Available online at
www.mdl.mazedan.com

www.mazedan.com ©2021 Mazedan International Research Academy www.mazedan.com/mjcea

MJCEA

ADUDU AND ITS ENVIRONMENT GROUNDWATER POTENTIAL ASSESSMENT, AKIRI SHEET 232, MIDDLE BENUE TROUGH, CENTRAL NIGERIA

M. J. MONDE[1], S. OLOGUN[2] AND M. I. ABUBAKAR[3]

MAZEDAN JOURNAL OF CIVIL ENGINEERING & ARCHITECTURE

e-ISSN:

Article id- MJCEA0101004
Vol.-1, Issue-1
Received: 24 Feb 2021
Revised: 20 Mar 2021
Accepted: 29 Mar 2021

Citation: Monde, M. J. et. al. (2021). Adudu and Its Environment Groundwater Potential Assessment, Akiri Sheet 232, Middle Benue Trough, Central Nigeria. *Mazedan Journal of Civil Engineering & Architecture*. 1(1), 22-28.

Abstract

Investigation of the geoelectrical properties of Adudu and the surrounding area, which makes up a portion of Akiri sheet 232 in the Middle Benue Trough in Central Nigeria. The sedimentary rock and basement complex rocks that underlie the research region are composed of baked and compacted shale, basalt sandstone, and bluish-grey to dark-black carbonaceous shale. The purpose of the geoelectrical survey that was conducted was to ascertain the distance to the aquifer as well as the width of the subsurface layers. A total of seventeen (17) VES were performed, each with a current electrode ranging from one to one hundred fifty metres and a potential electrode ranging from three hundred thirty metres to seven hundred and fifty metres. The results were interpreted with the help of a piece of software called WinResist. The geologic sequence that lies under the region under investigation is made up of a hard pan top soil (clayey and sandy-lateritic), a weathered layer, a partially weathered or fractured basement, and a fresh basement. The resistivity value for the topsoil, which can range from 17-828 m up to 2 metres of depth; the resistivity value for lateritic, which can range from 80-1700 m and 1.4 metres to 2.9 metres; the resistivity value for shaley sand, which can range from 46-132 m and 6 metres to 19 metres; the resistivity and thickness value for fractured basement, which can range from 161-457 m and 4.8 metres to 30 metres The resistivity of the aquifer in the region under investigation varies from 80 to 457 m, with 120 m serving as the average value. Gari VES 1 and 2, Adudu VES 3 and 5, Ngah VES 6, Kucha VES 8, Kanje VES 9 and 10, VES 11, and Abuni VES 13 and 15 are some of the areas that have a strong possibility of finding groundwater between a depth of 50 and 120 metres.

Keywords: Aquiferious, Shaly sand, Structural Trend and Formation

1. INTRODUCTION

Water is an essential component for many aspects of life, including agriculture and the natural world. To reduce one's susceptibility to the occurrence of severe hydrological events, nature, ecosystems, and biodiversity are all necessary components. Groundwater is the most abundant source of clean water on the planet and contributes around one third of one percent of the total water supply to the globe. Prior to the year 1980, there was only a little amount of development done on the state's groundwater resources. As a means of obtaining water, the inhabitants relied on natural bodies of water and a limited number of wells that had been dug by hand. Hand-dug wells are often no deeper than 15 metres and can only provide sufficient water to their customers during the wet season. As a direct consequence of this, the population's water requirements have not been satisfied to an acceptable level, particularly during the dry season. Over the course of the years, there have been efforts made to satisfy the water requirements of the population. This has included the establishment of government agencies, in addition to private companies and individuals who have been involved in the exploration and exploitation of sustainable water supply for the growing population. The water found in lakes and rivers, in addition to abandoned wells, has been considered a potential waste storage facility.

Several different methods of geophysical investigation, including seismic, electromagnetic, geophysical borehole logging, and geo-electric exploration, are used to identify the composition of water-bearing strata (Alile, et al., 2008). The porosity and permeability of formation materials to act as an aquifer may be better shown with the assistance of these approaches. In groundwater research, the electrical resistivity technique of geophysical approach is considered to be the most accurate (Araffa, et al., 2019). This is because it is simple to use when out in the field, the necessary equipment is portable, it has a deeper depth of penetration, and it is accessible to contemporary communication systems.

