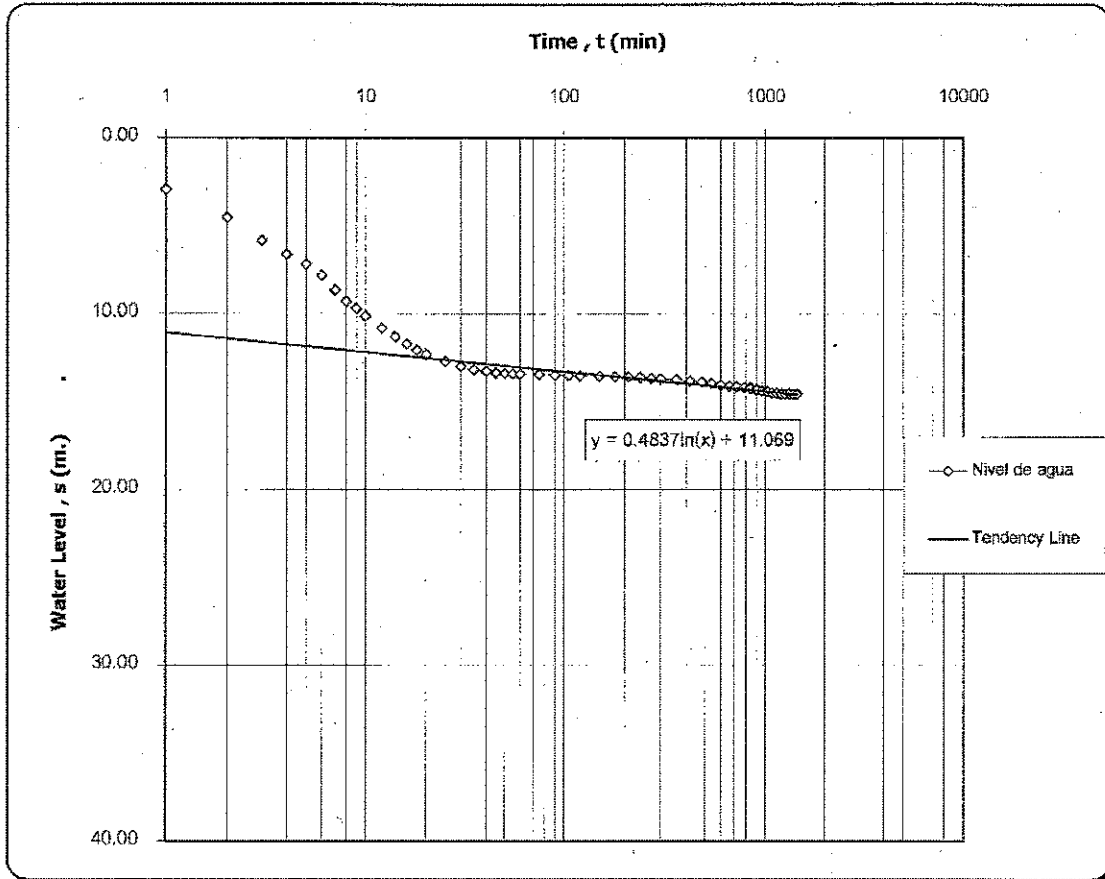
CONSTANT DISCHARGE TEST

Name of Project	C. D. S PHASE III		
Borehole No.	R6 - No 2	Depth	56 M
Name of Location	MZOMA C. D. S. S	Casing Depth	52 M
District	MZIMBA	Static Water Level	8.75 M
		Dynamic Water Level	23.33 M
Date	17/11/2013	Pump Set Depth	47M

