

**HYDROGEOLOGICAL AND GEOPHYSICAL INVESTIGATION REPORT FOR  
SELECTION OF BOREHOLE ONE (1) DRILLING SITE LOCATED AT MIHALE  
IN BUNDA DISTRICT, MARA REGION.**

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## **ABBREVEATIONS**

CP	Central Point of Vertical Electrical Sounding
H	Anticipated Regolith Thickness
LVBWB	Lake Victoria Basin Water Board
RDD	Recommended Drilling Depth
VES	Vertical Electrical Sounding
AR	Apparent Resistivity
WRMA	Water Resources Management Act

## GLOSSARY

- (i) **Aquifer** - A geological formation or structure, which stores and transmits water and which is able to supply water to wells, boreholes or springs.
- (ii) **Conductivity** - Transmissivity per unit length (m/day).
- (iii) **Confined aquifer** - A formation in which the groundwater is isolated from the atmosphere by impermeable geologic formations. Confined water is generally at greater pressure than atmospheric, and will therefore rise above the struck level in a borehole.
- (iv) **Fault** - A larger fracture surface along which appreciable displacement has taken place.
- (v) **Gneiss** Irregularly banded rock, with predominant quartz and feldspar over micaceous minerals. A product of regional metamorphism especially of the higher grade.
- (vi) **Hydrogeological** - Those factors that deal with subsurface waters and related geological aspects of surface waters.
- (vii) **Infiltration** - Process of water entering the soil through the ground surface.
- (viii) **Joint** - Fractures along which no significant displacement has taken place.
- (ix) **Migmatite**- Rocks in which a granitic component (granite, aplite, pegmatite, etc.) is intimately mixed with a metamorphic component (schist or gneiss).
- (x) **Percolation** - Process of water seeping through the unsaturated zone, generally from a surface source to the saturated zone.
- (xi) **Permeability** - The capacity of a porous medium for transmitting fluid.
- (xii) **Porosity** - The portion of bulk volume in a rock or sediment that is occupied by openings, whether isolated or connected.
- (xiii) **Pumping test**- A test that is conducted to determine aquifer and/or well characteristics.
- (xiv) **Recharge** - General term applied to the passage of water from surface or subsurface sources (e.g. rivers, rainfall, and lateral groundwater flow) to the aquifer zones.
- (xv) **Regolith** - General term for the layer of weathered, fragmented and unconsolidated rock material that overlies the fresh bedrock.
- (xvi) **Unconfined** - Referring to an aquifer situation whereby the water table is exposed to the atmosphere through openings in the overlying materials (as opposed to >confined conditions

## **EXECUTIVE SUMMARY:**

Groundwater investigation that involved Hydrogeological, Geological and Geophysical methods was conducted at **Mihale village** in Bunda district by the Staff of Lake Victoria Basin Water Board-Mwanza. Aim of the survey was to locate potential site for drilling exploratory cum production borehole for domestic use.

Generally the study area is located in Nyanzian supergroup lying within the Sukumaland greenstone belt geologically consists of inner arc which consists of mafic volcanics, rare sediments and felsic flows, while the outer arc comprises of BIF, felsic pyroclastics, shales, sandstones and siltstones.

The borehole drilling sites were selected based on the maximum recharge, positions of weak zones, extent of the upstream catchment area, and resistivity surveys results. Therefore, **one (1)** potential borehole drilling sites were selected **(Appendix I)**

The interpretation of data was done using IP2win software one borehole drilling sites were recommended as the first choice **(Appendix I)**. The second choice can be drilled only if there is a technical problem during drilling the first choice.

## **1.0 INTRODUCTION:**

The survey was conducted at Mihale to establish borehole drilling site for the purpose of supplying safe and clean water for domestic use. In these areas, the only means of achieving reliable and steady water supply are through developing a groundwater sources.

## **2.0 LOCATION:**

Surveyed area is located in Mihale, Bunda, Mara Region.

## **3.0 GEOMORPHOLOGY AND DRAINAGE:**

Low-lying parts of the area are occupied by wide plains or gently undulating terrain. There also exist several ephemeral streams trending in different directions most of which follow the localized weak zones. In fact, the drainage patterns of particular study areas are drained by the seasonal rivers.

