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# Geophysical Approach to Groundwater Resource Appraisal in Afe Babalola University, Ado-Ekiti, Southwestern Nigeria

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***Abstract***

*This study investigates the groundwater potential of Afe Babalola University, Ado-Ekiti, Southwestern Nigeria, using the Vertical Electrical Sounding (VES) technique of the electrical resistivity method with a Schlumberger electrode configuration. Eight VES stations were occupied to delineate the subsurface lithological units and evaluate aquifer potential. The interpreted results indicated the presence of four to five geoelectric layers with the following ranges of resistivity and thickness: topsoil, 52.4–789.4 Ω·m and 0.3–0.8 m thick; sandy-clay/lateritic horizon, 25.9–1,338.6 Ω·m and 1.5–8.0 m thick; weathered layer, 10.7–142.8 Ω·m and 7.3–22.1 m thick; and fresh basement, 172.8–2,862 Ω·m with effectively infinite thickness. Longitudinal conductance values range between 0.05 and 0.75 mhos, indicating moderate to good overburden protective capacity across 70% of the study area. Transverse unit resistance values (1200–3000 Ω·m) reflect variable aquifer potentials, with relatively lower values suggesting zones of enhanced groundwater occurrence. The coefficient of anisotropy (λ), ranging from 1 to 4, delineates subsurface inhomogeneities and structural controls influencing groundwater accumulation. Geo-electric sections and resistivity maps identified the weathered/fractured basement as the primary aquifer unit, with the most prospective groundwater zones located at VES 1 and VES 2, corresponding to areas of high overburden thickness and moderate resistivity. These zones also exhibit good to moderate aquifer protection from surface contaminants. The study validates the reliability of electrical resistivity methods in groundwater appraisal and provides a scientific basis for sustainable groundwater development and management within the university. It is recommended that groundwater abstraction, waste disposal, and subsurface infrastructure be confined to zones with adequate protective capacity to ensure long-term water security.*

***Keywords:*** *Evaluation, ABUAD, VES Sounding, Groundwater, Schlumberger, Ado-Ekiti.*

## 1.0 Introduction

The demand for water resources globally has been growing rapidly, and they play a vital role in the sustainable development of agriculture, society, and the economy [21]. Groundwater resources are critical for sustaining ecosystems and meeting various human water needs. It behaves as a paramount component of the hydrological cycle, which subsequently plays a vital role in sustaining ecosystems, agriculture, industry, and human populations worldwide [31]. Its importance lies in supplying a renewable source of freshwater, with a specialty attributed to the arid and semi-arid regions where surface water may be limited and, in most cases, seasonal. The Earth's surface is comprised of 70% water and 30% land. Of this 70% of water on the earth's surface, 30% of its entirety is represented by groundwater, which shows its extra high importance and need [30]. According to [12], the average amount of water used by a person each day is about 200 liters of water in various ways. The norm for access to these water resources is through surface water, i.e., rivers, streams, oceans, lakes, and ponds. Regrettably, freshwater lakes and rivers are less common than one may initially think. While the distribution of surface water is uneven worldwide and often polluted due to exposure to environmental contaminants, groundwater, by contrast, remains largely protected as overlying subterranean layers continually filter potential pollutants [33]. One very good advantage of using groundwater is not only its purity, but the cost of its development is relatively cheap when compared to accessing and upgrading the surface water assets. Groundwater just doesn't occur in the subsurface randomly; it is enclosed in geological formations, i.e., aquifers. The water flows through these geological formations under the influence of gravity and pressure, which makes it easy to detect, assess, and explore by use of geophysical methods, namely, the electrical resistivity method, seismic refraction and reflection methods, electrical resistivity tomography, and ground penetrating radar method [14]. Using the Schlumberger electrode array and the vertical electrical sounding (VES) method of electrical resistivity, the spatial distribution and depths to the various formations can be investigated [10], [3], [4]. The vertical electrical sounding geophysical method is used mostly in groundwater geological investigations due to the frequent relationships that exist between the electrical qualities, geological formations, and fluid composition, and also due to the austereness and toughness of the equipment used. It is used to measure the electrical resistivities of the groundwater at different depths. The technique has been used to deal with environmental challenges, viz, estimation of geo-hydraulic parameters and mapping aquifers [11], [16]; describing the water-bearing zone, appraising the infiltration rate of the unsaturated zone, and examining groundwater contamination. Scholars like [7] and so many others have employed this method