The location of Adudu and the surrounding region may be found between the latitudes of 08°10'00" North and 08°19'00" North, as well as between the longitudes of 08°55'00" East and 09°6'30" East (Figure 1). It is surrounded on all sides by the regions of Awe, Keana, and Lafia, with Awe lying to the east, Keana to the west, and

[1]Department of Geology and Mining, Nasarawa State University Keffi, Nigeria
[2]Nigeria Building and Road Research Institute, Abuja, Nigeria
[3]Nigeria Building and Road Research Institute, Natonal Laboratory Complex Ota, Ogun State, Nigeria.
*Corresponding author email: chunmada385@gmail.com

Lafia to the north. The area is accessible by the Lafia-Obi motorways, in addition to a network of other, more localised roads and paths. It is a town that is governed by the Obi Local Government Area since it is located inside that area.

The study conducted by Offodile investigated whether or not there was a potential for groundwater to be present in the sedimentary layers of the state of Nasarawa (1976, 2002). He made the discovery that there is a possibility of finding groundwater in the rocks that compose each of the following formations:

Location, Extent and Accessibility

Adudu and the surrounding area are located between the latitudes of 08°10'00" North and 08°19'00" North, and between the longitudes of 08°55'00" East and 09°6'30" East (Figure 1). Awe lies to the east, Keana to the west, and Lafia to the north enclose it on all sides. The region may be reached by the Lafia-Obi highways, in addition to other smaller roads and trails. It is a town that falls under the jurisdiction of the Obi Local Government Area.

Offodile's research looked at the possibility of groundwater being present in the sedimentary strata of the state of Nasarawa (1976, 2002). He discovered that groundwater may be found in the rocks that make up each of the following formations:

i. The Aquifer of Awe Formation

ii. The Aquifer of Makurdi / Keana and Ezeaku Formations.

iii. (iii)The Aquifer of Awgu Formation and

iv. The Aquifer of Lafia Formation.

2. GEOLOGY AND HYDROGEOLOGY OF THE STUDY AREA

Adudu and its surrounding areas are located within the Awe and Agwu Formations (Figure 1.2), which are classified as part of the Middle Benue Trough in Nigeria and are of an igneous nature. Shales, basalt, and sandstone are the types of rocks that can be found outcropping in Adudu. According to Obaje (2009), the research area is dominated by bluish-grey to dark-black carbonaceous shales that date back to the Late Albian and Early Cenomanism time periods. Basalts intruded the black shale, creating a hill with a height of around 250 metres. Mud cracks, veins, and joints are the most prevalent structural elements that can be identified.

Furthermore, the Formations consist of Top soil/laterite, Sandy shale, Shaly sand (aquiferous), and Shale (aquiferous), as well as highly indurated sandstones, which are impermeable in places, where well fractured or less indurated, and yet, the formation is typically less compact, more permeable, and has a better prospect as an aquifer. The secondary permeability of the Formations, which is the result of weathering and fracture, is a crucial factor in determining whether or not they are valuable as a prospective groundwater reservoir.

3. MATERIAL AND METHOD

The data collected in the field were analysed with the use of a computer simulation tool called Win Resist version 1.0. (Vander Velpen, 2004). The VES point was figured out in the field with the use of a GARMIN channel personal navigation Global Position System (GPS) receiver to find the points, and the Golden Surfer 12 application was used to make the maps.