## **4.0 LOCAL GEOLOGY AND HYDROGEOLOGY:**

Regionally, Granitic outcrop was observed in vicinity of the area of survey. Therefore, the basement of the surveyed area is represented by granite and granodiorite belonging to Nyanzian system of Precambrian era.

The study area mainly comprised of archean granites, and granodiorites. Surveyed area also composed of superficial deposits which include reddish sand, clayey sand and clay. Topographically higher areas which display the bedrock are mostly the recharge zones for the surveyed areas.

These surveyed areas receive moderate rainfalls annually which act as the main recharging agent of groundwater reservoir. Groundwater in these areas are most likely to percolate through fractured/faulted rocks (as the secondary porosity of the rocks) to lower areas and make them rich in groundwater storage thus why we observed the present of shallow wells at some places.

## **5.0 GEOPHYSICAL SURVEY:**

### **5.1 ELECTRICAL RESISTIVITY METHOD:**

Vertical Electrical Soundings (VES) were applied in all selected points by using SAS 300 instrument applying the Four-Electrode Schlumberger's Configuration to a separation distance of  $AB/2$  up to 100m as the maximum one. The resistivity data obtained were interpreted using computer aided by Ip2win software.

### **6.0 RESULTS AND DISCUSSION**

The Interpretation of VES curves were carefully done by complete matching techniques using Standard Graphs for resistivity prospecting using IP2win Software. The values were plotted against the corresponding current electrode separation distance  $AB/2$  on a double log graph paper of modulus 62.5 mm. The selection of proposed points for drilling was made as seen in **Appendix I** as well as the results are obtained in **Appendix II**

## 7.0 CONCLUSION AND RECOMMENDATIONS

### 7.1 CONCLUSION

The hydro geological and geophysical survey, which comprised Vertical Electrical Sounding (VES) was done on 17<sup>th</sup> May, 2023 and completed on 17<sup>th</sup> May, 2023. From data collection, processing and interpretation indicate the potentiality as recommended in **Appendix I**.

### 7.2 RECOMMENDATIONS

1. Based on desk studies, morphological, Hydrogeological set up, and the interpretation results of vertical electrical soundings the selected point is groundwater potential.
2. The site of **VES No.1** has been selected for drilling to a depth of **170m** with a desired final casing diameter required by a client.
3. Drilling works should be carried out under the supervision of Hydrogeologist as per drilling depth, water quality monitoring, lithological logging, borehole designing, pumping test, etc.
4. Exploratory borehole/pilot borehole should be developed by using 4" bit, before drilling of production borehole commenced.
5. Air rotary method of drilling is recommended at this site and borehole should be packed with non-carbonate gravels mainly quartz of pea size (3-5mm) after thorough sieving and washing.
6. Development of the borehole shall be performed until a silt-free stage is reached.
7. Pumping test to determine yield and other hydraulic parameters should be done for at least 24 hours.
8. The quality and quantity of water will be known after drilling.
9. Physical/Chemical and bacteriological analysis of the water samples shall be ascertained before human use.

