Assessment of Aquifer Potential Using Electrical Resistivity Survey in Sasa, Oyo State, Nigeria

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Abstract: **Sasa community in Ibadan southwestern Nigeria is a fast growing community because of its closeness to several research institutions but there is scarcity of potable water in the community. This research work is therefore aimed at delineating the subsurface geology in the study area using electrical resistivity and to identify aquifer zone that are productive for groundwater exploration. The field survey consists of eight VES using Schlumberger configuration with maximum electrode spacing of 130m. Five lithological layers comprised of top soil, clay/sandy clay, lateritic soil/ laterite, weathered layer and fresh bedrock was delineated from the electrical resistivity survey. Aquiferous zone of sufficient overburden thickness were delineated at an average depth of 11.0m. Most of the hand-dug wells existing prior to this survey were less than the depth obtained in this research which explains why there is abortive borehole and scarcity of groundwater in the study area.**

Keywords: **Groundwater, VES, Potable-Water, Aquiferous - Zone, Geophysical-Prospecting,**

I. INTRODUCTION

The demand for water has increased over the years due to agricultural and technological advancement, increase in industrialization and population explosion but surface water isgrossly inadequate to meet or cope with the ever increasing demands for water, the only sufficient alternative source of perennial water supply is groundwater because it is almost an inexhaustible source of water. Sasa community in Akinyele Local Government Area of Oyo state have suffered enormous challenge of scarcity of potable water and larger percentage of the community relied on hand dug wells while others often travel several kilometers in search of potable water at an exorbitant rate. Several researchers have adopted geophysical methods to identify zones of groundwater potentials for groundwater development purposes in communities with inadequate water supply and poor hydrological characteristics (Hazell et al., 1988; Dan-Hassan and Olorunfemi, 1999; Ekwe et al., 2006; Oladapo and Akintorinwa, 2007; Mohammed et al., 2008; Oladapo et al., 2009; Olayanju et al 2011 and Batayneh, 2011). This research work is therefore aimed at delineating the subsurface geology in the study area using electrical resistivity a geophysical method and to identify aquifer zone that are productive for groundwater exploration.

II.THE STUDY AREA

Sasa is a town in the Akinyele local government area of Ibadan metropolis, Nigeria and lies between longitude 3^0 54' East of the Greenwich meridian and 7^0 28' North of the equator. Sasa Area is a town with an inter link with the following areas, Apete, Ajibode, Ojoo and Akinyele all in the Ibadan metropolis which is the capital of Oyo state and has been an important administrative centre since colonial times. The study area is underlain by basement complex rocks of metamorphic origin of the pre-Cambrian age. These rocks can be grouped into major and minor rock types. The major types are quartzite of the meta sedimentary series and the migmatite complex comprising banded gneiss, augen gneiss and magnetite, while the minor rocks types are pegmatite, quartz, aplite, diorites, amphibolites and xenoliths (Oyawole, 1970)(Rahaman, 1976).Sasa area is located near the forest grassland boundary of Southwestern Nigeria (Amanambu and Ojo-Kolawole 2013). The latitudinal location (lat $07^0 26'$N) of Ibadan means it enjoys the characteristic West African monsoon climate, marked by a seasonal shift in the wind pattern. It therefore means that the climate of Ibadan and Akinyele Local Government Area in particular is tropical with distinct wet and dry seasons and a mean annual temperature of 27.1^0C (Egbinola and Amanambu 2013) but in consonance with seasonal variations in radiation, sunshine and cloud cover, the mean annual temperature could change.

III. MATERIALS AND METHODS

The Vertical Electrical Sounding (VES) using Schlumberger configuration was employed for the survey, the maximum electrode spacing (AB) was 130m. The data obtained from the field were highlighted on a bi-logarithmic table,the curves for each of the eight soundings were obtainedfrom the auxiliary resistivity curves using partial curve matching technique. The vertical electrical sounding graph of apparent resistivity (ohm.m) against distance (m) was obtained using Winresist software.