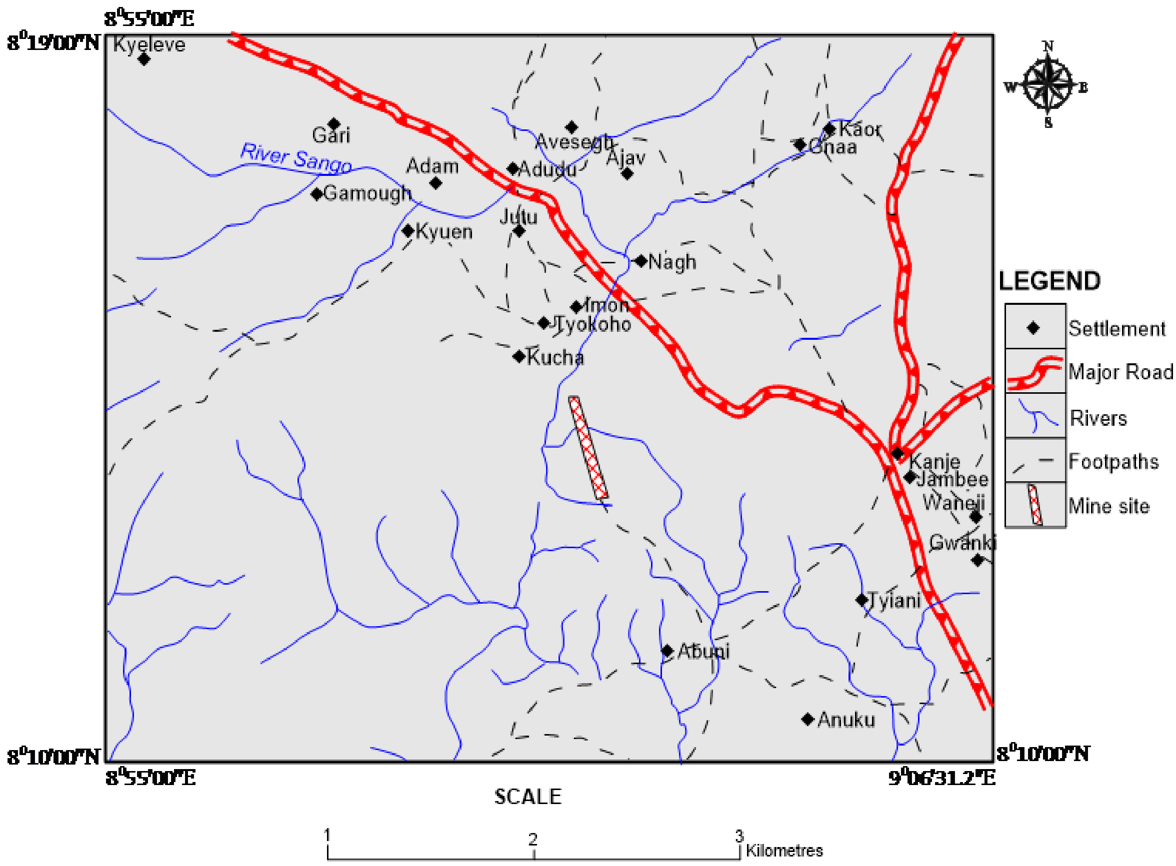

Figure 1 Location Map of the study area

4. RESULTS AND DISCUSSION

In this investigation, the VES sounding curves were obtained by plotting the values of the apparent resistivity, _a, against the electrode spacing, AB/2, on a log-log scale. The necessary computer programme for this was Wine Rsisit. The modelling of the VES data that were carried out at seventeen (17) different stations was employed in order to generate the geoelectric sections for the various profiles. The geoelectric sections that are displayed in Figures 1 through 17 each have five layers on the probe station that they were taken from. Table 1 displays the field data that were acquired after conducting seventeen (17) soundings.

According to table 1, the layers of the 17 soundings reveal various thickness and aquifer resistivity of aquifers in the area, which revealed four to six geologic layers, composed of topsoil with resistivity values ranging from 17-828 m up to 2m lateritic with a resistivity value ranging from 80-1700m and 1.4m to 2.9m, shaley sand, with resistivity and thickness value ranging between 46-132m and 6

The resistivity of the aquifer in Adudu and the surrounding area ranges from 80 to 757 micrometres, and its thickness may range from 5 to 35 metres, with 15 metres being the typical thickness. The greatest thickness, 30 metres, is seen in VES 17, whereas the thickness ranges from 10 to 30 metres in VES 15, 16, and 18. The areas of Gamough, Adudu, Nagh, Kanje, and Abuni are home to the majority of the area's aquifers, which are indicative of the region's healthy water supply. Kanje has a number of regions that have a poor prospective water supply. The seventeen VES spots' individual geoelectric curves are shown here, along with their corresponding depths, thicknesses, and types of curves.