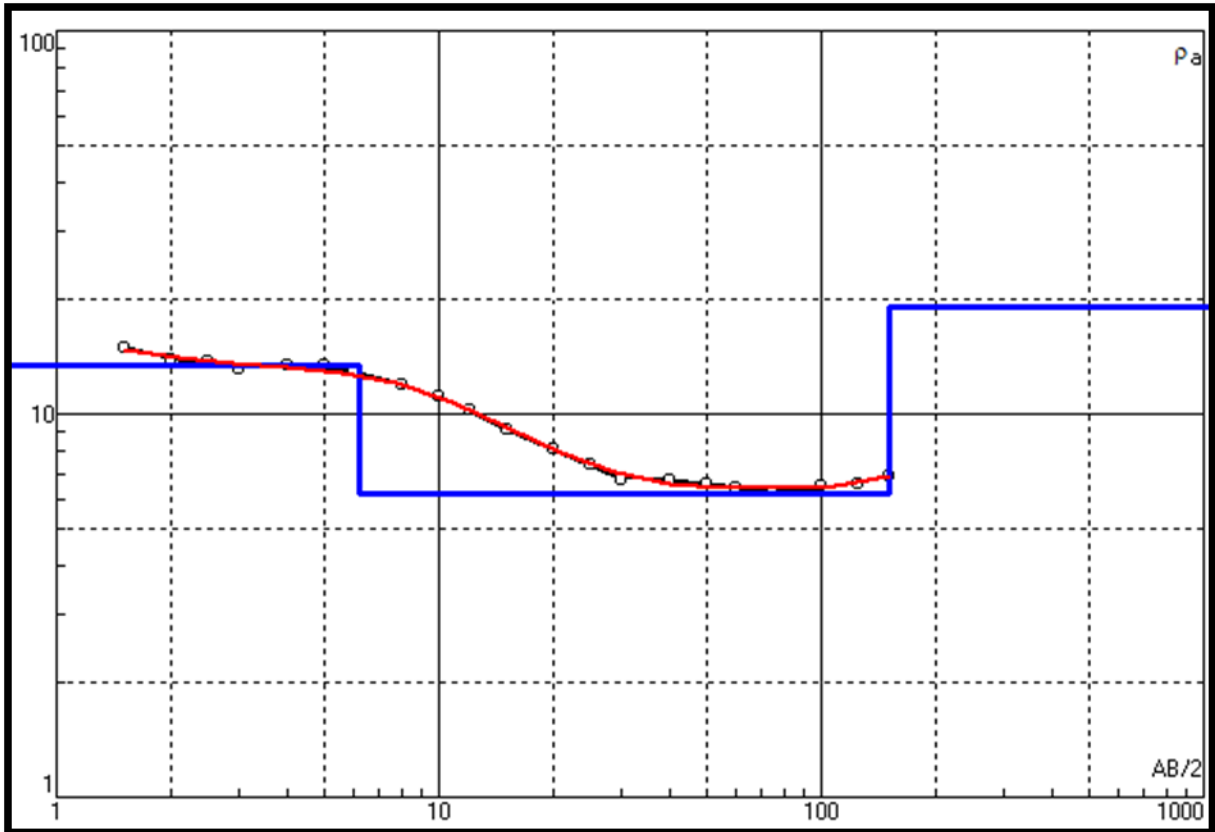
**Drilling Permit** and **Water Use Permit** must be obtained from the Water Officer – Lake Victoria Basin Water Board (LVBWB) Mwanza as indicated on Water Resources Management Act No.11 (WRMA) of 2009



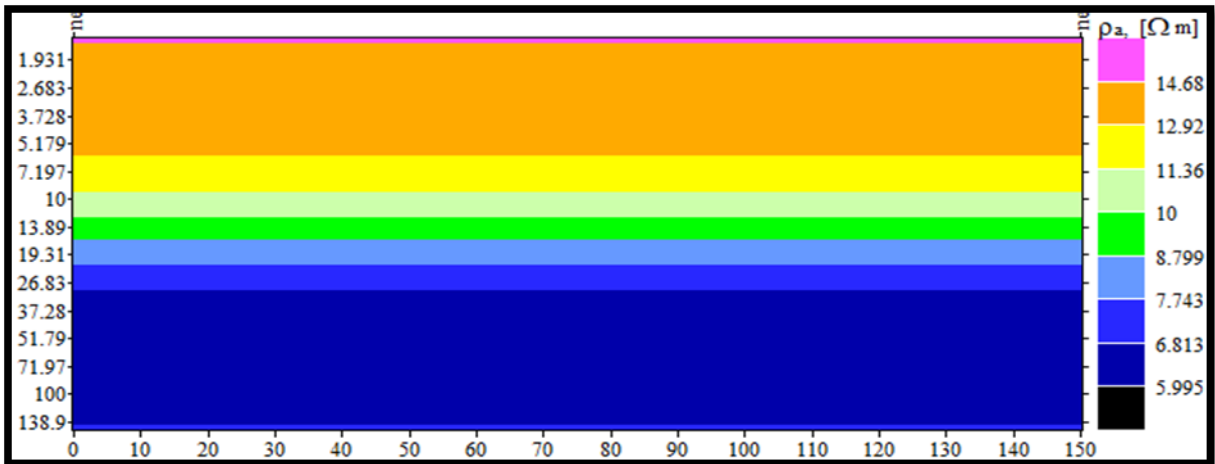
**APPENDIX I: Summary of Table of Results**

