EDAL DRILLING COMPANY LTD.

GEOPHYSICAL SURVEY REPORT
KOSSOH TOWN

SUBMITTED TO:

Mr. PAKAI

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1. INTRODUCTION

In the quest to search for groundwater and as a prerequisite to borehole drilling, Mr. Pakai therefore contracted EDAL Drilling Company to carry out geological, hydrogeological/ Geophysical investigations at the proposed drilling site.

These studies, among others, provided enough data and information used in assessing the possibility of striking groundwater in the project area.

This report therefore documents the work carried out during the investigations.

2. BACKGROUND / GEOLOGY OF PROJECT AREA

The project area lies between the Bullom sedimentary formation and the Freetown Basic Complex.

The Bullom Group is comprised of unconsolidated to poorly consolidated sediments occupying the coastal plains of Sierra Leone. The deposits extend up to 50k inland and are found at heights up to 40m above present sea level (Culver and Williams, 1979). Although outcrop of the Bullom Group are rare and generally poor, the available evidence suggest a lateral variable sequence of poorly consolidated, near horizontal, often iron-stained gravels, sands, clays with occasional intra-formational laterites.

The Freetown Basic Complex on the other hand outcrops in the west as a result of younger igneous intrusions and it is predominantly of basaltic magmatism. The Freetown Complex is a layered gabbroic anorthosite intrusion, emplaced gneisses and schist of the Kasila group. The Bullom Group is resting unconformably on the Freetown Complex.

However, groundwater potential could be high within the upper Sedimentary Formation and at depth within fractured bed rock if properly located using the appropriate siting methods.

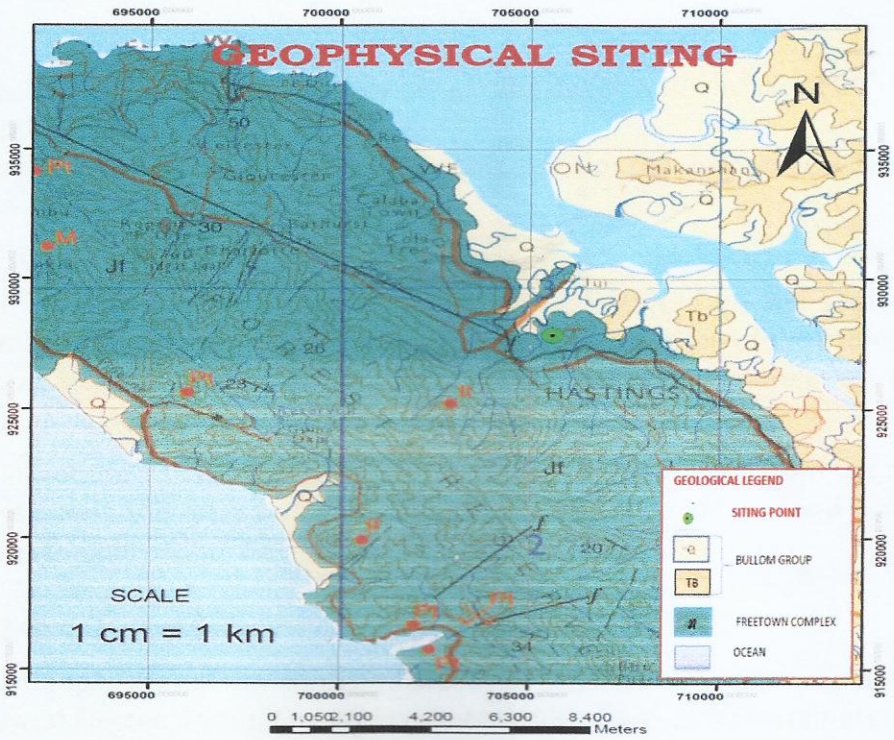


Figure 1. Geological Map of the Project Area

3. FIELD WORK

3.1 Reconnaissance Survey

The aim of the reconnaissance survey was to select suitable area (s) for geophysical survey; considering the geological/hydrogeological, environmental and other physical conditions.

The reconnaissance survey included the following:

- **Geomorphological Survey of the Area**

This includes the landscape and other physical features.
The project area is relatively flat with no visible outcrops or elevated ground in the immediate surroundings. Out crops can be seen from a distance. The Geomorphology of the area therefore suggests high groundwater potentials.

