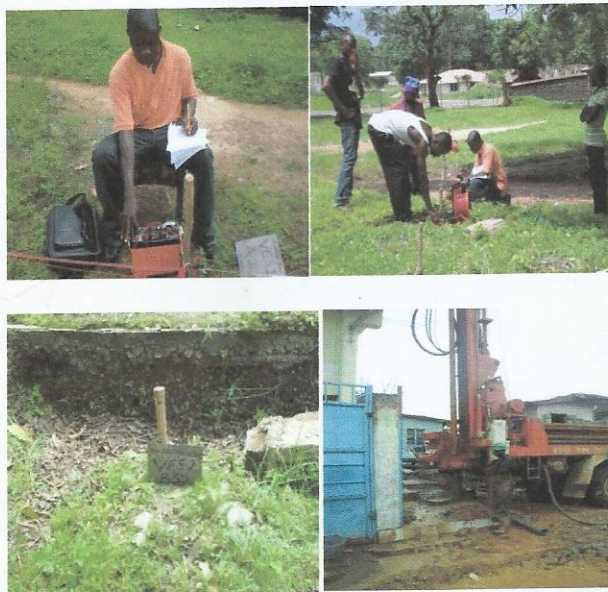


EDAL DRILLING COMPANY LIMITED

UNITED NATION CHILDREN'S FUND (UNICEF) BOREHOLE SITTING & DRILLING REPORT



HYDROGEOLOGICAL INVESTIGATION & DRILLING AT *CALABA TOWN*

PREPARED BY:

EDALL DRILLING COMPANY
49 WATERLOO STREET
SIERRA LEONE
FREETOWN

FOR:

UNICEF
NEW ENGLAND
KISSY, FREETOWM

Cal

1.0 FIELD WORK

3.1 SITTING METHOD USED: (Tick appropriate Box)

- ☐ Terrain evaluation only
- ☐ Terrain evaluation = Geophysical studies (VES)
- ☒ Terrain evaluation + Geophysical studies (Electrical Profiling + VES)
- ☐ Terrain evaluation + Geophysical studies (Electrical Profiling /EM, VLF + VES)

3.2 Geophysical Survey

All geophysical measurements were carried out using ABEM Terrameter SAS 1000C equipment.

3.2.1 Traverse Line

A 20m traverse line denoted as A was cut and pegged at 2m interval in the E-W direction using a magnetic compass to cut the general NE-SW foliation of the area. B traverse line was pegged at 2m interval with 10m length.

3.2.2 Resistivity Profiling

Electrical resistivity profiling was carried along the selected traverses at 2m intervals to provide a lateral inventory of subsurface resistivity so as to delineate any anomalies for groundwater that may exist.

The ground resistivity measurement were obtain for two depth horizons (i.e. the weathered zone bedrock interface and at depth in the fresh bedrock based on Schlumberger electrode configuration of $(L/2, a/2) = (20m, 0.5)$ and $(40m, 5m)$ using DRAG Cable set. Readings were taken and their respective correspondent plots are shown in Annex 1.

3.2.3 Resistivity Sounding (VES) Points

Anomalous zones were determined from the electrical resistivity profiling for vertical electrical sounding (VES) and Dipole-Dipole electrical configuration was used to carry out sounding at this selected point. The purpose of this measurement is to determine resistivity in the bedrock at the depth evaluate the possible that aquifer exists at the selected point.

Clearly labeled metal pegs were fixed at promising sounding points.

2.0 DATA ANALYSIS AND INTERPRETATION

2.1 Resistivity Profiling

The interesting feature of resistivity profiling interpretation is the identification and selection of anomalous zone. These anomalous zones generally have apparent resistivity values below the average apparent resistivity value for points along a given profile.

2.2 Resistivity Sounding (VES)

Apparent resistivity values of vertical electrical sounding, VES at all the chosen anomalous points are generally low with curves suggesting series of fractured or weathered zones that could probably contain groundwater.