Actual Time (Hours:Minutes)	Time (Min)	Yield (Lit/Sec)	Dynamic Water Level (M)	Drawn Down (M)	Remarks
5:30	0	1 L/S	8.75	0.00	
5:31	0:01	1 L/S	11.69	2.94	
5:32	0:02	1 L/S	13.27	4.52	
5:33	0:03	1 L/S	14.58	5.83	
5:34	0:04	1 L/S	15.37	6.62	
5:35	0:05	1 L/S	15.94	7.19	
5:36	0:06	1 L/S	16.56	7.81	
5:37	0:07	1 L/S	17.41	8.66	
5:38	0:08	1 L/S	18.04	9.29	
5:39	0:09	1 L/S	18.45	9.70	
5:40	0:10	1 L/S	18.89	10.14	
5:42	0:12	1 L/S	19.58	10.83	
5:44	0:14	1 L/S	20.05	11.30	
5:46	0:16	1 L/S	20.49	11.74	
5:48	0:18	1 L/S	20.83	12.08	
5:50	0:20	1 L/S	21.06	12.31	
5:55	0:25	1 L/S	21.47	12.72	
6:00	0:30	1 L/S	21.72	12.97	
6:05	0:35	1 L/S	21.93	13.18	
6:10	0:40	1 L/S	22.01	13.26	
6:15	0:45	1 L/S	22.10	13.35	
6:20	0:50	1 L/S	22.13	13.38	
6:25	0:55	1 L/S	22.16	13.41	
6:30	1:00	1 L/S	22.18	13.43	
6:45	1:15	1 L/S	22.20	13.45	
7:00	1:30	1 L/S	22.24	13.49	
7:15	1:45	1 L/S	22.27	13.52	
7:30	2:00	1 L/S	22.29	13.54	
8:00	2:30	1 L/S	22.30	13.55	
8:30	3:00	1 L/S	22.31	13.56	
9:00	3:30	1 L/S	22.32	13.57	
9:30	4:00	1 L/S	22.36	13.61	
10:00	4:30	1 L/S	22.43	13.68	
10:30	5:00	1 L/S	22.47	13.72	
11:30	6:00	1 L/S	22.50	13.75	
12:30	7:00	1 L/S	22.56	13.81	
13:30	8:00	1 L/S	22.63	13.88	
14:30	9:00	1 L/S	22.70	13.95	
15:30	10:00	1 L/S	22.78	14.03	
16:30	11:00	1 L/S	22.87	14.12	
17:30	12:00	1 L/S	22.91	14.16	
18:30	13:00	1 L/S	22.95	14.20	
19:30	14:00	1 L/S	22.99	14.24	
20:30	15:00	1 L/S	23.07	14.32	
21:30	16:00	1 L/S	23.13	14.38	
22:30	17:00	1 L/S	23.18	14.43	
23:30	18:00	1 L/S	23.24	14.49	
23:30	18:00	1 L/S	23.28	14.53	
1:30	20:00	1 L/S	23.30	14.55	
2:30	21:00	1 L/S	23.32	14.57	
3:30	22:00	1 L/S	23.30	14.55	
4:30	23:00	1 L/S	23.33	14.58	
5:30	0:00	1 L/S	23.33	14.58	

CONSTANT DISCHARGE TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R6 No.2	STATIC WATER LEVEL	8.75 m.
SITE	Mzoma CDSS	DATE	17/11/13



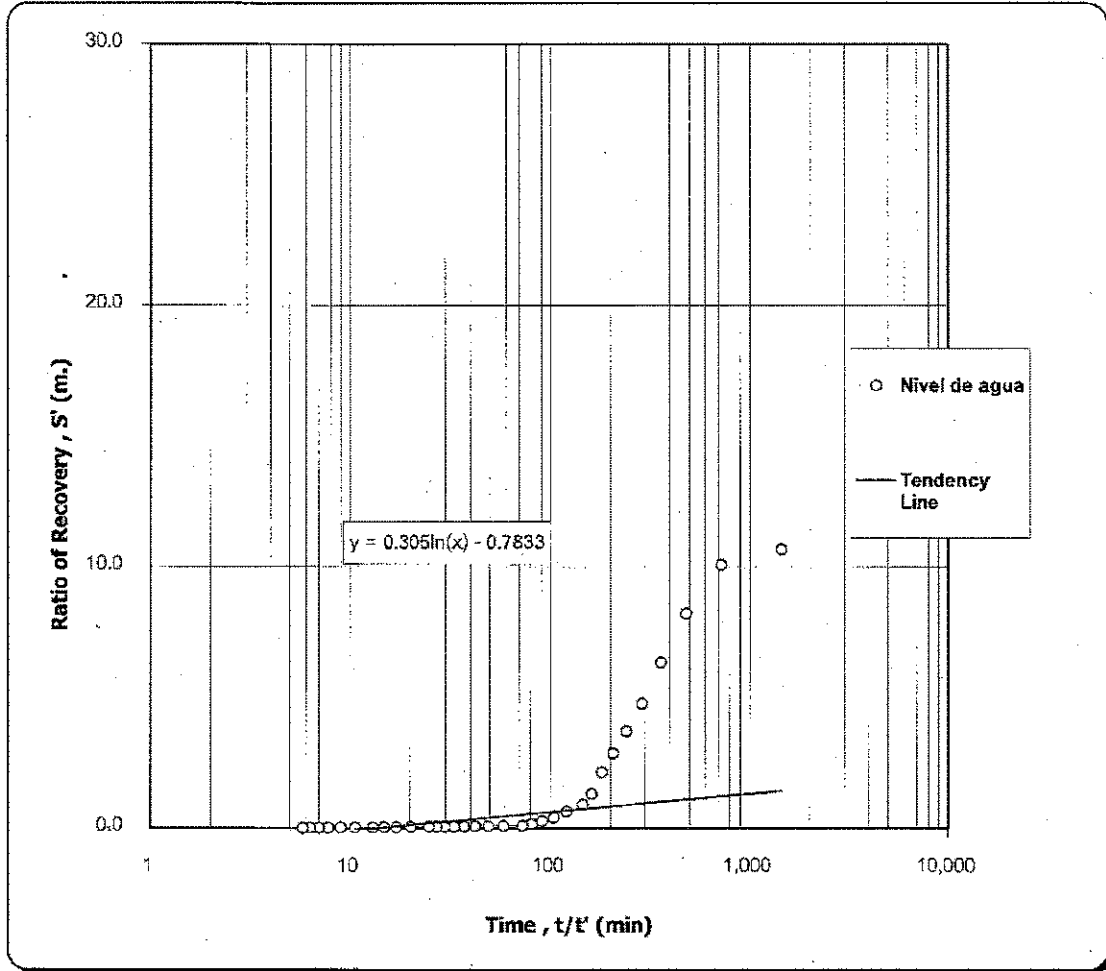
DESCRIPTION	
Discharge, Q (m ³ /hr.)	3.60 m ³ /hr.
water Level ΔS (m.)	1.16 m.
Transmissivity, T (m ² /hr.)	
$T = (2.30 Q) / (4\pi\Delta S)$	0.568 m ² /hr.
Screen Length, b (m.)	21.00 m.
Hydraulic Gradient, K (m./hr.)	
$K = T/b$	2.705E-02 m./hr.