- **Geological survey to determine the formation of the area and to identify possible features.**

The project area is overlain by hard compacted laterites and some sedimentary formations.

However, sedimentary formations hold high groundwater potentials because of their aquifer characteristics especially in poorly consolidated gravels and sands. There is a stream running very close to the selected site; suggesting the presence of groundwater because there is always a hydraulic continuity between surface and groundwater. Trees within the area are fresh with

green leaves indicating that they are getting direct water intake at a more or less shallow depth.
Note that trees/plants are essential component of the Hydrological Cycle.

- **Selection of Traverse Line for geophysical Survey**

The traverse line for resistivity profiling was selected on the basis of geomorphologic and geological/hydrogeological features as well as the location of the project area. There were no visible strike directions of the geological formation of the area due to weathering and other human activities.

Point for the Vertical Electrical Sounding (VES) was obtained from the resistivity profiling result, considering the environmental and other physical conditions and was marked with a peg for identification.

3.2 Geophysical Survey

The Geophysical survey consisted mainly of Electrical Resistivity i.e. Resistivity Profiling and Vertical Electrical Sounding (VES) using the ABEM SAS 1000 Terrameter system.

3.2.1 Resistivity Profiling

Electrical resistivity profiling was carried out along the selected traverse of 50m length at 10m interval to determine the lateral variation in subsurface resistivities so as to delineate anomalous point(s) with groundwater potential which can be used for the Vertical Electrical Sounding (VES).

Resistivity values were obtained at two depth horizons (i.e. upper zone and at depth). The Schlumberger electrode configuration was used with the following electrode separation in meters; AB/2 = 20; MN/2 = 0.5; and AB/2 = 40; MN/2 = 5.0

3.2.2 Selection of VES point

The Vertical Electrical Sounding (VES) point was selected based on the resistivity profiling results as well as the location of the project area. From the resistivity profiling results, station **A3** showed the lowest (best) resistivity value at a depth of 40m and therefore was selected.

3.2.3 Vertical Electrical Sounding (VES)

Vertical Electrical Sounding (VES) was carried out with the aim of determining the formation resistivities and the depth to bedrock, as well as the possibility of finding water bearing formations or aquifer(s) at depth with the corresponding thicknesses of such aquifer(s). The Schlumberger electrode configuration and the required procedures were used for the VES.

4.0 DATA ANALYSIS AND INTERPRETATION

CLIENT: **Mr. Pakai**
DISRICT: **Western Area**
PROFILE LENGTH (m): **40**
STATION INTERVAL (m): **10**
PROFILE No. **1**

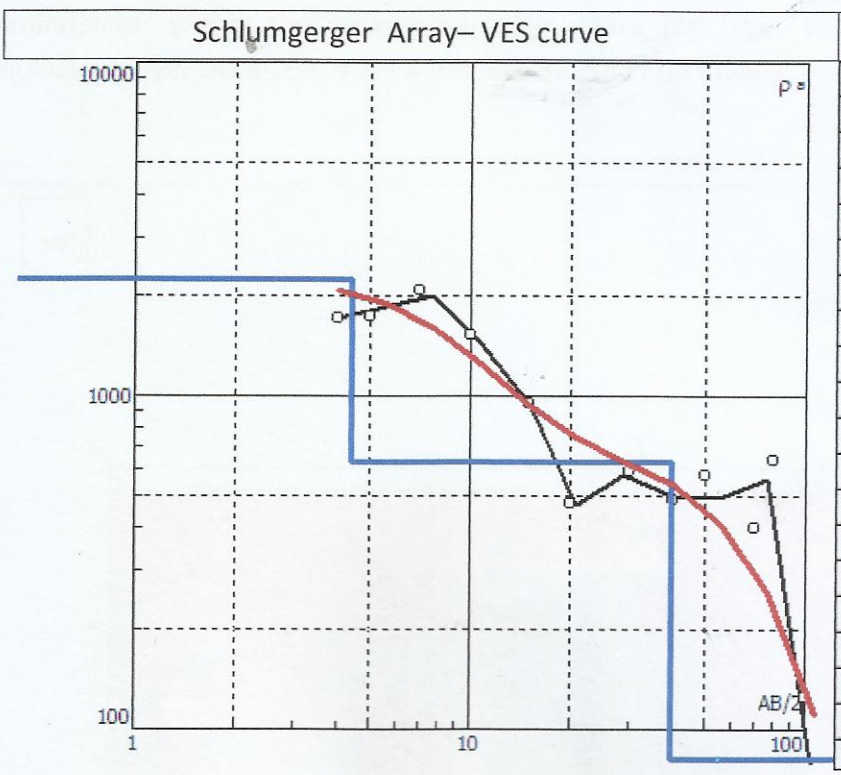
Table 1. Resistivity Profiling Data (Schlumberger Electrode Array)