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to explore groundwater resources in the subsurface. Geophysical studies are of paramount importance in groundwater appraisal and exploration. There have been different journals and reports on groundwater exploration and assessment by the use of different geophysical methods. [25] conducted integrated geophysical and hydrogeological measurements to assess groundwater vulnerability at Odigbo, Southwestern Nigeria. It was concluded that vulnerability assessment is imperative to enable the delineation of areas of high or low aquifer sensitivity in the planning and management of groundwater resources. [18] presented a geophysical study using combined high-resolution electrical resistance tomography and accurate time-domain electromagnetic measurements to study the relationships between saltwater and groundwater via estuarine rivers at two sites along the lower part of the Alexander River in Israel. The objective of the study was to delineate the expected saline water intrusion from estuarine rivers into adjacent aquifers by means of high-resolution and accurate geoelectric/electromagnetic methods. [29] presented field investigations and measurements that revealed the nature and extent of the saltwater intrusion in the coastal aquifer of Wadi Ham, UAE. Using geophysical techniques, a three-dimensional geologic and true earth resistivity modeling for the aquifer was presented. Results of the earth resistivity imaging surveys and chemical analyses of collected water samples were used to obtain an empirical relationship between the inferred earth resistivity and the amount of total dissolved solids. [18], [27] combined electrical resistivity and induced polarization methods to investigate saltwater intrusion into freshwater aquifers in the coastal environments of Lagos Lagoon at the University of Lagos. The result revealed that even under non-pumping conditions, the study area suffered from acute saline water intrusion and could be aggravated if there is groundwater abstraction. [26] carried out VES across Adagbakuja Newtown in the southern part of Ondo state using maximum current electrode separation (AB/2) of 130-225m. The result revealed four geoelectric layers, namely: topsoil (0.4-199 ohm-m), mud and peat (0.4-102 ohm-m), clayey silts/fine sand (0.4-76 ohm-m), and brackish/saline water and sand units (2-1528 ohm-m). Brackish or saline water intrusion was delineated within the silt/fine sand formation. [6] successfully used the DC resistivity method to map perched water tables containing saline water and freshwater lenses in Southern Australia. [1] investigated saline water intrusion into freshwater aquifers using an integrated geophysical survey involving electrical resistivity and induced polarization methods at the Oniru area, Lekki, Lagos. Results showed the effectiveness and usefulness of electrical resistivity and induced polarization methods in mapping saline water intrusion in coastal areas. [23] used borehole logs to study saline water intrusion in Lagos Municipality; their result revealed that the hydrogeologic importance of the Coastal Plain Sand aquifer unit in Lagos is under severe threat of continued seawater intrusion on its southern flank. [2] used VES methods to locate aquifers affected by saltwater intrusion in Nigeria. This is based on the principle that relatively low resistivity values indicate increasing salinity with depth. This study aims to evaluate and provide adequate hydrogeological information about the subsurface layers and their geoelectric parameters for the assessment of the groundwater potential in Afe Babalola University, Ado-Ekiti.

### 1.1 Description of the study area

The study area, Afe Babalola University, Ado-Ekiti, is situated along Ijan Road, opposite the Federal Polytechnic, in the capital of Ekiti State, Ado-Ekiti. The university is situated between latitudes 7°36'32" N and 7°036'55" N and longitudes 5°18'05" E and 5°18'45" E (Figure 1).


Figure 1: Aerial photograph of the study location [42]

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The study area (ABUAD) is located within Ado Ekiti, southwestern Nigeria. It has a relatively low relief with isolated hills that are dome-shaped. The climate is characterized by a tropical type influenced by monsoon winds during the rainy season, with maximum rainfall in October, and a dry season. Annual temperature ranges between 28 to 30°C with a mean annual rainfall of 1500 mm.

### 1.2 Geology, climate, and hydrogeology of the study area

The study area lies within the Basement Complex terrain of southwestern Nigeria. The dominant lithological units comprise crystalline basement rocks, including coarse-grained charnockite, granite, migmatite gneiss, and banded gneiss, with localized superficial deposits of clay and quartzite [34] (Figure 2). The occurrence of fine-grained charnockite alongside porphyritic biotite-hornblende granite suggests a contemporaneous origin. Structurally, the area exhibits various geomorphic and tectonic features such as inselbergs, hills, valleys, folds, and joints, which significantly influence the distribution of rock units and the overall landscape morphology [35]. Hydrogeologically, groundwater occurs within the weathered overburden and the fractured zones of the underlying crystalline basement. Due to the low primary porosity and permeability of the basement rocks, groundwater storage and transmission are controlled mainly by secondary features such as fractures, joints, and weathered zones [36]. The area is drained primarily by the River Elemi, which flows in a southwest–northeast direction. Climatically, the study area falls within the tropical rainforest belt and experiences two distinct seasons: the wet and dry seasons. The mean annual rainfall is approximately 1300 mm, distributed over about 100 wet days per year, while the mean annual temperature ranges between 18°C and 34°C [37].

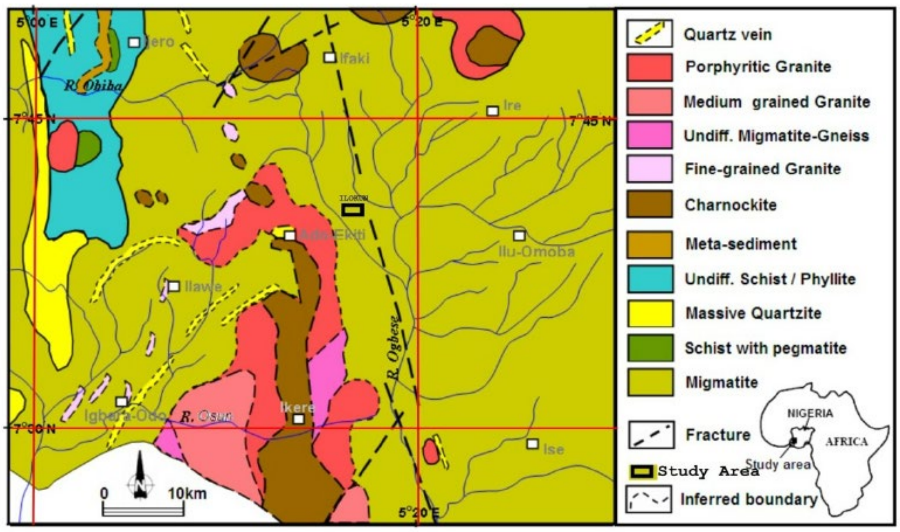

Figure 2: Geological map of Ado-Ekiti [37].