CONSTANT DISCHARGE TEST (RECOVERY)

Name of Project	C. D. S. S PHASE III				
Borehole No.	R6 - No 2	Depth	56 M		
Name of Location	MZOMA C. D. S. S	Casing Depth	52 M		
District	MZIMBA	Static Water Level	8.75 M		
		Dynamic Water Level	23.33 M		
Date	18/11/2013	Pump Set Depth	47M		
Actual Time (Hours:Minutes)	Time (Min)	Accumulated time (Min)	Water Level (M)	Recovery (m)	Remarks
5:30	0:00	1440	23.33	14.58	
5:31	0:01	1441	19.42	10.67	
5:32	0:02	1442	18.83	10.08	
5:33	0:03	1443	16.97	8.22	
5:34	0:04	1444	15.09	6.34	
5:35	0:05	1445	13.52	4.77	
5:36	0:06	1446	12.47	3.72	
5:37	0:07	1447	11.63	2.88	
5:38	0:08	1448	10.89	2.14	
5:39	0:09	1449	10.08	1.33	
5:40	0:10	1450	9.66	0.91	
5:42	0:12	1452	9.40	0.65	
5:44	0:14	1454	9.16	0.41	
5:46	0:16	1456	9.03	0.28	
5:48	0:18	1458	8.92	0.17	
5:50	0:20	1460	8.85	0.10	

WATER LEVEL RECOVERY TEST

PROJECT NAME	Malawi CDSS Phase 3		
BOREHOLE No.	R6 No.2	STATIC WATER LEVEL	8.75 m.
SITE	Mzoma CDSS	DATE	18/11/13



DESCRIPTION	
Discharge, Q (m ³ /hr.)	3.60 m ³ /hr.
Water Level, ΔS (m.)	0.65 m.
Transmissivity, T (m ² /hr.)	
$T = (2.30 Q) / (4\pi \Delta S)$	1.01 m ² /hr.
Screen Length, b (m.)	21.00 m.
Hydraulic Gradient, K (m./hr.)	
$K = T/b$	4.827E-02 m./hr.

Tel. No. (265) 01 770 344/221
Fax No. (265) 01 773 737
Email: sec@irriwater.org



Tikwere House,
City Centre,
Private Bag 390,
Lilongwe 3,
Malawi.

MINISTRY OF WATER DEVELOPMENT AND IRRIGATION

REF. No. WQPC 5/11

12th December, 2013

The Managing Director,
Chitsime Drilling Company,
P.O. Box 764
LILONGWE.

Dear Sir/ Madam,

**LABORATORY TEST RESULTS OF WATER SAMPLES FROM BOREHOLES
CONSTRUCTED UNDER JICA AT SELECTED LEARNING INSTITUTIONS IN
KASUNGU, MZIMBA, LILONGWE, NTCHEU, CHIRADZULU AND ZOMBA
DISTRICTS**

Attached, please find physical, chemical and bacteriological test results of water samples from water points (Boreholes) newly constructed by your Organization under JICA Schools Development Project at Mwalawanyenje, Kabekere, Mahasua and Mwatibu Community Day Secondary Schools (CDSS) in Kasungu, Ntcheu, Chiradzulu and Lilongwe districts, respectively, Nasawa Secondary School in Zomba and Mzoma Full Primary (F.P) School in Mzimba district. As per your request, sampling of the water points was conducted by our personnel under your guidance during the period 18th October to 27th November, 2013.