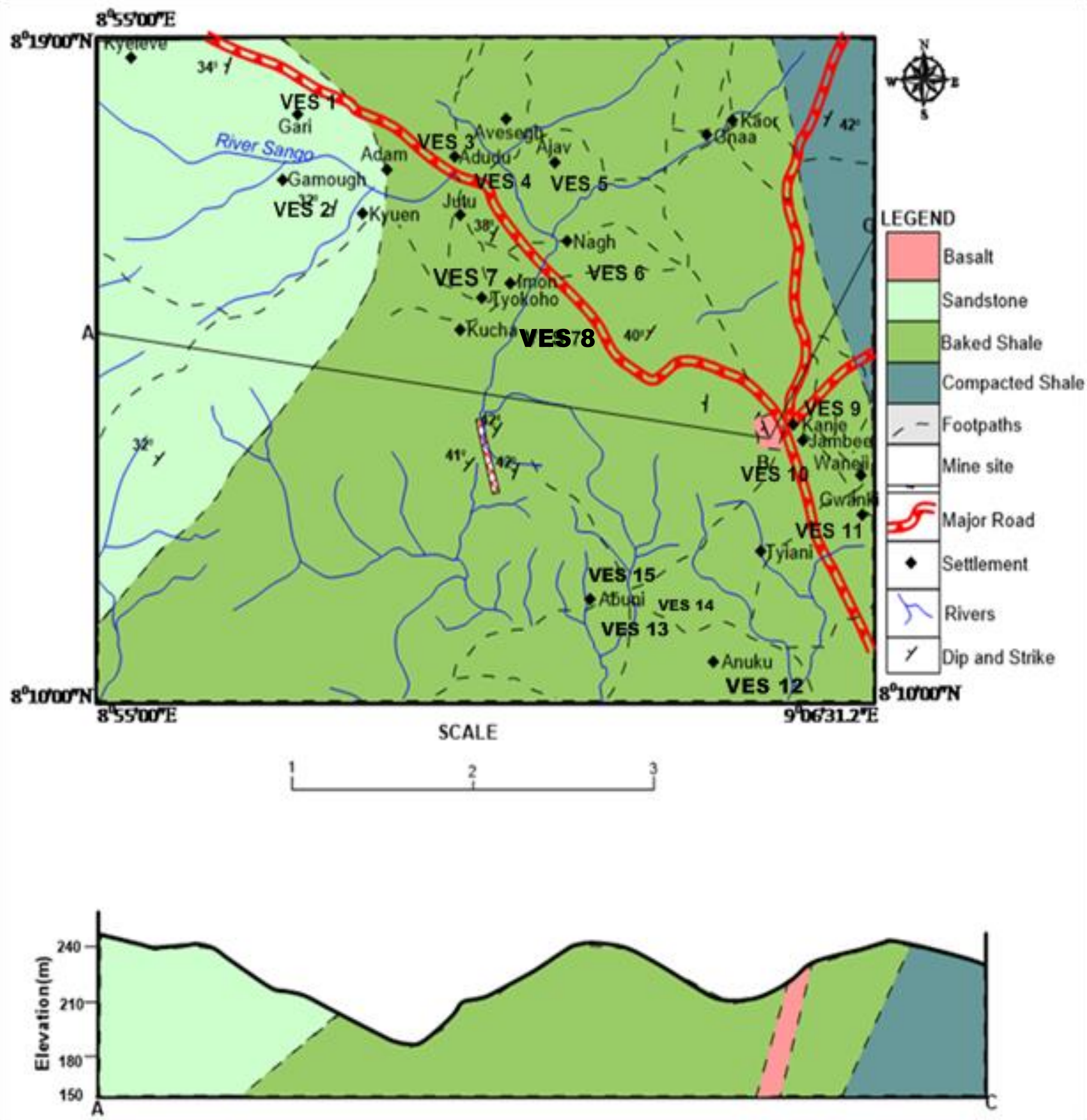

Figure 2 Geology and VES map of Adudu and its Environ

Table 1 Geoelectric interpretation of parameters of Adudu and environ

S/N	VES Station	Curve type	Location	No of layer[s]	Resistivity [ohm-m]	Thickness [m]	Depth [m]	Lithological Units
1	V1	QHA	Gari	5	326 69 15 117 2452	0.6 4.4 14 25.9 -	0.6 5.0 19.0 44.9 -	Topsoil/laterite Sandy shale Shaly sand Sandstone
2	V2	QH	Gamough	5	118 28 21 231 106	0.8 4.9 22.3 98 -	0.8 5.7 28 126 -	Topsoil/laterite Sandy shale Shaly sand Sandstone
3	V3	AAK	Adudu	5	17 63 144 492 163	0.8 2.1 5.6 65 -	0.8 2.9 8.5 74 -	Topsoil/laterite Sandy shale Shaly sand Shale sand
4	V4	AAK	Adudu	5	87.5 137 234 1988 632	2.0 4.0 9.2 95 -	2.0 6.0 15.2 110 -	Topsoil/laterite Sandy shale Shaly sand Shale sand
5	V5	AAK	Adudu	5	75 100 218 1741 558	1.7 5.2 9.5 101 -	1.7 7.0 16.5 117 -	Topsoil/laterite Sandy shale Shaly sand Shale sand
6	V6	KHA	Nagh	5	60 84 31.7 135 665	1.9 5.2 11.4 12.6 -	1.9 7.2 18.5 31 -	Topsoil/laterite Sandy shale Shaly sand Shale sand
7	V7	QHK	Imon	5	98 57 43.8 660 556	0.4 6.4 18.8 52.8 -	0.4 6.8 25.6 78.4 -	Topsoil/laterite Sandy shale Shaly sand Shale sand
8	V8	QHK	Kucha	5	144 58 40.9 93.6 6.7	0.4 6.9 12.2 12.5 -	0.4 7.2 19.4 31.9 -	Topsoil/laterite Sandy shale Shaly sand Shale sand
9	V9	QHA	Kanje	5	1912 63.3 11.1 60.2 396	0.7 2.4 4.7 5.3 -	0.7 3.1 7.7 13.0 -	Topsoil/laterite Sandy shale Shaly sand Shale sand
10	V10	QHK	Kanje	5	264 79 14.8 289 181.9	0.7 2.5 6.3 34 -	0.7 3.1 9.4 44 -	Topsoil/laterite Sandy shale Shaly sand Shale sand
11	V11	QHA	Kanje	5	133 62.3 14.8 239 266	1 1.9 4.8 12 -	1 2.9 7.7 19.8 -	Topsoil/laterite Sandy shale Shaly sand Shale sand
12	V12	HKH	Anuku	5	104 34 1054 558 35	0.3 0.6 10.6 14.4 -	0.3 0.9 11.5 26 -	Topsoil/laterite Sandy shale Shaly sand Shale sand
13	V13	HAA	Abuni	5	139 13.6 111 365 1055	1.3 2.0 5.5 19.3 -	1.3 3.3 8.8 28 -	Topsoil/laterite Sandy shale Shaly sand Shale sand