## 2.0 Methodology

### 2.1 Materials and Instruments

The equipment and materials employed for the electrical resistivity survey are as follows:

Hammers: Utilized to drive the electrodes firmly into the ground to ensure effective electrical contact with the subsurface.

Stainless Steel Electrodes: These were installed at uniform spacing to facilitate the detection of lateral variations in apparent resistivity that reflect subsurface lithological heterogeneity or localized anomalies.

Calibrated Measuring Tape: Used to measure electrode spacing along the survey line accurately.

Resistivity Meter: This device, consisting of a current transmitter and a voltage-measuring unit, was used to inject current into the ground and measure the resulting potential differences.

Connecting Cables: Employed to transmit electrical current between the resistivity meter and the electrodes.

Global Positioning System (GPS) Receiver and Compass: Used to record the geographic coordinates and azimuth of each Vertical Electrical Sounding (VES) station.

Power Source: Provided the direct current (DC) required for potential difference measurement between the current and potential electrodes implanted in the ground.

### 2.2 Electrical resistivity method

The electrical resistivity method was employed at Afe Babalola University, Ado-Ekiti, using the Schlumberger electrode array configuration across eight vertical electrical sounding (VES) stations. Preliminary activities involved reviewing relevant literature, identifying earlier related studies, and collecting the geographic coordinates required for generating the base map of the study area. The electrical resistivity approach was applied to delineate subsurface zones favorable for groundwater resource exploration. Data acquisition was carried out using a resistivity meter, with a maximum current electrode spacing (AB/2 = 100 m) during measurements. The apparent resistivity values ($\rho_a$) obtained at each station were plotted against half-current electrode spacing (AB/2) on a bi-logarithmic graph, and partial curve matching was performed to interpret the resulting curves.

The parameters derived from the curve matching—namely, layer resistivity and thickness—were subsequently used as initial model inputs for iterative forward modeling using WINRESIST software. The interpreted VES curves revealed the thicknesses and resistivities of the subsurface layers, which were classified based on resistivity contrast into H, K, Q, and A curve types, following the classification of [15], [28]. The resulting resistivity models effectively characterize the vertical variations in the subsurface lithological units at every sampling point within the study area.

## 3.0 Results and Discussion

### 3.1 VES results

Eight VES points were occupied using the electrical geophysical method (Schlumberger array) and different VES curves (Figure 3a, b), namely KA, QA, HKA, and H, were obtained at the distinguished points showing variable lithological descriptions, mainly: topsoil, sandy-clay/lateritic layer, the weathered layer, partially weathered/fractured basement, and fresh basement (Table 1). The curves with their percentages are shown in Table 2, and their frequency distribution is shown in Figure 4. It is often possible to make qualitative hydrogeologic deductions from curve types [32].

Table 1: Summary of geoelectrical parameters obtained from Interpreted VES Data

| VES No | Layer No | Resistivity No (Ohm-m) $\rho_1/\rho_2/\ldots\rho_n$ | Curve Types | Thickness (m) $h_1/h_2/\ldots h_n$ | Depth (m) $d_1/d_2/\ldots d_n$ | Lithological Units |
|---|---|---|---|---|---|---|
| 1 | 4 | 52.4 | | 0.6 | 0.6 | Topsoil |
| | | 192.4 | | 5.3 | 5.9 | Sandy clay |
| | | 51.8 | KA | 12.3 | 18.1 | Weathered layer |
| | | 1814.3 | | | | Fresh basement |
| 2 | 5 | 206.1 | | 0.6 | 0.6 | Topsoil |
| | | 25.9 | | 1.5 | 2.1 | Clayey soil |
| | | 439.9 | | 4.6 | 6.7 | Sandy soil |
| | | 33.8 | HKA | 22.1 | 28.8 | Weathered layer |
| | | 1093.2 | | | | Fresh basement |
| 3 | 3 | 789.4 | | 0.5 | 0.5 | Topsoil |
| | | 142.8 | H | 8.0 | 8.5 | Weathered layer |
| | | 172.8 | | | | Fresh basement |
| 4 | 4 | 301.9 | | 0.6 | 0.6 | Topsoil |
| | | 102.7 | | 5.0 | 5.6 | Sandy clay |
| | | 40.7 | QA | 14.1 | 19.7 | Weathered layer |
| | | 2862.0 | | | | Fresh basement |
| 5 | 4 | 203.6 | | 0.3 | 0.3 | Topsoil |
| | | 1821.9 | | 1.1 | 1.4 | Lateritic sand |
| | | 13.3 | KA | 7.3 | 8.7 | Weathered layer |
| | | 1050.8 | | | | Fresh basement |
| 6 | 4 | 344.3 | | 0.4 | 0.4 | Topsoil |
| | | 1338.6 | | 0.9 | 1.3 | Lateritic sand |
| | | 17.5 | KA | 7.8 | 9.1 | Weathered layer |
| | | 1333.0 | | | | Fresh basement |
| 7 | 4 | 360.0 | | 0.8 | 0.6 | Topsoil |
| | | 323.6 | | 1.6 | 1.1 | Lateritic sand |
| | | 36.6 | QA | 12.7 | 7.1 | Weathered layer |
| | | 2699.7 | | | | Fresh basement |
| 8 | 4 | 551.3 | | 0.6 | 0.6 | Topsoil |
| | | 807.2 | KA | 1.1 | 1.7 | Lateritic sand |
| | | 10.7 | | 8.9 | 8.9 | Weathered layer |
| | | 2580.5 | | | | Fresh basement |