3.0 RANKING OF SITES AND RECOMMENDATIONS

The combined result of the Terrain evaluation, electrical resistivity profiling and vertical electrical sounding were used to rank sites for the borehole drilling as presented in the table below,

It was done on the basis of the comparative potential of the selected stations

Ranking of Promising Sites

Site ID	Ranking	GPS Localization	Remarks
A16/VES-1	1	5° 44.892' N/O° 20.881' W	
A14/VES-2	2	5° 44.888' N/O° 20.908' W	

5.2 Recommendations

A16/VES-1, a good drilling point but with extremely high apparent resistivity values and probably pointing to the good drinkable water.

Site selected for drilling	Possible fractures (water zones)	Max drilling depth	Remarks
A16/VES-1	40-45, 60-70m	90	

Alternative site for drilling	Possible fractures (water zones)	Max drilling depth	Remarks
B20/VES-1	70 - 80, 100 - 110	120	

MEASURED BY: Amlado Divine

DATE: Oct, 21st 2009

0

EDAL DRILLING COMPANY LIMITED: HYDROGEOLOGICAL STUDIES

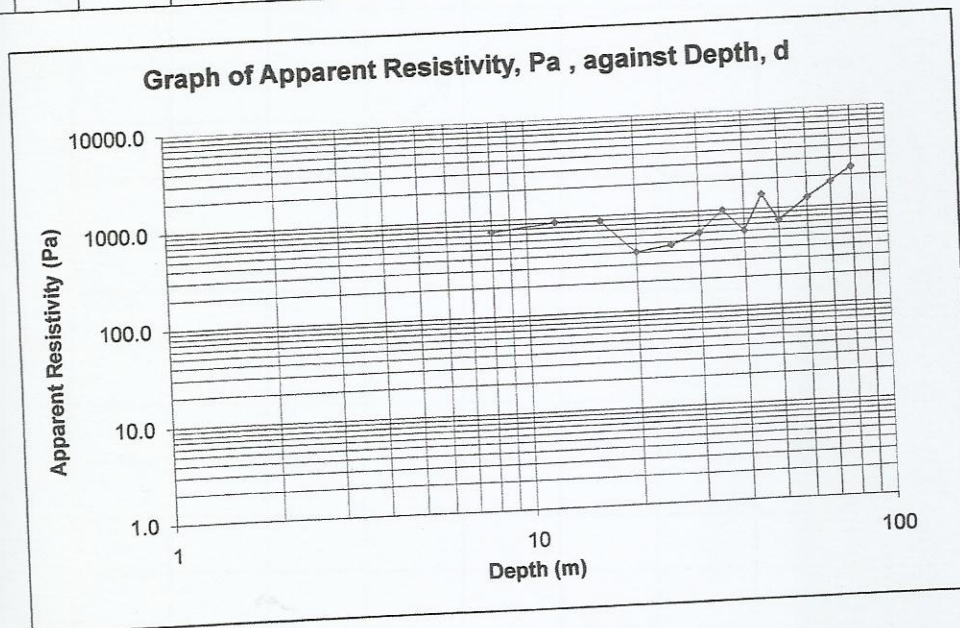
DIPOLE-DIPOLE RESISTIVITY SOUNDING DATA SHEET -

A08/VES-1

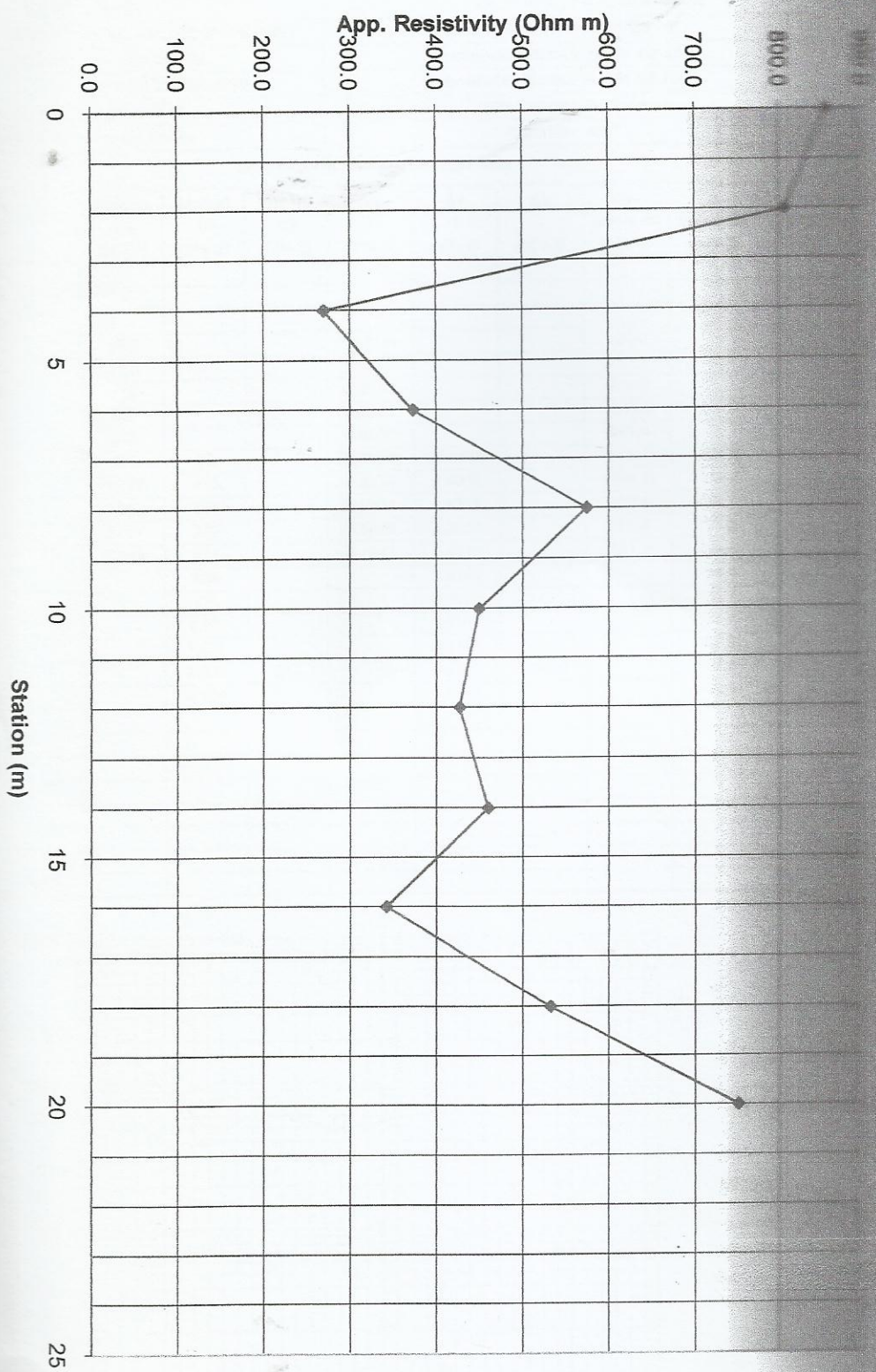
REGION: Eastern
DISTRICT : Calaba Town
PROFILE NO: A
BEARING: 330
MEASURED BY: AMLADO DIVINE