14	V14	KHAK	Abuni	6	82 83 44.5 1323 4207 320	1.5 2.7 2.2 10.2 132 -	1.5 4.1 6.4 16.5 148 -	Topsoil/laterite Sandy shale Shaly sand Shale sand
15	V15	QHA	Abuni	5	385 271 54 95 1239	1.3 0.5 2.7 12.7 -	1.3 1.8 4.4 17.2	Topsoil/laterite Sandy shale Shaly sand Shale sand
16	V16	HAAK	Abuni	6	828 83 445 1323 4707 3206	1.5 2.7 2.2 10.2 132 -	1.5 4.1 6.4 16.5 148 -	Topsoil/laterite Sandy shale Shaly sand Shale sand Shale sand
17	V17	QHA	Abuni	5	385 271 5.4 946 1739	1.3 0.5 2.7 12.7 -	1.3 1.7 4.4 17.2	Topsoil/Laterite Sandy shale Shaly sand Shale sand

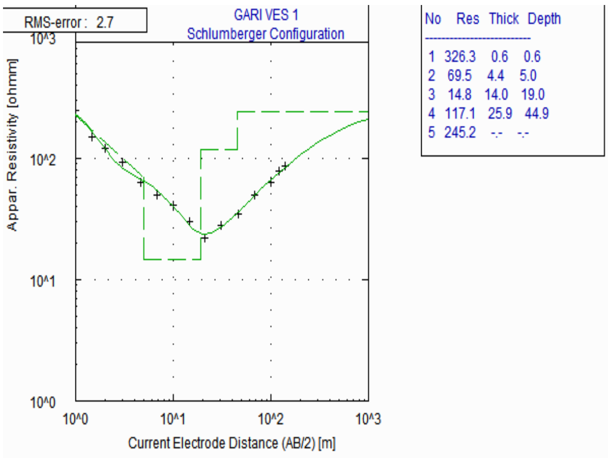

Figure 4: QHA-curve type

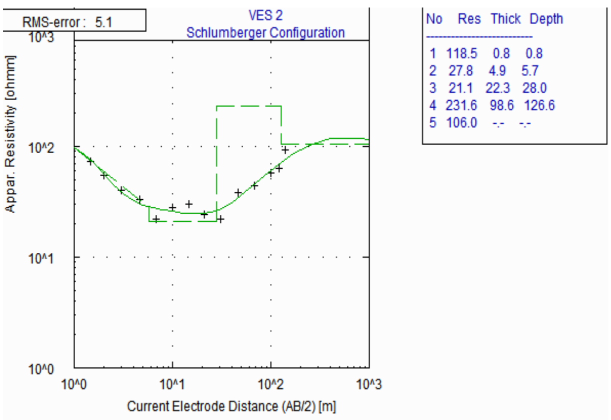

Figure 3 QH-curve type

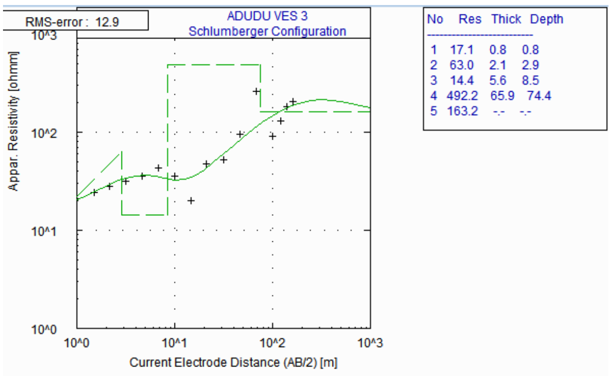

Figure 4 HQHA-curve type

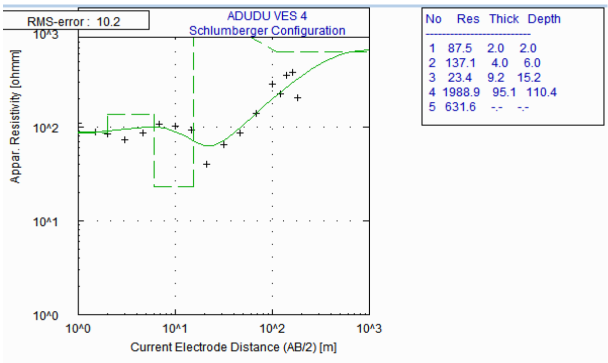

Figure 5 HQHK-curve type

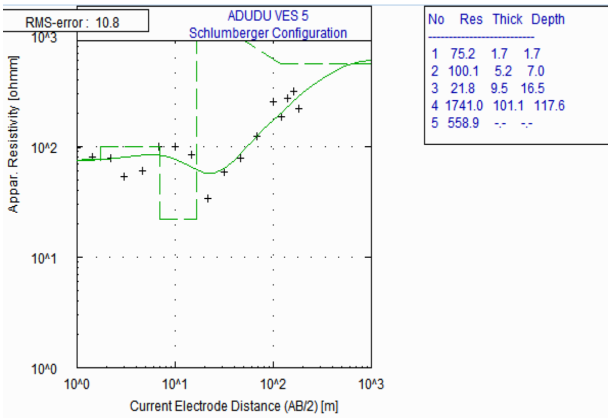

Figure 6 AHKHK-curve type

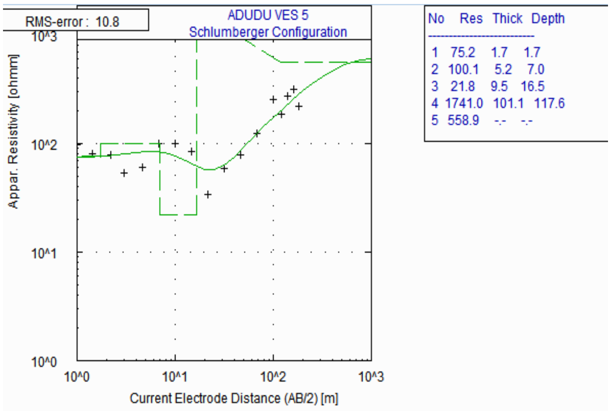

Figure 7 AHKHK-curve type

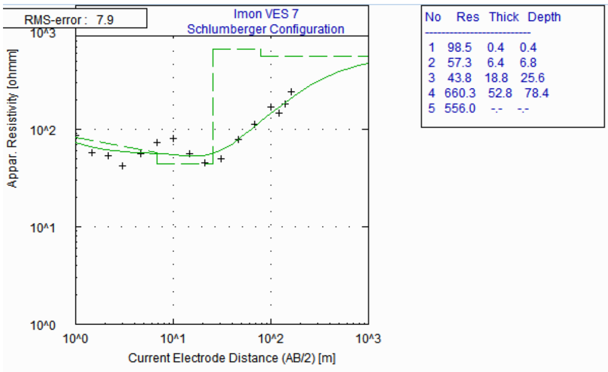

Figure 8 AHKHK-curve type

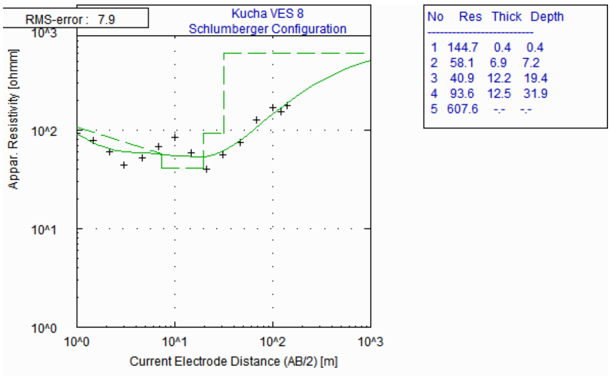

Figure 9 AHKHA-curve type

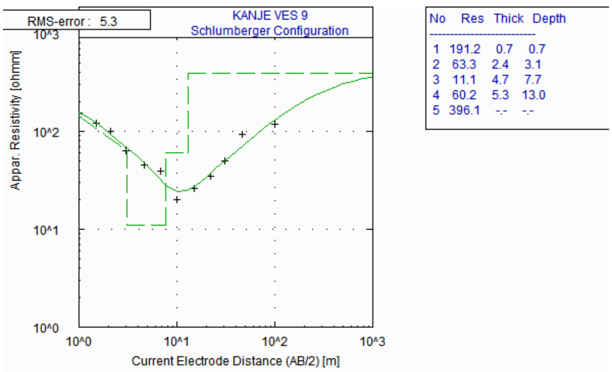

Figure 10 HQHK-curve type

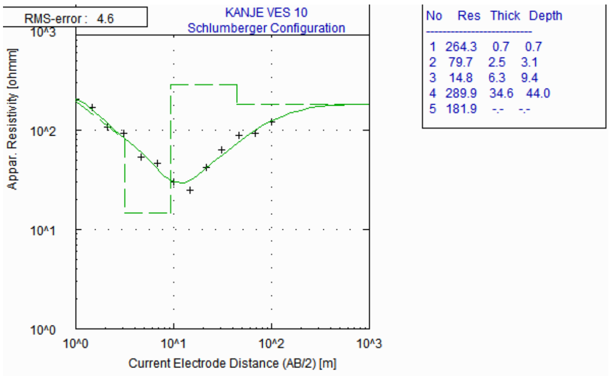

Figure 11 HQHA-curve type

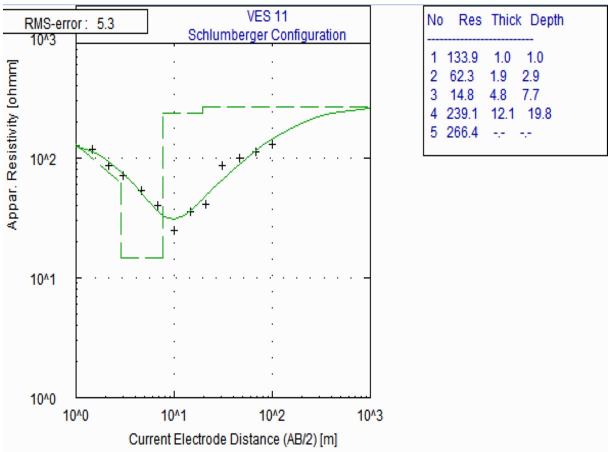

Figure 12 HQHA-curve type

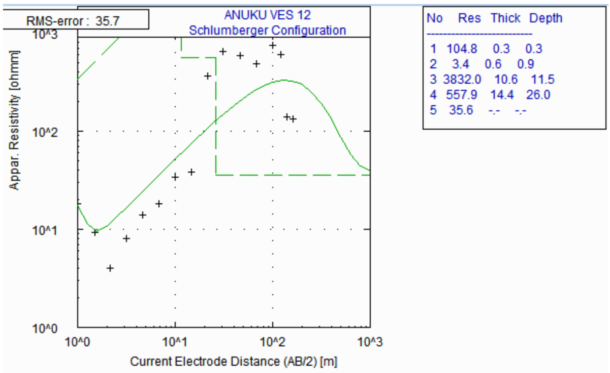

Figure 13 HQHK-curve type