Analysis of the water quality parameters requested was conducted in accordance with Standard Methods for Examination of Water and Wastewater, 21st Edition and the data generated was compared with Malawi Standards for drinking water delivered from Boreholes and Protected Shallow Wells (MS733:2005).

1.0 DISCUSSION ON THE WATER QUALITY TEST RESULTS

1.1 Microbiological Water Quality

Water delivered from the boreholes under review was enumerated for *Faecal* (Thermotolerant) *coliform* (FC) and *Faecal streptococcus* (FS) types of bacteria and the values registered ranged from Zero to 188 FC counts and Zero to 306 FS counts per 100 ml.

It is worth to note that the bacteria values registered at Mzoma F.P. School and Kabekere CDSS boreholes exceeded the acceptable limits of 50 FC counts and Zero FS counts per 100 ml according to Malawi Standards for drinking water delivered from Boreholes and Protected Shallow wells (MS733:2005).

Therefore, water from these two boreholes was at the time of sampling not safe for human consumption without any mode of treatment.

1.2 Chemical and Physical Water Quality

Chemically, water delivered from the boreholes under review can be said to be ranging from moderately soft to hard and acidic to alkaline. This remark is made basing on Total Hardness (as CaCO₃) and power of hydrogen ion (pH) values registered that ranged from 73-269 mg/l and 6.40-8.36, respectively. It is worth noting that the Total Hardness (as CaCO₃) and power of hydrogen ion (pH) values registered conformed to Malawi Standards (MS733:2005).

Clarity of water delivered from all the boreholes was not found to be objectionable. The Turbidity and Suspended Solids values registered ranged from <0.01-7.4 NTU and <0.10-4.0 mg/l, respectively. Note that all the values registered conformed to Malawi Standards (MS733:2005).

In general, all the constituents tested registered values that conformed to Malawi Standards for water delivered from Boreholes and Protected Shallow Wells (MS733:2005).

2.0 REMARK (S) /CONCLUSION (S)

Basing on this single set of data generated from water analysis of the samples from the boreholes under review, the following can be said;

- Microbiologically, water from the boreholes at Mzoma F.P. School and Kabekere CDSS was found to be contaminated with *Faecal (Thermotolerant) coliform* and *Faecal streptococcus* types of bacteria, thereby rendering it unsafe for human consumption. The unacceptable bacteria values registered were 188 FC and 140 FS counts per 100 ml for Mzoma F.P. School borehole in Mzimba district and 113 FC and 306 FS counts per 100 ml for Kabekere CDSS borehole in Ntcheu district. It is worth to note that all the other boreholes were at the time of sampling delivering water that was safe for human consumption without any mode of treatment.

The scenario at Mzoma F.P. School and Kabekere CDSS boreholes calls for disinfection to be followed by resampling in order to establish water quality trend.

- Chemically, water delivered from the Boreholes ranged from moderately soft to hard and acidic to alkaline. All the values registered conformed to Malawi Standards.
- Clarity of water from all the boreholes was not objectionable. Besides, the Turbidity and Suspended Solids values registered conformed to Malawi Standards.

In general, most of the water quality constituents tested registered values that conformed to Malawi Standards for water delivered from Boreholes and Protected Shallow Wells (MS733:2005).

Please feel free to contact this office should you need more clarification in the laboratory test results provided.

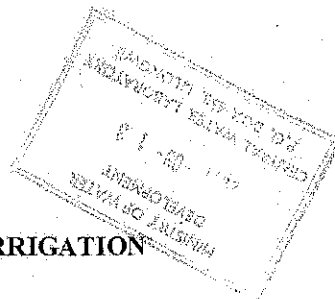



J. Peaches Phiri
Deputy Director/ Water Quality Services

for: **SECRETARY FOR WATER DEVELOPMENT AND IRRIGATION**

- cc: *Secretary for Ministry of Water Development and Irrigation, Private Bag 390, Capital City, Lilongwe 3.*
- " *The Director of Water Resources, Ministry of Water Development and Irrigation, Private Bag 390, Capital City, Lilongwe 3.*
- " *The Regional Water Development Officer, Regional Water Office (C), P.O. Box 458, Lilongwe.*
- " *The Regional Water Development Officer, Regional Water Office (S), P.O. Box 13, Lilongwe.*
- " *The Regional Water Development Officer, Regional Water Office (N), P/ Bag 68, Lilongwe.*

REF. No. WQPC 5/1



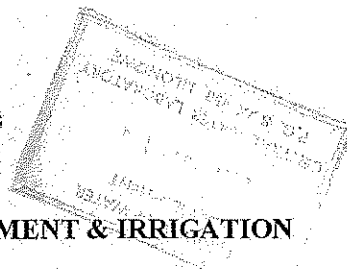
MINISTRY OF WATER DEVELOPMENT & IRRIGATION