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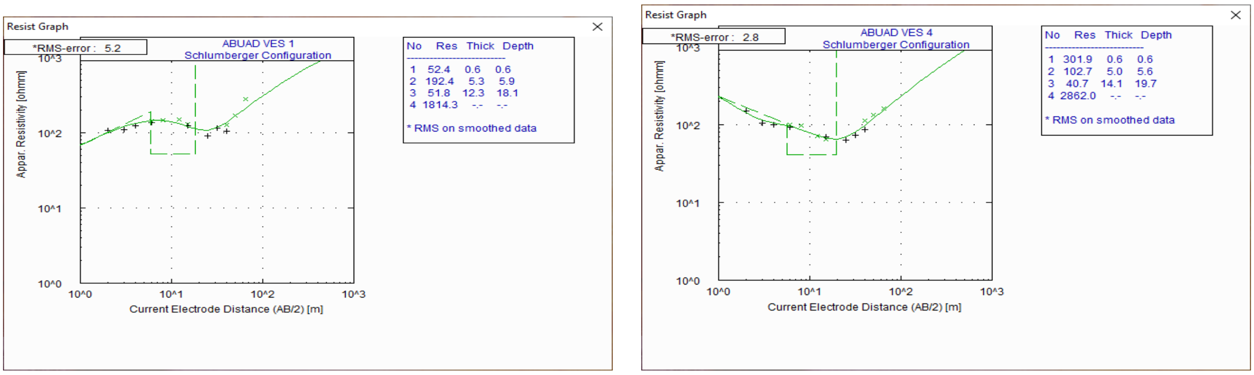
Table 2: Curve Types Percentages

| Curve Type | Frequency | Percentage | Geo-Electric Characteristics |
|---|---|---|---|
| KA | 4 | 60 | ϱ1<ϱ2>ϱ3<ϱ4 |
| HKA | 1 | 10 | ϱ1>ϱ2<ϱ3>ϱ4<ϱ5 |
| H | 1 | 10 | ϱ1>ϱ2<ϱ3 |
| QA | 2 | 20 | ϱ1>ϱ2>ϱ3<ϱ4 |




Figures 3a, b: Typical VES curves (VES 1 and 4) from the study area

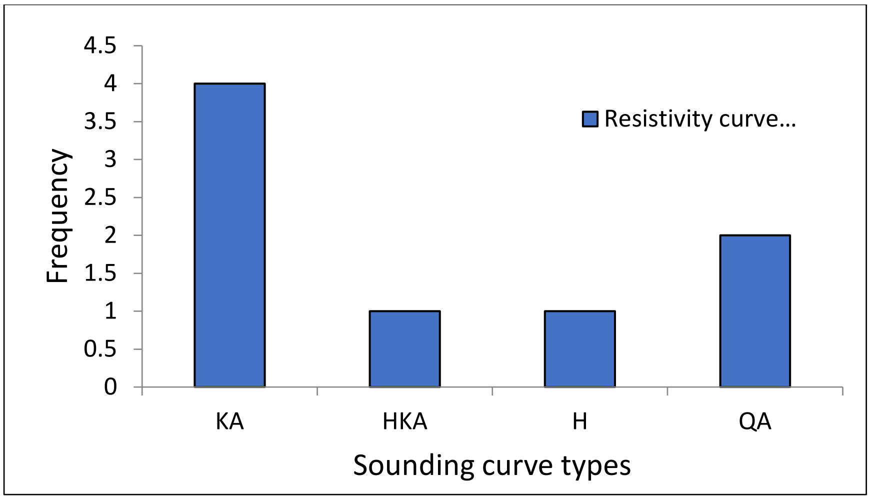



Figure 4: Bar chart showing the frequency and distribution of curve types

### 3.2 Dar-Zarrouk's Parameters

Dar–Zarrouk parameters are key hydrogeophysical indices used to characterize subsurface hydrogeological conditions and evaluate groundwater potential and aquifer protective capacity [38]. These parameters were computed based on layer resistivity and their corresponding thicknesses. The concept, originally introduced by [19], defines two primary parameters: the transverse resistance (T) and the longitudinal conductance (S). Transverse resistance (T) represents the product of resistivity and layer thickness, reflecting the resistance perpendicular to the geological strata, while longitudinal conductance (S) represents the ratio of thickness to resistivity, indicating conductance parallel to the strata. A third derived parameter, the coefficient of anisotropy (λ), expresses the degree of electrical anisotropy in stratified formations, which are typically more conductive along the bedding plane than across it [9], [20]. These parameters are fundamental in interpreting aquifer characteristics when resistivity and thickness data are shown in Table 3.

Table 3: Dar-Zarrouk Parameters, Weathered Layer Thickness, and Resistivity and Overburden Layer Thickness

| VES No. | Overburden Thickness (m) | Weathered Layer Thickness (m) | Weathered Layer Resistivity (Ohm-m) | Longitudinal Conductance (S) $\sum h_i/\rho_i$ | Transverse Resistance (T) $\sum \rho_i/h_i$ | Coefficient Of Anisotropy (λ) $(Pt/Pl)^{1/2}$ |
|---|---|---|---|---|---|---|
| 1 | 18.2 | 12.3 | 51.8 | 0.39 | 1688.3 | 1.41 |