IV.RESULTS AND DISCUSSION

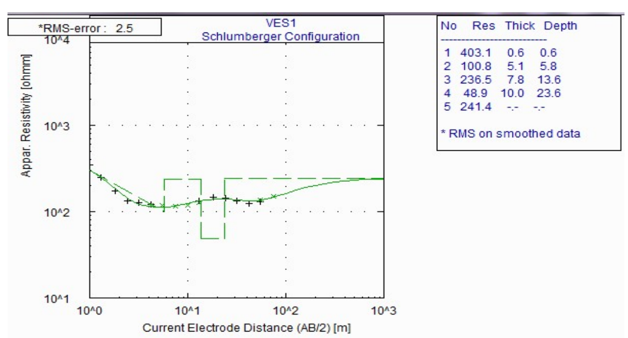

Figure1; Curve for VES 1

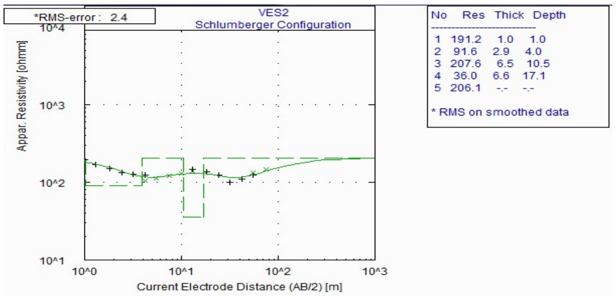

Figure 2: Curve for VES 2

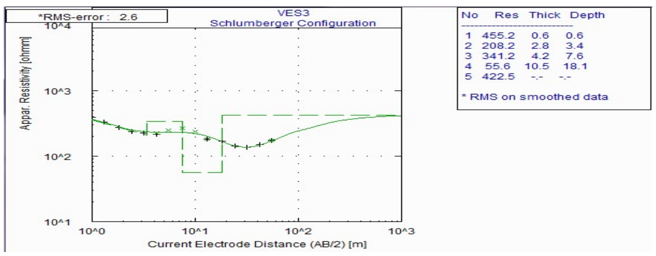

Figure 3: Curve for VES 3

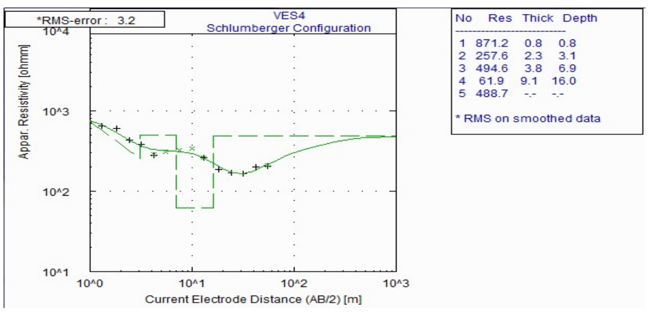

Figure 4: Curve for VES 4

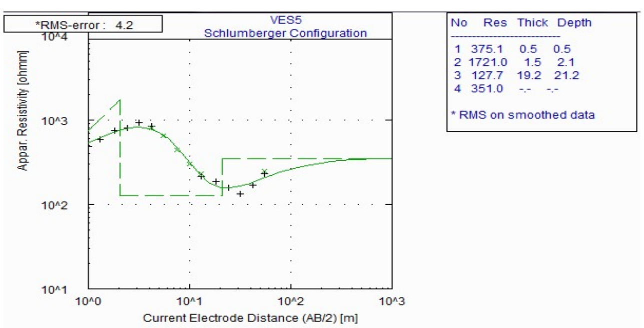

Figure 5; Curve for VES 5

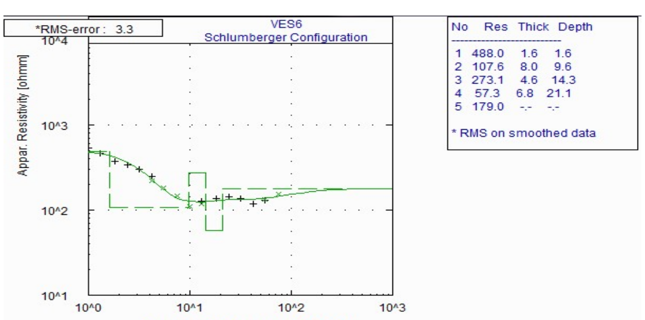

Figure 6; Curve for VES 6

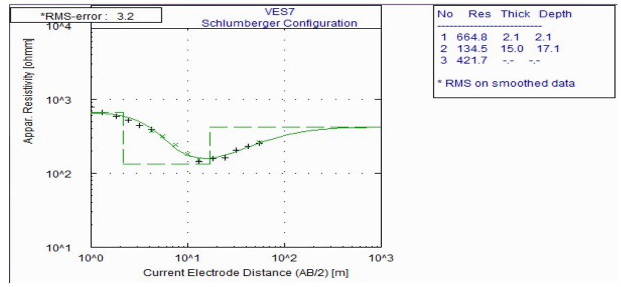

Figure 7; Curve for VES 7

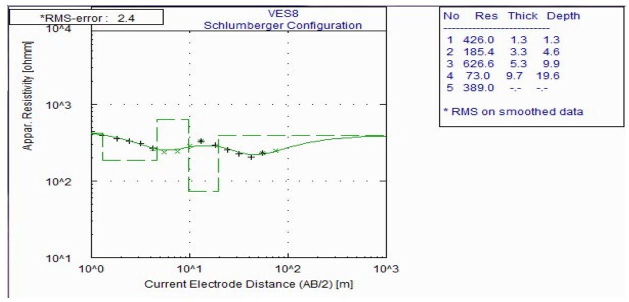

Figure 8; Curve for VES 8

VES1, 2, 3, 4, 6 and 8 have 5 layers of similar curve type $\rho_1 > \rho_2 < \rho_3 > \rho_4 < \rho_5$which is the HKH curve type. The top soil which is the first layer ranges in resistivityfrom 191.2 Ωm to 971.2 Ωm and layer thicknesses between 0.6m and 1.6m, the next layer which is the second layer iscomposed of clay/sandy clay, it has a thickness range 2.3m to 8.0m and resistivity ranges between range 91.6 Ωmand 257.6 Ωm, the third layerwhich is a lateritic soil of apparent resistivity between 207.6 Ωm to 494.6 Ωm and thicknesses 3.8m to 7.8m, the fourth layer is highly conductive with resistivity as low as 36.0 Ωm and thickness 6.6m to 10.5m. Water is highly conductive and consequently have low resistivity which is a featured of this fourth layer, the aquifer potential here is probably around 15m depth from the top soil level 12m,

VES 5 has 4 layers$\rho_1 < \rho_2 > \rho_3 < \rho_4$ which is the KH, the top soil is 0.5m in thickness and the apparent resistivity is 375.1Ωm, the second layer is laterite of thickness 1.5m and an apparent resistivity of 1721.0 Ωmwhile the third layer