COMMUNITY: Family Home Movement
GRID REFERENCE:
PROFILE LENGTH(m): 20
STATION INTERVAL(M): 2
DATE: 21st Oct 2009

	n	Electrode Inner	Position (M) Outlet	Depth (m)	Resistance (Ohm)	Mult. Factor	App.Res. (Ohm m)	Remarks
							37.7	
2	1	1	3	2			37.7	
2	3	3	5	4			1319.6	
2	5	5	7	6			754.1	766.2
4	3	6	10	8	1.016		2639.3	908.4
4	5	10	14	12	0.3442		6334.3	896.3
4	7	14	18	16	0.1415		1885.2	407.2
10	3	15	25	20	0.216		3770.4	467.2
10	4	20	30	25	0.1239		6598.2	605.1
10	5	25	35	30	0.0917		10557.1	1005.0
10	6	30	40	35	0.0952		15835.7	606.5
10	7	35	45	40	0.0383		22622.4	1395.8
10	8	40	50	45	0.0617		7540.8	749.6
20	4	40	60	50	0.0994		13196.4	1243.1
20	5	50	70	60	0.0942		21114.2	1767.3
20	6	60	80	70	0.0837		31671.4	2413.4
20	7	70	90	80	0.0762		45244.8	
20	8	80	100	90			62211.6	
20	9	90	110	100			107833.4	
20	11	110	130	120			171553.2	
20	13	130	150	140			256387.2	
20	15	150	170	160			90489.6	
40	8	160	200	180			124423.2	
40	9	180	220	200				



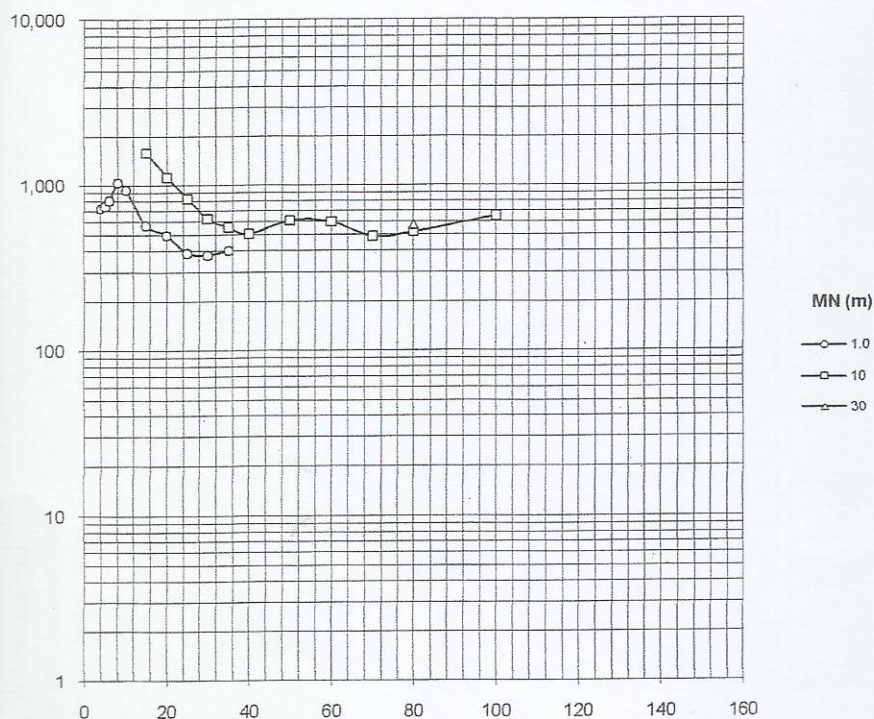
Possible Fractures (water zones): 35-40; 45 - 50m
Maximum Drilling Depth: 120m