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| VES No. | Overburden Thickness (m) | Weathered Layer Thickness (m) | Weathered Layer Resistivity (Ohm-m) | Longitudinal Conductance (S) $\sum h_i/\rho_i$ | Transverse Resistance (T) $\sum \rho_i/h_i$ | Coefficient Of Anisotropy (λ) $(Pt/Pl)^{1/2}$ |
|---|---|---|---|---|---|---|
| 2 | 28.8 | 22.1 | 33.8 | 0.73 | 2933.03 | 1.61 |
| 3 | 8.5 | 8.0 | 142.8 | 0.06 | 1537.1 | 1.13 |
| 4 | 19.7 | 14.1 | 40.7 | 0.40 | 1268.51 | 1.14 |
| 5 | 8.7 | 7.3 | 13.3 | 0.55 | 2162.26 | 3.96 |
| 6 | 9.1 | 7.8 | 17.5 | 0.45 | 1478.96 | 2.84 |
| 7 | 15.1 | 12.7 | 36.6 | 0.35 | 1270.58 | 1.40 |
| 8 | 8.9 | 7.1 | 10.7 | 0.67 | 1294.67 | 3.35 |

### 3.2.1 Longitudinal unit conductance

Longitudinal conductance (S) is a geoelectric parameter that quantifies the cumulative ratio of the thickness of each subsurface layer to its corresponding resistivity at a Vertical Electrical Sounding (VES) station. It indicates the protective capacity of the overburden and reflects spatial variations in subsurface conductivity across the study area. The longitudinal conductance was computed for all VES locations using the relation:

$$S = \sum_{i-1}^{n} \frac{h_i}{\rho_i} \qquad 1$$

where h and ϱ represent the thickness and resistivity of the *i*th layer, respectively. The computed values (Table 3) were used to generate a longitudinal conductance chart (Figure 5), which shows conductance values ranging from 0.06 to 0.73 mhos within the study area. According to [13], the protective capacity of an overburden is directly proportional to its longitudinal conductance, as higher conductance values generally indicate clay-rich layers with low resistivity and reduced permeability, thereby providing better protection to the underlying aquifer. Conversely, low conductance values signify sandy or coarse-grained overburden materials with limited filtration potential [22]. Based on standard classifications, zones with longitudinal conductance values greater than 0.7 mhos are considered to have good protective capacity [5], values between 0.2 and 0.69 mhos represent moderate protection, 0.1–0.19 mhos indicate weak protection, and values below 0.1 mhos denote poor overburden protective capacity. Figure 5 reveals that VES 1, 2, 4, 5, 6, and 7 exhibit good to moderate protective capacity, while VES 3 (Near Bogoro Research Center) displays weak to poor protection. Overall, approximately 87% of the study area falls within the moderate to good protective capacity zones, whereas about 13% shows weak to poor overburden protection.

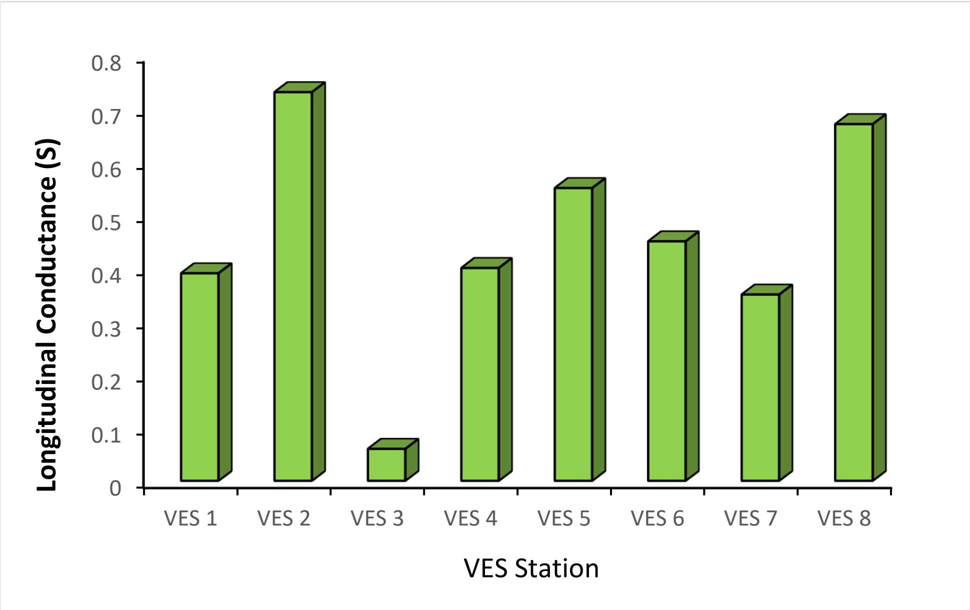


Figure 5: Longitudinal unit conductance chart of the study area

### 3.2.2 Transverse unit resistance

Transverse unit resistance (T) represents the cumulative measure of the product of the thickness and resistivity of all geoelectric layers at each vertical electrical sounding (VES) location. Mathematically, it is expressed as:

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$$\sum_{i=1}^{n} \rho_i / h_i \qquad 2$$

where $\rho_i$ and $h_i$ denote the resistivity and thickness of the *i-th* geoelectric layer, respectively. Within the study area, transverse unit resistance values range from approximately 1200 to 3000 $\Omega$·m and were used to generate the transverse unit resistance chart presented in Figure 6. The spatial distribution of transverse unit resistance provides valuable insights into the hydrogeological framework and can be applied to delineate groundwater potential zones [8]. Generally, areas characterized by low transverse unit resistance (TUR $\leq$ 10 $\Omega$·m) correspond to zones of enhanced groundwater potential [17], often associated with moderate (LUC 0.01-0.1) to high longitudinal unit conductance (LUC $<$ 0.1). In this study, all the points sampled exhibit relatively high transverse unit resistance (TUR $>$ 100 Ohm-m), indicating moderate overburden thickness and low bedrock resistivity, which may suggest limited groundwater prospects.