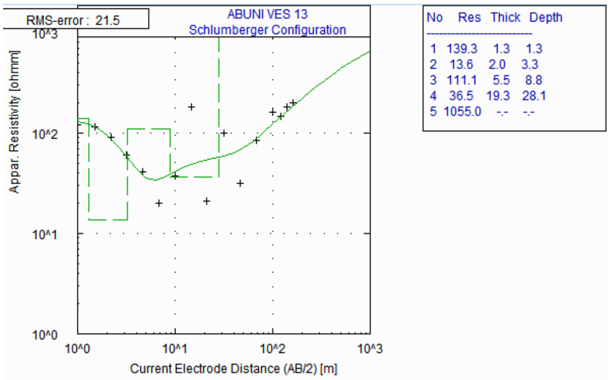

Figure 14 : HQHA-curve type

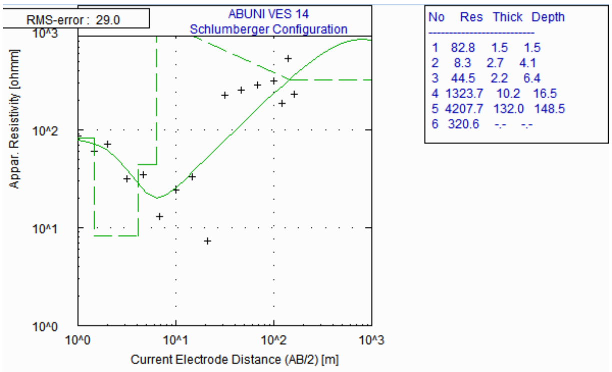

Figure 15 KHHKA-curve type

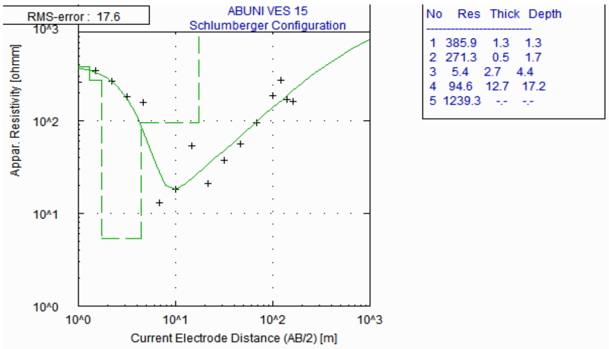

Figure 16 HHKH-curve type

The geoelectrical survey that was carried out had the goal of determining not only the distance to the aquifer but also the breadth of the underlying layers. A total of seventeen (17) VES were carried out, each of which had a potential electrode ranging from three hundred thirty metres to seven hundred and fifty metres and a current electrode ranging from one to one hundred fifty metres. With the use of a piece of software known as WinResist, the data were analysed and interpreted. A hard pan top soil, which is clayey and sandy-lateritic in composition, a weathered layer, a partly weathered or cracked basement, and a fresh basement are the components that make up the geologic sequence that lies under the area that is the subject of the current study. The resistivity value for the topsoil, which can range from 17-828 m up to 2 metres of depth; the resistivity value for lateritic, which can range from 80-1700 m and 1.4 metres to 2.9 metres; the resistivity value for shaley sand, which can range from 46-132 m and 6 metres to 19 metres; the resistivity and thickness value for fractured basement, which can range from 161-457 m and 4.8 metres to 30 metres; and the resist