STATION	**ELECTRODE SEPERATION (m) AB/2 = 20; MN/2 = 0.5**	**ELECTRODE SEPARATION (m) AB/2 = 40; MN/2 = 5**	**REMARKS**
A	APP. RESISTIVITY (Ohm.m)	APP. RESISTIVITY (Ohm.m)	
1	1299	541.03	
2	1014	498.56	
3	**1187**	**262.85** ←	**VES**
3	818.3	488.37	

Table 2: Schlumberger Array VES Data

Client: **Mr. Pakai**			Community: **Kossoh Town**
Project: **Geophysical Survey**			Sounding Number: **1**
District: **Western Area**			GPS Coordinate East: **0705603**
Date: **30th May, 2015**			GPS Coordinate North: **0927849**
Field Operator: **Morlai Kanu**			Elevation: **73m**
Schlumberger Array VES Field Data			
No.	**AB/2**	**MN**	**Apparent Resistivity (ohm-m)**
1	4	0.8	1703
2	5	0.8	1724
3	7	0.8	2081
4	10	1.5	1524
5	15	1.5	943.3
6	20	1.5	175.4
7	30	1.5	591.9
8	40	7.6	491.5
9	50	7.6	518.7
10	70	7.6	401.6
11	80	14	641.0
12	100	14	124.6

The VES data is first presented in the form of a table (as shown above) from which a graph of Apparent Resistivity (p_a) Vs half the Current Electrode Spacing (AB/2) is plotted.



Model Parameters

N	ρ	h	d	Alt
1	2227	4.4	4.4	-4.405
2	637	35.2	39.6	-39.59
3	0.942			

Figure 2. Schlumberger Array VES Curve and Model

The data shows a two-layer subsurface in which $p_1 > p_2$. The unusually low apparent resistivity registered in layers 1 and 2 are indicative of the presence of pore electrolyte, possibly groundwater within the weathered/sedimentary top layer and fractures in bedrock. The equivalent layer thicknesses are 4.4m and 35.2m respectively.