WATER QUALITY TEST RESULTS

LAB No.	1333	493	494	MALAWI STANDARDS FOR BOREHOLE WATER
DATE SAMPLED	17/11/2013	23/12/2013	15/11/2013	
MAP SHEET/GRID REF, UTM				
SOURCE TYPE/LOCATION	R6 Mzoma F.P. School BH No., T/A Mbelwa, Mzimba District	R1 Mahasua CDSS BH No., T/A Kadewere, Chiradzulu district	R3 Nasawa Secondary School BH No., T/A Chikowi, Zomba district	
pH Value	6.35	7.05	6.40	6.0-9.5
CONDUCTIVITY ($\mu\text{s}/\text{cm}$ at 25°C)	257	538	285	3,500
TOTAL DISSOLVED SOLIDS, mg/l	130	295	156	2,500
CARBONATE (as CO_3^{2-}), mg/l	0.00	0.00	0.00	-
BICARBONATE (as HCO_3^-), mg/l	116	223	59	-
CHLORIDE (as Cl ⁻), mg/l	23.1	47	30.9	750
SULPHATE (as SO_4^{2-}), mg/l	0.76	13.8	28.4	800
NITRATE (as NO_3^-), mg/l	0.086	0.400	3.10	45
FLUORIDE (as F ⁻), mg/l	0.18	0.07	0.27	6.0
SODIUM (as Na ⁺), mg/l	17	40	23.8	500
POTASSIUM (as K ⁺), mg/l	5.7	3.4	5.6	200
CALCIUM (as Ca ⁺⁺), mg/l	19.1	47.6	18.6	-
MAGNESIUM (as mg ⁺⁺), mg/l	7.2	10.8	6.2	250
IRON (Fe ⁺⁺), mg/l	<0.001	0.810	0.800	3.0
MANGANESE (Mn ⁺⁺), mg/l	<0.001	<0.001	<0.001	1.5
TOTAL HARDNESS (as CaCO_3), mg/l	77	165	73	800
TOTAL ALKALINITY (as CaCO_3), mg/l	95	183	48	-
SILICA (as SiO_2), mg/l	12	31	14	-
TURBIDITY, NTU	4.0	<0.01	2.0	25
SUSPENDED SOLIDS, mg/l	1.0	<0.10	<0.10	-
FAECAL COLIFORM, Count/100 ml	113	0	0	50
FAECAL STREPT. Count/100 ml	306	0	0	0

Analysis Conducted by Central Water Laboratory

REF. No. WQPC 5/1



MINISTRY OF WATER DEVELOPMENT & IRRIGATION

WATER QUALITY TEST RESULTS

LAB No.	1133	1132	1332	MALAWI STANDARDS FOR BOREHOLE WATER
DATE SAMPLED	18/10/2013	30/10/2013	27/11/2013	
MAP SHEET/GRID REF, UTM	R2	R5	R4	
SOURCE TYPE/LOCATION	Mwatibu CDSS BH No., T/A Mazengera, Lilongwe District	Mwalawanyenje CDSS BH No., T/A Lukwa, Kasungu District	Kabekere CDSS BH No., T/A Ganya, Ntcheu District	
pH Value	8.36	6.65	6.67	6.0-9.5
CONDUCTIVITY ($\mu\text{s}/\text{cm}$ at 25°C)	756	596	423	3,500
TOTAL DISSOLVED SOLIDS, mg/l	361	322	250	2,500
CARBONATE (as CO_3^{2-}), mg/l	43	0.00	0.00	-
BICARBONATE (as HCO_3^-), mg/l	227	375	220	-
CHLORIDE (as Cl), mg/l	22.8	1.0	17.3	750
SULPHATE (as SO_4^{2-}), mg/l	49.7	5.97	10.3	800
NITRATE (as NO_3^-), mg/l	0.003	<0.001	0.139	45
FLUORIDE (as F), mg/l	0.97	0.84	0.84	6.0
SODIUM (as Na^+), mg/l	32	63	13	500
POTASSIUM (as K^+), mg/l	2.3	6.4	1.1	200
CALCIUM (as Ca^{++}), mg/l	89	49.4	43	-
MAGNESIUM (as mg^{++}), mg/l	11.4	11.2	18.8	250
IRON (Fe^{++}), mg/l	0.001	<0.001	<0.001	3.0
MANGANESE (Mn^{++}), mg/l	<0.001	<0.001	<0.001	1.5
TOTAL HARDNESS (as CaCO_3), mg/l	269	169	184	800
TOTAL ALKALINITY (as CaCO_3), mg/l	257	307	180	-
SILICA (as SiO_2) mg/l	14	8.0	50	-
TURBIDITY, NTU	<0.01	1.2	7.4	25
SUSPENDED SOLIDS, mg/l	<0.10	<0.10	4.0	-
FAECAL COLIFORM, Count/100 ml	0	3	188	50
FAECAL STREPT. Count/100 ml	0	0	140	0