The resistivity of the aquifer in the area that is the focus of the inquiry ranges from 80 to 457 m, with 120 m acting as the value that serves as the average. Some of the regions that have a good chance of discovering groundwater between a depth of fifty and one hundred and twenty metres are Gari VES 1 and 2, Adudu VES 3 and 5, Ngah VES 6, Kucha VES 8, Kanje VES 9 and 10, VES 11, and Abuni VES 13 and 15. These are only a few of the areas.

5. CONCLUSION

Shale that has been baked and compacted, together with basalt and sandstone, as well as bluish-grey to dark-black carbonaceous shales that date back to the Late Albian and Early Cenomanism periods underlie Adudu (Obaje, 2009). The orientation from northeast to southwest is the structural trending of the region. Vertical electrical sounding was utilised to determine seventeen (17) Lateritic with resistivities ranging from 80-1700m and thicknesses ranging from 1.4m to 2.9m, Sandy shale with resistivities ranging from 46-132m and thicknesses ranging from 6m to 19m, Shaly sand (aquiferious) with resistivities ranging from 161-600m and thicknesses ranging from 4.8m to 30m, and Shale (Gari VES 1 and 2, Adudu VES 3 and 5, Ngah VES 6, Kucha VES 8, Kanje VES 9 and 10, VES 11, and Abuni VES 13 and 15 are examples of areas that have a strong possibility of developing groundwater between a depth of 50 and 120 metres. It is recommended as a result that Adudu and the areas around it be able to harvest groundwater at a high level while maintaining a high quality.