Series 1
19m separation

FAMILY HOME MOVEMENT (CALABA TOWN) A16/VES - 1

Client : UNICEF				Community : CALABA TOWN					
Project : FAMILY HOME MOVEMENT				Sounding Number : A14/VES - 2					
District : CALABA TOWN				Coordinates East : W 01° 00' 260"					
Date : 21ST OCTOBER 2009				Coordinates North : N 05° 12' 760"					
Field Operator : Amlado Divine				GPS Datum : GPS datum					
Interpreted by : Amlado Divine				Azimuth : 330°					
Schlumberger Array VES Field Data									
AB/2 (m)	MN(m) 1.0 (MN-1)	MN(m) 10 (MN-2)	MN(m) 30 (MN-3)	$\frac{\Delta V}{I}$ 1 (MN-1)	$\frac{\Delta V}{I}$ 1 (MN-2)	$\frac{\Delta V}{I}$ 1 (MN-3)	ρ (ohm-m) (MN-1)	ρ (ohm-m) (MN-2)	ρ (ohm-m) (MN-3)
1.0									
2.0									
3.0									
4.0	49.5			14.7130			728.0		
5.0	77.8			9.6617			751.2		
6.0	112			7.2442			813.6		
8.0	200			5.2224			1045.9		
10.0	313			3.0180			945.8		
15.0	706	63		0.8089	25.1660		571.1	1581.2	
20.0	1,256	118		0.3974	9.4960		499.1	1118.7	
25.0	1,963	188		0.1984	4.4016		389.4	829.7	
30.0	2,827	275		0.1340	2.2683		378.8	623.5	
35.0	3,848	377		0.1043	1.4680		401.3	553.4	
40.0		495			1.0188			504.1	
50.0		778			0.7829			608.7	
60.0		1,123			0.5317			597.2	
70.0		1,532			0.3183			487.5	
80.0		2,003	647		0.2583	0.8885		517.3	574.5
100.0		3,134			0.2071			649.0	
125.0									
150.0									
53.7									
53.7									



FAMILY HOME MOVEMENT (CALABA TOWN) A16/VES - 1

Client : URICEF
 Project : FAMILY HOME MOVEMENT
 District : CALABA TOWN
 Date : 21ST OCTOBER 2008
 Field Operator : Amadio Divine
 Interpreted by : Amadio Divine

Community : CALABA TOWN
 Sounding Number : A16/VES - 2
 Coordinates East : W 01° 00' 260"
 Coordinates North : N 06° 12' 760"
 GPS Datum : GPS datum
 Azimuth : 330°

Geoves 1.3

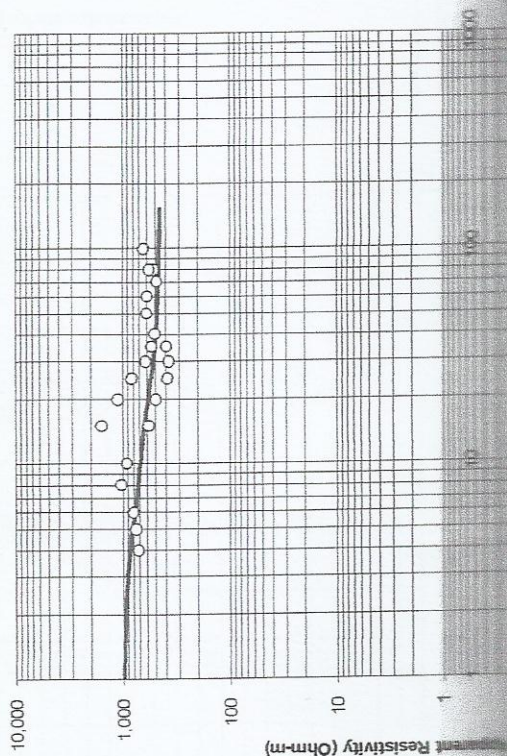
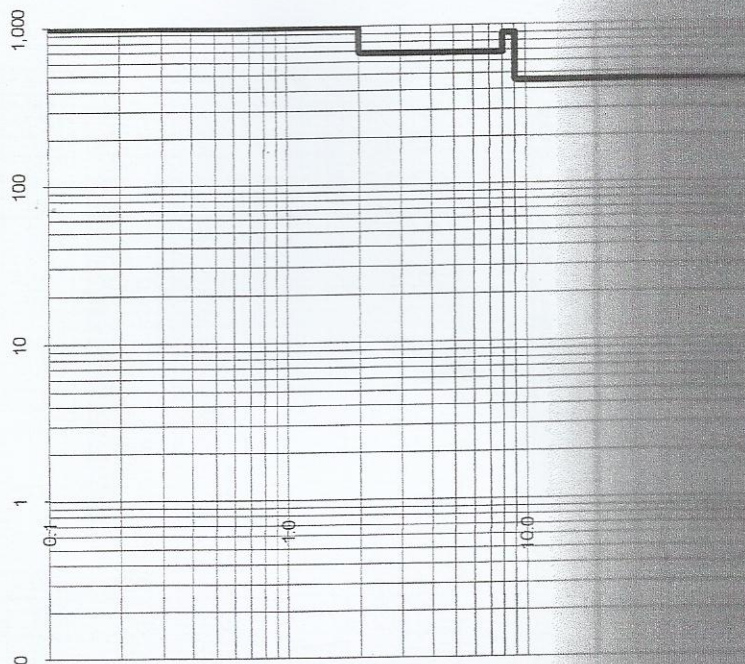
MS Excel based modelling of Vertical Electrical Soundings
 in the Schlumberger Array using Gosh linear filters