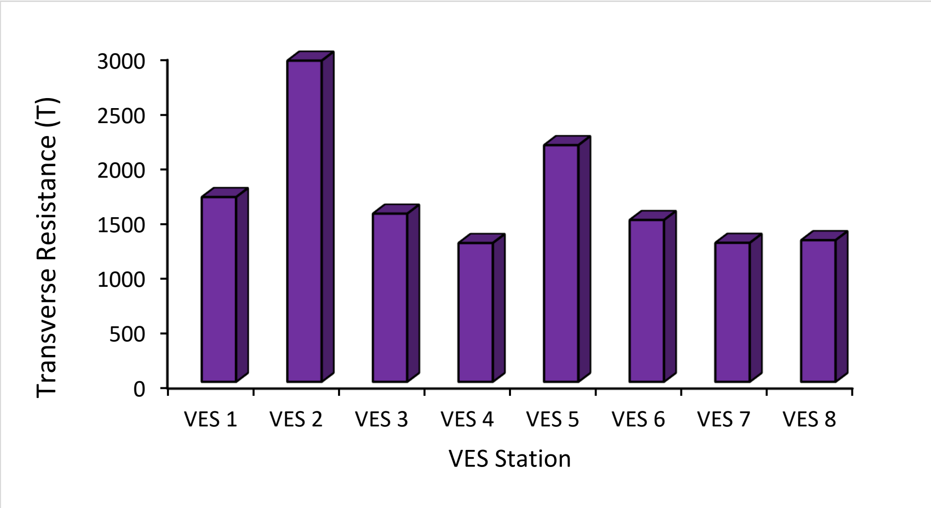


Figure 6: Transverse unit resistance chart of the study area

**3.2.3 Coefficient of anisotropy**

The coefficient of anisotropy (λ) reflects the degree of subsurface inhomogeneity and has been widely employed to delineate lithological boundaries in crystalline basement terrains [24]. The computed values (Table 3) were used to generate the coefficient of anisotropy chart (Figure 7). These values range between 1 and 4 across the study area. Relatively high values (3–4) were recorded at VES 5, 6, and 8 (near Animal Farm House, IPP building, and Sport Complex), indicating a higher degree of subsurface anisotropy typically associated with shallow basement ridges and near-surface heterogeneity within the topsoil and weathered layers. Such conditions are generally unfavourable for groundwater accumulation and development. In contrast, VES 1, 2, 3, 4, and 7 exhibit lower λ values (1–2), particularly within basement depressions, suggesting more homogeneous and potentially productive zones. These variations in anisotropy are primarily attributed to structural features such as fractures, joints, and faults that control groundwater occurrence. A shallow basement may limit groundwater potential, while thick overburden suggests moderate protection against surface contamination [39].

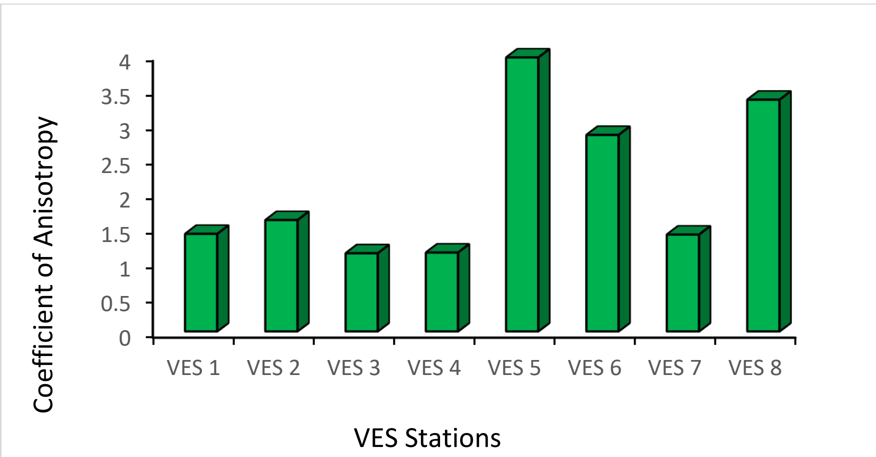


Figure 7: Coefficient of anisotropy chart of the study area

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### 3.3 Overburden thickness and weathered layer resistivity chart

The thickness of the overburden obtained from the interpretation results was summarized as shown in Table 3. The values for the overburden were plotted against the VES stations as shown in Figure 8. The chart displayed the variation in overburden thickness across the study area. Furthermore, high values such as those recorded in VES 1, 2, 4, and 7 suggest possible areas for high groundwater potential, while overburden thickness lower than 10 m, as shown in VES 3, 5, 6, and 8, suggest low groundwater potential.