REFERENCES

Alile, M. O., Jegede. S. I. and Ehigiato, O. M. (2008), Underground Water Exploration Using Electrical Method in Edo State. Asian of Journal of Earth Science, 1(1):38-42.

Akinbinu VA (2015). Delineation of saline water intrusion to safe-inland groundwater resource. Ocean Coastal Manage. 116: 162-168.

Araffa. S. A. S., Soliman, S. A., El-Khafif, A., Younis, A. and Shazley, T. F. (2019). Environmental Investigation using Geophysical Data at East Sadat City, Egypt. Egyptian Journal of Petroleum, 2:117-125.

Elhang, A. B. and Musa, M. A. (2020). Investigation of Geology and Hydro-geophysical Features Using Electomagnetic and Vertical Sounding Methods for Abu Zabad Area, western Kordofan State, Sudan. Journal of Environmental & Earth Sciences, 2(1):1-6.

Obaje, N.G. (2009): Geology and Mineral Resources of Nigeria. Lecture Notes in Earth Sciences 120, Springer-Verlag Berlin Heidelberg, 57-63.

Offodile, M. E. (2002). Groundwatter Study and development in Nigeria. Mecon geology and Engineering services Limited, Jos, Nigeria, 2nd Edition, 452p.

Offodile, M.E., (1976): The Geology of the Middle Benue Nigeria. Cretaceous Research, Paleontological Institute, University of Uppsala, Special Publication 4, 1-166.