which is probably a weathered layer has a thickness 19.2m and an apparent resistivity of 127.7 Ωm, though there is a characteristic drop in the apparent resistivity from second to the third layer, the overburden thickness of 2.1m is very thin this has ruled out the possibility of a potential aquifer, the fourth layer is the fresh basement at a depth 21.2m. VES 7 has 3 layers $\rho_1 > \rho_2 < \rho_3$which H type curve, the first is the top soil of thickness 2.1m and apparent resistivity 664.8Ωm, the second layer is lateritic soil of thickness 15.0m and an apparent resistivity of 134.5Ωm while the third layer is the basement.

V.CONCLUSION

Five lithological layers comprised of top soil, clay/sandy clay, lateritic soil/ laterite, weathered layer and fresh bedrock were delineated from the electrical resistivity survey.

Six out of the eight VES curves were HKH –type, one of the remainder was KH-type and another H type.

A relatively high overburden thickness is necessary requirement for a potential aquifer in a basement complex, the very thin overburden thickness of VES 5 and 7 has ruled out the possibility of a good aquiferous zone with high yield hence these areas are not recommended as a potential aquifer.

Aquiferous zone of sufficient overburden thickness were delineated at locations VES1, 2, 3, 4, 6 and 8,these locations are very viable for groundwater exploitation at an average depth 14.0m. Most of the hand-dug wells existing prior to this survey were less than the depth obtained in this research which explains why there is abortive borehole, dry well and scarcity of groundwater in the study area.

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