Analysis Conducted by Central Water Laboratory

Tel. No. (265) 01 770 344/221
Fax No. (265) 01 773 737
Email: sec@irriwater.org



Tikwere House
City Centre
Private Bag 390
Lilongwe 3
Malawi

MINISTRY OF WATER DEVELOPMENT AND IRRIGATION

REF. No. WQPC 5/11

13th February, 2014

The Managing director,
Chitsime drilling Company,
P.O. Box 764
Lilongwe

Dear Sir/Madam,

WATER QUALITY TEST RESULTS OF WATER SAMPLES FROM BOREHOLES IN TRADITIONAL AUTHORITY MBELWA AND GANYA IN MZIMBA AND NTCHEU DISTRICTS, RESPECTIVELY

Attached, please find microbiological test results of two (2) water samples from boreholes located in Traditional Authorities (T/As) Mbelwa and Ganya in Mzimba and Ntcheu Districts, respectively. As per your request, water sampling was conducted by our personnel under your guidance on 24th and 28th January, 2014.

This was a follow up to a similar exercise conducted on 17th and 27th November, 2014 whereby the two boreholes located at Mzoma and Kabekela Community Day Secondary Schools (CDSS) were recommended for disinfection and re-sampling following microbiological contamination that was observed.

Analysis of the water samples was conducted in accordance with Standard Methods for Examination of Water and Wastewater, 21st Edition, and the data generated was compared with Malawi Standards for drinking water delivered from Boreholes and Protected Shallow Wells (MS733:2005) in order to determine compliance.

1.0 DISCUSSION ON THE MICROBIOLOGICAL WATER ANALYSIS RESULTS

Bacteria types, namely, *Faecal (Thermotolerant) coliform (FC)* and *Faecal streptococci* were enumerated in water delivered from the boreholes under review. It is worth to note that none of the bacteria types enumerated was registered in all the two water points sampled. This was remarkable improvement in quality of water compared to last time. The scenario could be attributed to the chlorination process that was done just before the re-sampling exercise.

2.0 REMARK (S) / RECOMMENDATION(S)

It is worth to note that whatever remark(s) that have been made in this report are based on the two sets of data generated from analysis of water from the water points under review.

- Water delivered from Mzoma CDSS in Traditional Authority (T/A) Mbelwa of Mzimba district and Kabekele CDSS in T/A Ganya of Ntcheu district was safe for human consumption. This scenario is an indication of significant improvement in quality of water delivered from the water points.

Please feel free to contact this office should you need further clarification on any of the issues raised/discussed in this report.



J. Peaches Phiri

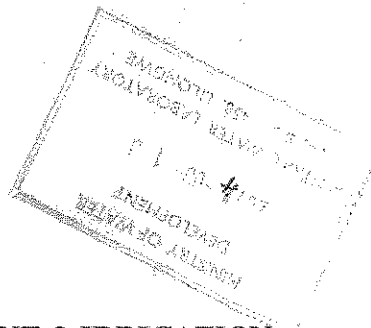
DEPUTY DIRECTOR/ WATER QUALITY SERVICES

for: **SECRETARY FOR WATER DEVELOPMENT AND IRRIGATION**



- cc: *The Director of Water Resources, Ministry of Water Development and Irrigation, Private Bag 390, Capital City, Lilongwe 3.*
- " *The Deputy Director of Water Resources (Groundwater), Ministry of Water Development and Irrigation, Private Bag 390, Capital City, Lilongwe 3.*
- " *The Regional Irrigation and Water Development Officer, Regional Water Office (C), P/Bag 68, Mzuzu.*
- " *The Regional Irrigation and Water Development Officer, Regional Water Office (C), P.O. Box 458, Lilongwe.*

FILE No. WQPC 5/11



MINISTRY OF WATER DEVELOPMENT & IRRIGATION

Table I: Water Quality Data for Mzoma Community Day Secondary School in Traditional Authority Mbelwa, Mzimba District = **R6**

LAB No.	1330	238	MALAWI STANDARDS FOR BOREHOLE WATER (MS733:2005)
DATE SAMPLED	17/11/2013	24/01/2014	
WATER RESOURCE UNIT			
MAP SHEET/GRID REF.	R6	R6	
SOURCE TYPE/LOCATION	Mzoma Community Day Secondary School BH. No., T/A Mbelwa, Mzimba District	Mzoma Community Day Secondary School BH. No., T/A Mbelwa, Mzimba District	
FAECAL COLIFORM, COUNTS/100 ml	113	0	50
FAECAL STREPTOCOCCUS, COUNTS/100 ml	306	0	0