<b>VILLAGE</b>	<b>VES NO.</b>	<b>COORDINATES (WGS84)</b>	<b>RECOMMENDED DEPTH</b>	<b>PRIORITY</b>
<b>Mihale</b>	<b>1</b>	-2.030001/34.062496	<b>170m</b>	<b>First Choice</b>
	<b>2</b>	-2.029466/34.063028	<b>160m</b>	<b>Second Choice</b>

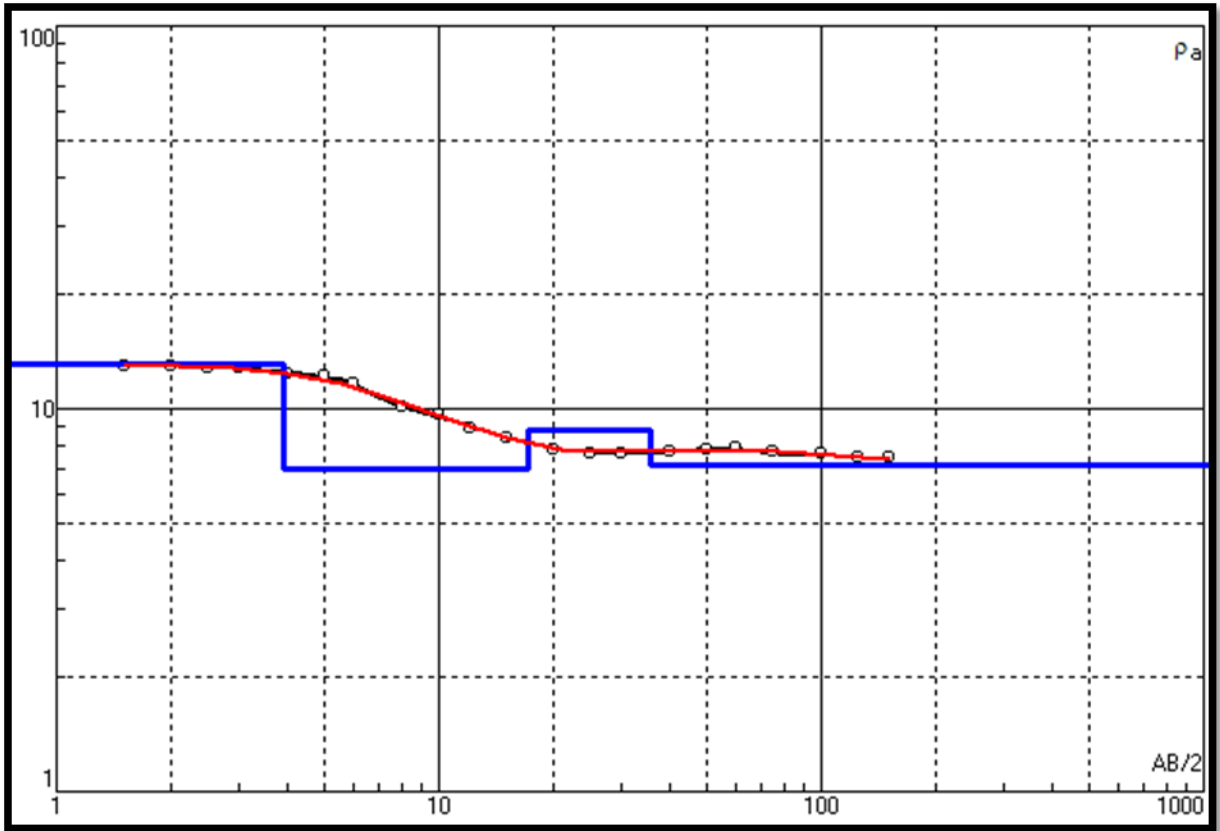
**APPENDIX II: VERTICAL ELECTRICAL SOUNDING INTERPRETED RESULTS**  
**VES01      -2.030001 34.062496 1151m      RDD=170m**