RMS Error : 271

Geoelectrical Model

Layer Number	1	2	3	4	5	6	7	8
Resistivity (Ohm-m)	987	675	890	450				
Thickness (m)	2.0	6.0	1.0					
Depth (m)	2.0	8.0	9.0					

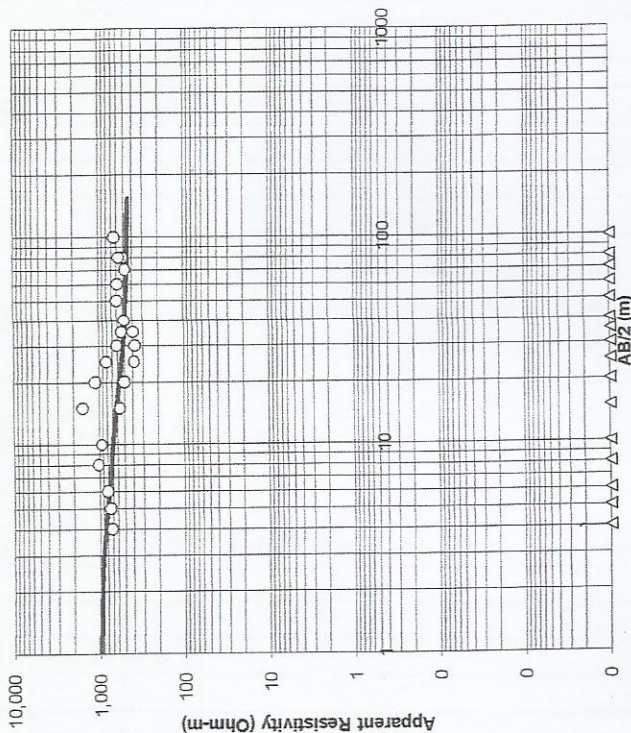
Geoelectrical Model



FAMILY HOME MOVEMENT (CALABA TOWN) A16/VES - 1

GeoVES 1.3

MS Excel based modelling of Vertical Electrical Soundings
in the Schlumberger Array using Gosh linear filters



Model Parameters				
Model Layer	Resistivity (Ohm-m)	Resistivity Range	Thickness (m)	Depth Range
1	10.7		2	2
2	6.7		6	8
3	6.0		1	9
4	3.0			

Client : UNICEF
Project : FAMILY HOME MOVEMENT
District : CALABA TOWN
Date : 21ST OCTOBER 2009
Field Operator : Amlado Divine
Interpreted by : Amlado Divine