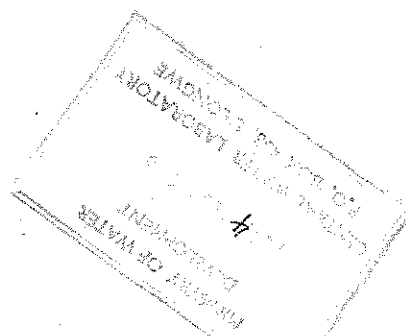
Table II: Water Quality Data for Kabekela Community Day Secondary School in Traditional Authority Nganya in Mzimba District = **R4**

LAB No.	1332	239	MALAWI STANDARDS FOR BOREHOLE WATER (MS733:2005)
DATE SAMPLED	27/11/2013	28/01/2014	
WATER RESOURCE UNIT			
MAP SHEET/GRID REF.	R4	R4	
SOURCE TYPE/LOCATION	Kabekela Community Day Secondary School BH. No., T/A Ganya, Ntcheu District	Kabekela Community Day Secondary School BH. No., T/A Ganya, Ntcheu District	
FAECAL COLIFORM, COUNTS/100 ml	188	0	50
FAECAL STREPTOCOCCUS, COUNTS/100 ml	140	0	0

ANALYSIS CARRIED OUT BY CENTRAL WATER LABORATORY

NB: -9: Not determined

FORM No. WQPC 5/1



MINISTRY OF WATER DEVELOPMENT & IRRIGATION
(WATER QUALITY SERVICES DIVISION)







WATER QUALITY TEST RESULTS

LAB No.	238	239	Malawi Standards for Borehole Water (MS733:2005)
DATE SAMPLED	24/01/2014	28/01/2014	
WATER RESOURCE UNIT			
MAP SHEET/GRID REF			
SOURCE TYPE/LOCATION	Mzoma Community Day Secondary School BH. No., T/A Mbelwa, Mzimba District R6	Kabekele Community Day Secondary School BH. No., T/A Ganya, Ntcheu District R4	
pH Value	7.34	7.95	6.0-9.5
CONDUCTIVITY ($\mu\text{s}/\text{cm}$ at 25°C)	344	593	3,500
TOTAL DISSOLVED SOLIDS, mg/l	206	356	2,500
CARBONATE (as CO_3^{2-}), mg/l	0.00	18.8	-
BICARBONATE (as HCO_3^-), mg/l	156	227	-
CHLORIDE (as Cl), mg/l	16.6	49.9	750
SULPHATE (as SO_4^{2-}), mg/l	18.4	6.36	800
NITRATE (as NO_3^-), mg/l	0.996	0.45	45
FLUORIDE (as F), mg/l	0.34	0.73	6.0
SODIUM (as Na^+), mg/l	24	18	500
POTASSIUM (as K^+), mg/l	10	1.6	-
CALCIUM (as Ca^{++}), mg/l	26.0	75.8	250
MAGNESIUM (as mg^{++}), mg/l	9.4	15.7	200
IRON (Fe^{++}), mg/l	0.003	0.001	3.0
MANGANESE (Mn^{++}), mg/l	<0.001	<0.001	1.5
TOTAL HARDNESS (as CaCO_3), mg/l	104	254	800
TOTAL ALKALINITY (as CaCO_3), mg/l	128	217	-
SILICA (as SiO_2) mg/l	13	34	-
TURBIDITY, NTU	6.0	20	25
SUSPENDED SOLIDS, mg/l	3.0	16	-
Faecal Coli., Count/100ml	0	0	50







**** -9=Not Determined

ANALYSIS CARRIED OUT BY CENTRAL WATER LABORATORY







**R1 Muhasuwa CDSS Phase 3 Test Drilling Working Record,
November to December 2013**

	
<p>1. R1-No.1 Muhasuwa CDSS Drilling Point (R1-No.1) November 2013</p>	<p>2. R1-No.1 Muhasuwa CDSS Test Drilling (R1-No.1) December 2013</p>
	
<p>3. R1-No.1 Muhasuwa CDSS Geological Sample (R1-No.1) December 2013</p>	<p>4. R1-No.1 Muhasuwa CDSS Discharge Test (R1-No.1) December 2013</p>
	
<p>5. R1-No.1 Muhasuwa CDSS Pumping Test (R1-No.1) December 2013</p>	<p>6. R1-No.1 Muhasuwa CDSS Completed and Protected Borehole (R1-No.1) December 2013</p>