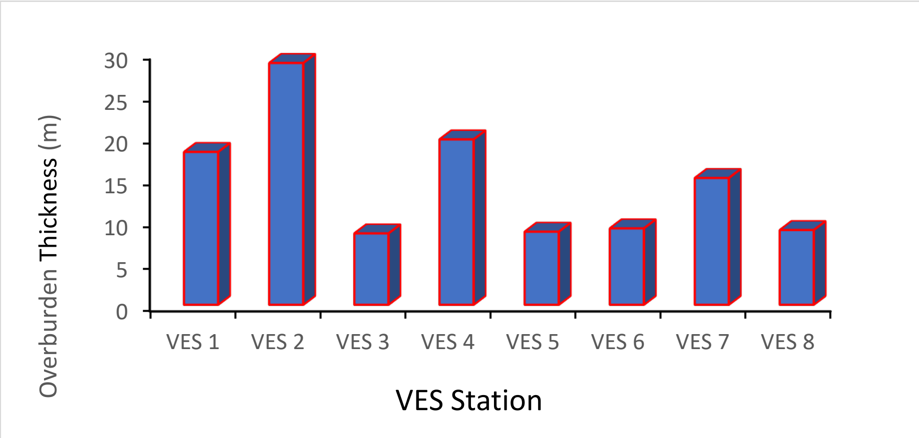


Figure 8: Overburden Thickness Chart

The weathered layer thickness chart (Figure 9) illustrates how the thickness of the layers varies across all the VES stations in the study area. The pattern observed closely mirrors that of the overburden thickness distribution. VES 1, 2, 4, and 7 exhibit comparatively thicker weathered layers, suggesting zones of enhanced weathering or deeper saprolite development. These thicker profiles may indicate areas with greater groundwater storage potential or reflect underlying lithological weaknesses that promote deeper weathering [40]. In contrast, the remaining VES points show relatively thin weathered layers, implying more resistant bedrock or limited weathering processes. Overall, the chart highlights the spatial variability of the weathered layer and helps in identifying zones with more favourable hydrogeological characteristics.

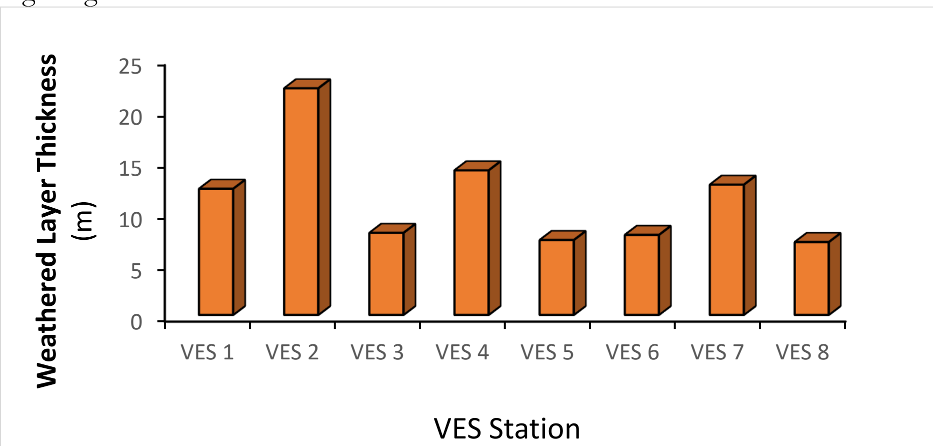


Figure 9: Weathered layer resistivity chart.

the resistivity of the weathered layer ranges from 5 to 145Ω-m with the areas where there is high saturation and high possibility of obtaining groundwater in the lower resistivity areas, which are at VES stations 4,5,6,7,8, and the places of high resistivity, which give off low saturation and possibility of groundwater in VES locations 1,2,3. This alone cannot be considered a yardstick for groundwater exploration as weathered layer thickness and lithology, amongst others, must be considered.

### 3.4 Geo-electric sections

A geo-electric section is a graphical representation of the subsurface electrical resistivity distribution, and it is used in identifying potential aquifers, their extent, and groundwater flow. The subsurface sequence comprises the topsoil with limited hydrologic appeal, a sandy-clay layer, a weathered/fractured basement, and a fresh basement. The weathered/fractured layer constituted the sole aquifer unit in the area. The two geoelectric sections were produced with Surfer 14 software. The first model (Figure 10) has varying topsoil resistivity of 52.4 – 789.4 ohm-m and thickness of 0.5 to 0.6m. The second lithologic layer corresponds to clayey sand with layer resistivities of

25.9 to 192.4 ohm-m and a thickness of 2.1 to 8.5m. The third layer is the weathered layer, having resistivities of 51.8 to 439.9 ohm-m and a thickness of 6.7 to 28.8m. There is the presence of a fractured/fresh basement with resistivity of about 172.8 to 1814.3 ohm-m and infinite thickness. The structural variation showed thickening of the overburden under the VES points 1 and 3, with the depth to bedrock being deep in the VES 2 location (with potential for high storage but requires deeper drilling to intersect the optimum aquifer horizon). A deeper weathered layer suggests more storage and a thicker shallow aquifer, which may be a good drilling target for shallow to intermediate-depth borehole [41]. However, thicker overburden can mean a deeper water table and possibly greater drawdown during pumping. VES 2 with a relatively thick weathered layer and low resistivity, which suggests coarse-weathered material is best for groundwater development.