Community : CALABA TOWN
Sounding Number : A14/VES - 2
Coordinates East : W 01° 00' 260"
Coordinates North : N 05° 12' 760"
GPS Datum : GPS datum
Azimuth : 330°

Data		Model	
AB/2 (m)	Measured Apparent Resistivity (Ohm-m)	Modelled Apparent Resistivity (Ohm-m)	Included in Model (1=yes)
4.0	728.0	859	1
5.0	751.2	816	1
6.0	813.6	781	1
8.0	1045.9	730	1
10.0	945.8	695	1
15.0	571.1	632	1
20.0	499.1	585	1
25.0	389.4	551	1
30.0	378.8	525	1
35.0	401.3	507	1
15.0	1581.2	632	1
20.0	1118.7	585	1
25.0	829.7	551	1
30.0	623.5	525	1
35.0	553.4	507	1
40.0	504.1	494	1
50.0	608.7	478	1
60.0	597.2	469	1
70.0	487.5	464	1
80.0	517.3	461	1
100.0	649.0	457	1
80.0	574.5	461	1

DAILY LOG FOR DRILLING SUPERVISION

CONTRACT		Family Home Movement		WELL EDCL/BH - 13		DATE		23-24/10/09	
LOCATION CODE		A14/VES-2				CONTRACTOR		Edo Drilling & Construction Limited	
TIME: 8:42am		START OF WORKING HR		END OF WORKING HR		WEATHER		Shining	
DATE: 23/10/09		12:45		2:37		DURATION OF RAINFALL			
DEPTH OF HOLE (M)		120				GEOPHYSICS		A14/VES-2	
DEPTH CASIED (M)		28				REF. POINT			
LITHOLOGICAL BOUNDARIES AND SAMPLES OF FORMATION									
DEPTH OF CONTACT ZONE		DRILLING PROCESS			DESCRIPTION OF FORMATION			YIELD	
DEPTH	SAMPLE	FROM	TO	SPEED					
0 - 5	5	12:45	1:00	3.0	Brownish Clay			at drilling started with 10' depth up to 11.5m	
					"				
					"				
5 - 10	10	1:01	1:06	1.0	Literite				
					"				
					"				
10 - 15	15	1:45	1:53	1.6	"				
					"				
					"				
15 - 20	20	1:57	2:02	1.0	"				
					"			muddy	
					"				
20 - 25	25	2:06	2:16	2.0	Greenish grey, moderately weathered granite			Continued with 6.5' depth	
					"				
25 - 30	30	5:10	5:29	3.8	"				
					"				
					"				
30 - 35	35	9:04	9:21	3.4	"				
					Greenish grey, moderately weathered granite				
35 - 40	40	9:22	9:39	3.4	"			wet	
					"				
					"				
40 - 45	45	9:41	9:59	3.6	"				
					"				
					"				
45 - 50	50	10:01	10:14	2.6	"			muddy	
					"				
					"				
50 - 55	55	10:15	10:29	2.8	Greenish grey, moderately weathered granite				
55 - 60	60	10:30	10:43	2.6					
60 - 65	65	10:44	10:55	2.2	Greenish grey granite collaborate with quartzite				