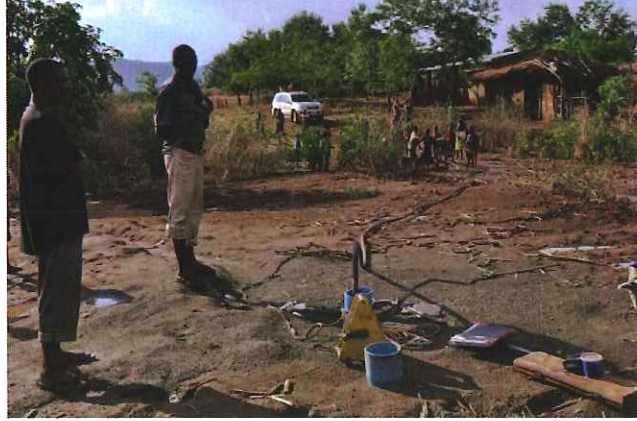
R2 Mwatibu CDSS Phase 3 Test Drilling Working Record, October 2013

	
<p>1. R2-No.1 Mwatibu CDSS Drilling (R2-No.1) October 2013</p>	<p>2. R2-No.1 Mwatibu CDSS Drilling (R2-No.1) October 2013</p>
	
<p>3. R2-No.1 Mwatibu CDSS Geological Sample (R2-No.1) October 2013</p>	<p>4. R2-No.1 Mwatibu CDSS Casing & Screen Installation (R2-No.1) October 2013</p>
	
<p>5. R2-No.1 Mwatibu CDSS Pumping Test (R2-No.1) October 2013</p>	<p>6. R2-No.1 Mwatibu CDSS Pumping Test (R2-No.1) October 2013</p>







R3 Chimwalira CDSS Phase 3 Test Drilling Working Record, December 2013

	
<p>1. R3-No.1 Chimwalira CDSS Geological Sample (R3-No.1) December 2013</p>	<p>2. R3-No.1 Chimwalira CDSS Casing & Screen Installation (R3-No.1) December 2013</p>
	
<p>3. R3-No.1 Chimwalira CDSS Gravel Packing (R3-No.1) December 2013</p>	<p>4. R3-No.1 Chimwalira CDSS Development (R3-No.1) December 2013</p>
	
<p>5. R3-No.1 Chimwalira CDSS Pumping Test (R3-No.1) December 2013</p>	<p>6. R3-No.1 Chimwalira CDSS Water Quality Test (R3-No.1) December 2013</p>







R4 Kabekere CDSS Phase 3 Test Drilling Working Record, November 2013

	
<p>1. R4-No.3 Kabekere CDSS Test Drilling (R3- No.3 Successful Borehole)</p>	<p>2. R4-No.3 Kabekere CDSS Drilling (R4- No.3 Successful Borehole in the Village)</p>
	
<p>3. R4-No.3 Kabekere CDSS Casing & Screen Installation, November 2013</p>	<p>4. R4-No.3 Kabekere CDSS Development (R4- No.3) November 2013</p>
	
<p>5. R4 Kabekere CDSS Geological Sample (R4- No.3) November 2013</p>	<p>6. R4 Kabekere CDSS No.3 Pumping Test (R4- No.3) November 2013</p>

R5 Mwalawanyenje CDSS Phase 3 Test Drilling Working Record, October 2013

	
<p>1. R5 Mwalawanyenje CDSS Drilling Point (R5- No.1) Octobor 2013</p>	<p>2. R5 Mwalawanyenje CDSS Confirmation of Drilling Point with Mrs. Head Teacher, Octobor 2013</p>
	
<p>3. R5 Mwalawanyenje CDSS Borehole Drilling (R5- No.1) Octobor 2013</p>	<p>4. R5 Mwalawanyenje CDSS Geological Sample (R5- No.1) Octobor 2013</p>
	
<p>5. R5 Mwalawanyenje CDSS Borehole Development (R5- No.1) Octobor 2013</p>	<p>6. R5 Mwalawanyenje CDSS Borehole Development (R5- No.1) Octobor 2013</p>

R6 Mzoma CDSS Phase 3 Test Drilling Working Record, October to November 2013

	
<p>1. R6 Mzoma CDSS Test Drilling (R6- No.1 Unsuccessful Well)</p>	<p>2. R6 Mzoma CDSS Test Drilling Geological Sample (R6- No.1 Unsuccessful but There is Water)</p>
	
<p>3. R6 Mzoma CDSS Test Drilling No.2 (R6- No.2) November 2013</p>	<p>4. R6 Mzoma CDSS No.2 Development (R6- No.2) November 2013</p>
	
<p>5. R6 Mzoma CDSS No.2 Geological Sample (R6- No.2) November 2013</p>	<p>6. R6 Mzoma CDSS No.2 Pumping Test (R6- No.2) November 2013</p>