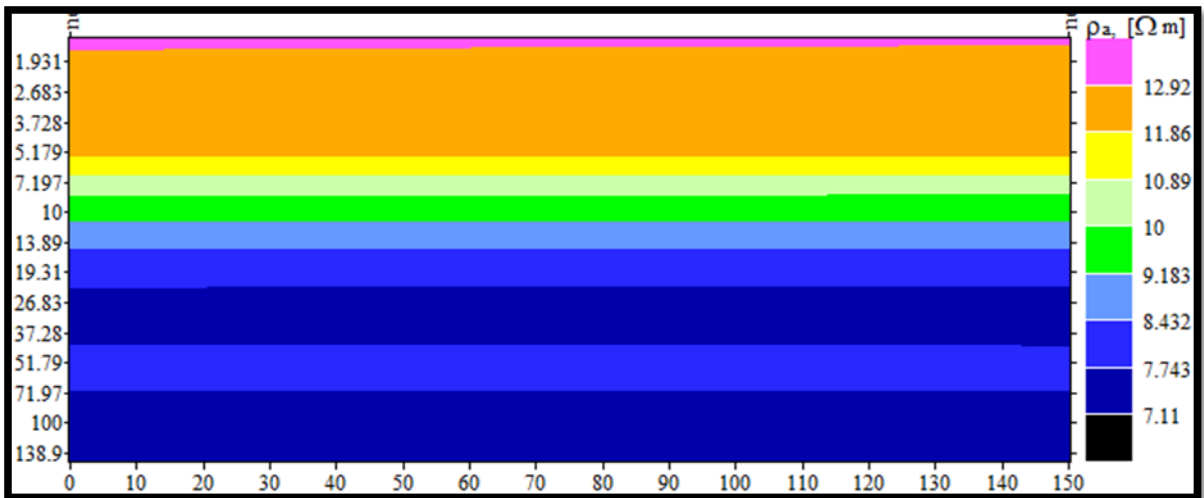
N	$\rho$	h	d	Alt
1	53.76	0.238	0.238	-0.238
2	13.47	5.949	6.187	-6.187
3	6.181	143.8	150	-149.99
4	18.94			



VES02 -2.029466 34.063028 1145m



N	$\rho$	h	d	Alt
1	13.08	3.933	3.933	-3.933
2	6.953	13.25	17.18	-17.183
3	8.811	18.72	35.9	-35.903
4	7.126			



**APPENDIX III: VERTICAL ELECTRICAL SOUNDING FIELD DATA**

AB/2	MN/2	Constant	R_VES01	R_VES02	AR_VES01	AR_VES02
1.5	0.5	6.28	3.127	1.798	19.638	11.291
2	0.5	11.78	1.441	0.953	16.975	11.226
2.5	0.5	18.84	0.884	0.559	16.655	10.532
3	0.5	27.48	0.63	0.389	17.312	10.690
4	0.5	49.46	0.358	0.225	17.707	11.129
5	0.5	77.77	0.227	0.145	17.654	11.277
6	0.5	112.26	0.152	0.09	17.064	10.103
8	0.5	200.18	0.079	0.044	15.814	8.808
10	0.5	313.22	0.047	0.027	14.721	8.457
10	2.5	58.88	0.22	0.145	12.954	8.538
12	2.5	86.61	0.137	0.09	11.866	7.795
15	2.5	137.38	0.077	0.057	10.578	7.831
20	2.5	247.28	0.038	0.028	9.397	6.924
25	2.5	388.58	0.022	0.016	8.549	6.217
30	2.5	561.28	0.014	0.012	7.858	6.735
30	5	274.75	0.029	0.025	7.968	6.869
40	5	494.55	0.016	0.014	7.913	6.924
50	5	777.15	0.01	0.009	7.772	6.994
50	10	376.8	0.021	0.021	7.913	7.913
60	10	549.5	0.014	0.015	7.693	8.243
75	10	867.43	0.008	0.009	6.939	7.807
100	10	1554.3	0.005	0.005	7.772	7.772
100	25	588.75	0.011	0.013	6.476	7.654
125	25	942	0.007	0.008	6.594	7.536
150	25	1373.8	0.005	0.005	6.869	6.869