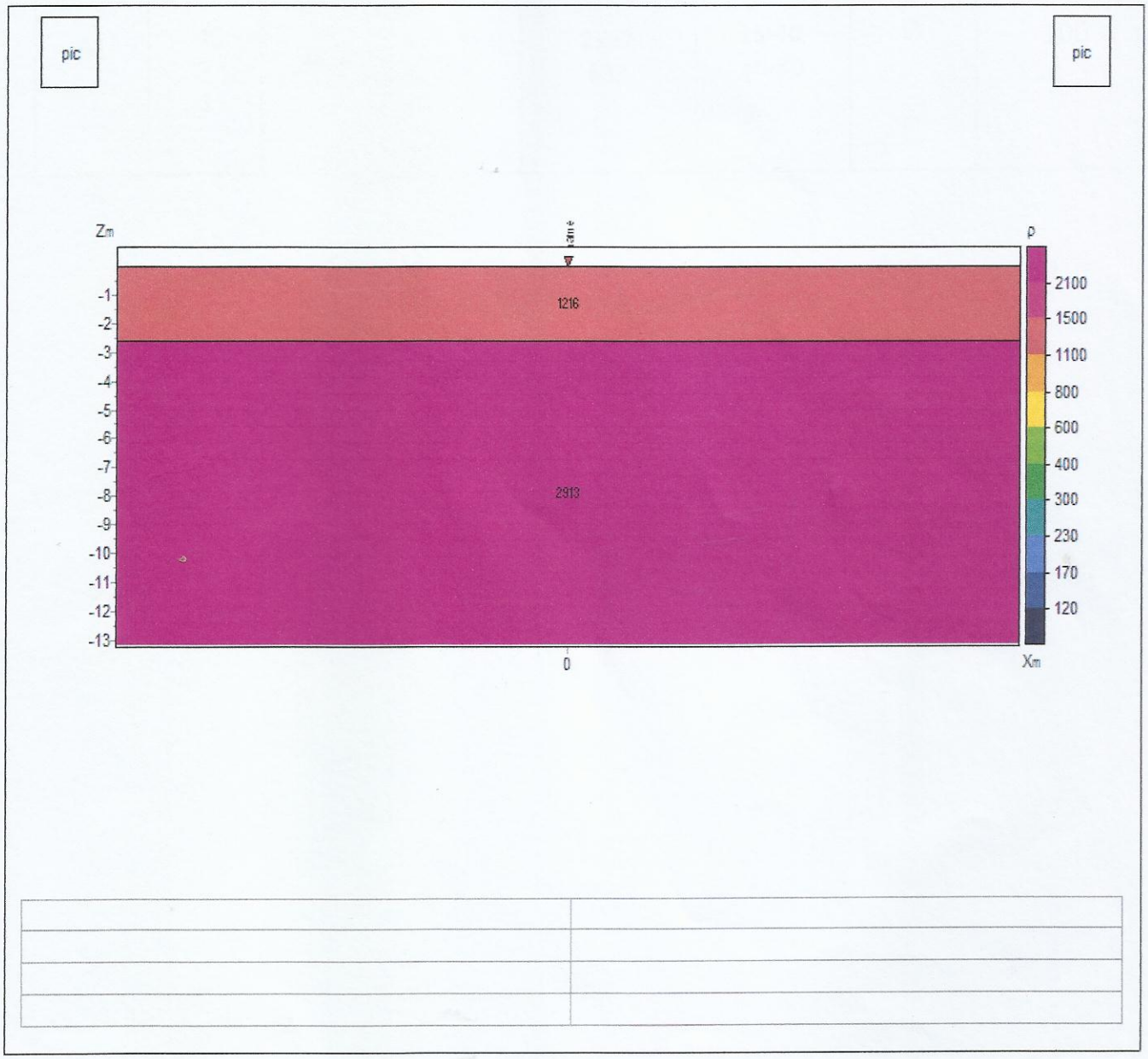


Figure 3. Pseudo Section Showing Apparent Resstivities and Layer Thicknesses

Table 3: Selection of Promising Points from VES Data

No.	VES POINT	LAYER	THICK NESS (m)	DEPTH (m)	APPARENT RESISTIVITY (Ohm-m)	POSSIBLE WATER ZONES (M)	RANKING	MAX DRILLING DEPTH (M)
1	A_3	1 2 3	4.4 35.2	4.4 39.6	2227 637	15-40 50-80	1ST	100

5.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the analyses of the entire results, and in line with the aims of the study, the drawn conclusions are;

- The project area lies between the Bullom Sedimentary formation and the Freetown basic Complex.
- Because of the location of the project area, the sedimentary formation of the Bullom Group is probably underlain by the Freetown Igneous Complex.
- Groundwater potential could be high within the sedimentary formation especially at depth between 15- 40m and 50-80 probably within the fractured bedrock.
- It is premature however, to estimate quantities/volume which could only be determined during drilling and test pumping.
- The borehole location was selected in accordance with both national and international borehole siting guidelines.

Recommendations

- Drilling could be carried out at the selected point to confirm the existence of groundwater.
- Borehole must be constructed using the correct and standard materials such as standard uPVC screens and plain casings, well sorted gravels etc. for water quality and high yield.
- The maximum drilling depth should be 100m to cut across the two promising zones of 15 - 40m and 50 - 80m respectively for sustainable productivity and high yield of the borehole.
- Both physico-chemical and bacteriological test should be carried out on the borehole water samples from completed well.

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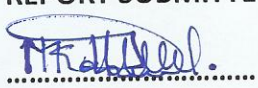

Morlai Kanu
Geologist/ Field Operator