DAILY LOG FOR DRILLING SUPERVISION

CONTRACT Family Home Movement		WELL NO		DATE		23 - 24 Oct 2009	
LOCATION CODE				CONTRACTOR		Edal Drilling Company Limited	
TIME	START OF	END OF WORKING HR	12:37		WEATHER		Shinning
DATE	WORKING HR			DURATION OF RAINFALL			
DEPTH OF HOLE (M)				GEOPHYSICS		A14/VES - 2	
DEPTH CASED (M)				REF. POINT			
LITHOLOGICAL BOUNDARIES AND SAMPLES OF FORMATION							
DEPTH OF CONTACT ZONE		DRILLING PROCESS			DESCRIPTION OF FORMATION		YIELD
							REMARKS (Drilling Method including change of bit)
DEPTH	SAMPLE	FROM	TO	SPEED	Greenish grey granite collaborate with quartzite		
65 70	70	10:57	11:06	1.8	"		7
					"		
70 75	75	11:07	11:14	1.4	"		
					"		
					"		
75 80	80	11:16	11:49	6.6	"		
					"		
					"		
80 85	85	11:50	12:23	6.6	"		
					"		12
					"		
85 90	90	12:24	1:05	8.2	Greenish grey granite collaborate with quartzite		
					"		
					"		
90 95	95	1:20	1:58	7.6	"		
					"		
					Slightly Hard granite		
95 100	100	2:00	2:37	7.4	"		
					"		8
					"		
100 105	105	12:33	1:01	5.6	"		
					"		
					"		
105 110	110	1:08	1:31	4.6	Slightly Hard granite		5
					"		
					"		
110 115	115	1:36	2:02	5.6	Slightly Hard granite		
115 120	120	2:07	2:44	7.4			5

Geophysics ref. No. A14/VES -2		Edal Drilling Company Limited 49 Waterloo Street Sierra Leone, Freetown		BH status: Successful Dry	
BOREHOLE RECORD					
Community	Calaba Town	BH ref. No.	EDCL/BH-13	Nat. grid ref.	
Drilling contractor	Edal Drilling Company	Drill rig	Super DTH	Method	Air Drilling
Drilling start date	23RD OCT 2009	Compl. date	26TH OCT 2009	Operator	Raju Govindaraju
TEST PUMPING		Date:		Top of screen *	m
Dynamic WL *	m	Pump type	Grunfos pump	Static WL *	m
Static WL *	m	Pumping rate (Q)	m ³ /h	Potential drawdown	m
Drawdown (s)	m	Duration	h	Potential yield	m ³ /h
* Levels to ground level datum		Specific capacity (Q/s)	m ³ /h/m	Depth of borehole *	120 m

BH SIZE & TYPE	TEMPERATURE	SCALE	PROFILE	TIME/DEPTH M/MIN	WATER ZONES CUMULATIVE Q (l/min)	WELL DIAGRAM with STATIC AND DYNAMIC WATER LEVELS	SCALE
10" DTH		10	Clay				10
		20	Literite		muddy		20
16.5" Drilling Bit		30					30
		40	Greenish grey, moderately weathered granite		Wet		40
		50				Open Hole	50
		60	Greenish grey granite with collaborate with quartzite		Muddy		60
		70					70
		80					80
		90					90
		100					100
		110	Slightly hard granite				110
		120					120
		130					130
		140					140
						E. O. H.	

Gravel for gravel pack Cement for grouting Bentonite for grouting Installation of grout seal Cleaning & development Centralisers fitted Safety cap fitted Backfill abund. BH Disinfection date Platform construct. date Platform transport adjust. Cut access to site	Yes	No	M ³	Remarks: Marginal well Prepared by: Edal Drilling Company Certified: Approved: Approved:
	Yes	No	KG	
	Yes	No	KG	
			M	
			HRS	
			KM	
			KM	

EDAL DRILLING COMPANY LIMITED, 49 BIG WATERLOO STREET, Freetown

BOREHOLE DEVELOPMENT FORM

Community: Family Home Movement

Date: 26th Oct 2009

Location Code: Calaba Town

Tested by: EDAL DRILLING CO LTD

Boreholes Ref No: EDCL/BH - 13

Ht. of datum 0.46m

Type of Test ☐ Step drawdown
☒ Constant discharge

Datum level ☒ Top of casing
☐ Base slab
☐ Other Specify

Depth 120m

Static water level

Total time of developmen 1Hrs

Time		Position of pipe BGL	Yield lpm	Pressure bar	Observations
From	To				
3:30pm	4:00pm	118	4	225	Muddy water lifted
4:10	4:40pm	78	5	225	Clean water