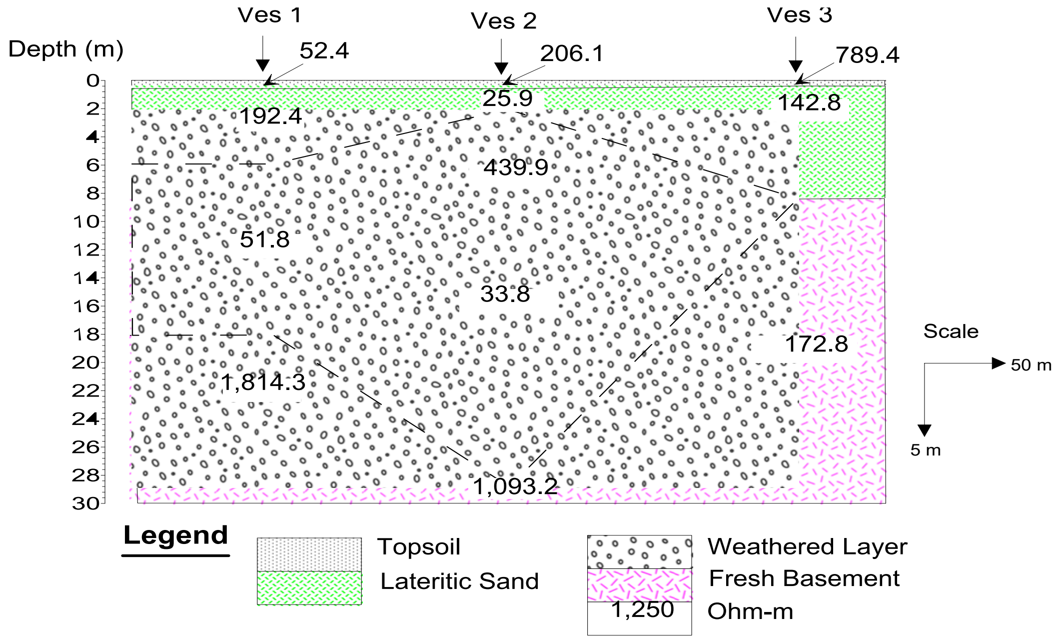

Figure 10: Geoelectric Section Cutting Across VES 1, 2, 3

In Figure 11, the topsoil resistivity ranges from 203.6 to 551.3Ω-m with a thickness of about 0.3 to 0.8 m. The second layer has a resistivity of 323.6 to 1821.9Ω-m and a thickness range of 0.9 to 1.6m, which corresponds to clay materials. There is the presence of a weathered layer with resistivity of 13.3 to 36.6Ω-m and thickness of 7.3 to 12.7m. The fresh basement layer, which is the fourth layer is ranges in resistivity from 1050.8 to 2699.7Ω-m and has infinite thickness. The weathered layer is relatively thick under VES 7, and the area is expected to have a high volume of extractable portable groundwater.

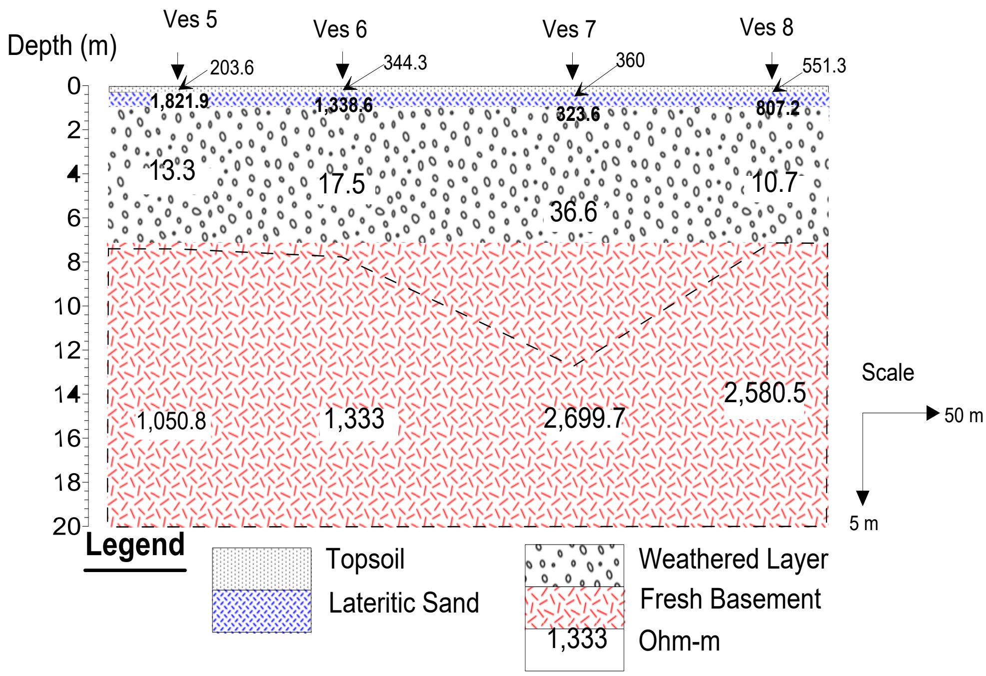

Figure 11: Geoelectric Section Cutting Across VES 5, 6, 7, and 8

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## 4.0 Conclusion

The integrated geophysical assessment of groundwater potential at Afe Babalola University, Ado-Ekiti, Southwestern Nigeria, revealed a subsurface composed of topsoil, sandy-clay/lateritic layer, weathered layer, partially weathered/fractured basement, and fresh basement. Overburden thickness and weathered-layer resistivity maps indicated that areas with greater overburden, particularly at VES 1, 2, and 7, exhibit high groundwater potential. Geoelectric sections showed that these locations also have the deepest basement and structural features favourable for groundwater accumulation. Additionally, these locations demonstrate good to moderate aquifer protective capacity, with sufficiently thick clayey overburden to shield groundwater from surface contamination. It is recommended that infrastructure such as underground petroleum storage tanks, sewage systems, and waste disposal sites be restricted to these zones (good to moderate groundwater protective capacity) to minimize the risk of groundwater contamination.

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