INFLUENCE OF BEDROCK ON GROUNDWATER FLOW AND QUALITY IN PARTS OF SOUTHWESTERN NIGERIA

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ABSTRACT

Limitations associated with conventional method applied by researchers on findings from groundwater investigation via analogue method clearly revealed lack of accurate geographical position of wells. Despite the versatility of a Geographical Information System (GIS), the extent to which GIS models marry varied bedrock composition with groundwater quality is yet to be subject of research. This study aims at providing much meaningful spatial information on near-surface groundwater dynamics, and quality as affected by bedrock nature via hydrological modelling. The study area is underlain by gneiss and schist of the Gneiss Complex in Southwestern Nigeria. 100 raw water samples were collected from wells tapping laterised overburden aquifer, for measurement of temperature, hydrogen ion concentration (pH), salinity, Total Dissolved Solids and specific electrical conductance using a water proof, one electrode multimeter. Depth to water table was measured and referenced to a common datum. The geological map overlaid onto the physical properties layers help to spatially delineate areas of groundwater flow and chemical variabilities. Simple inter-relationship exists between the hydrological landscape position and geology of the area. High hydrostatic distribution is found to be peculiar within the area underlain by gneiss, unlike the area underlain by schist. Spatial variability maps depicting TDS and specific electrical conductance display nearly similar pattern. The groundwater quality ranges from excellent to good considering World Health Organisation standards.

Key words: GIS, water, bedrock, quality and composition.

INTRODUCTION

Groundwater is an important part of the hydrologic cycle, and its evaluation for human consumption has been a subject of many researches (Nelson, 2002). As a landscape element, chemically active mobile and an excellent solvent, studies are yet to satisfactorily reveal aquifer material composition as the denominator for groundwater quality in areas where there is diverse bedrock types. Abimbola *et al.* (2002) employed reported the role of Precambrian crystalline bedrocks on quality of groundwater in Ibadan Metropolis. This study only confirmed geogenic factor influencing groundwater quality in the Northern part of Ibadan Metropolis.

Okeke *et al.* (2011) understudied how the geology of northern Ishan district Edo State, Southern Nigeria controlled groundwater quality. The study area is unique as it is underlain by rocks of sedimentary origin. The depth to groundwater occurrence in the area varies, limiting results of findings to wells tapping an aquifer of a particular aquifer type.

Researches carried out on the assessment of groundwater using the Geographic Information System (GIS) method brought to light, the limitations associated with conventional method applied by researchers earlier cited. Findings from such a crucial investigation via analogue method clearly revealed lack of accurate geographical position of wells. In addition, less perfect picture of spatial variation in physical properties governing quality of groundwater body has always been the result.

These limitations were taken care of in the wok of Igboekwe and Akankpo (2011) in which case, a GIS was employed to assess the deterioration of groundwater quality in the Southern Nigerian city of Uyo. This helped in revealing the effect of topographic slope, groundwater table variation, soil porosity and land use activities on the distribution of polluted groundwater. Nwaokala *et al.* (2012) evaluated the spatial variation of groundwater quality parameters in Port Harcourt metropolis of Nigeria using GIS method. The spatial variability maps generated for some groundwater parameters lead to a recommendation that periodical monitoring and assessment groundwater quality is important.

Nwachukwu *et al.* (2013) integrated110 vertical electric soundings (VES) with 50 down-hole logs and 44 pumping test data, from the Imo River basin, Southern Nigeria using a GIS. This study revealed significant correlation of water quality with geology in the basin. Furthermore, over 60% failure of public wells was as a result of proliferation of shallow substandard wells, poor distribution of public water wells, poor planning, and poor management.

So far, the scale and the scope to which a GIS could embrace variation in bedrock composition in groundwater quality modelling are still underexploited. Realising the due advantage of this computer technology advancement to develop solutions to groundwater related problems, it is considered in this study to present more reliable information on flow system and quality of groundwater over an area underlain by Precambrian rocks of varying mineralogical composition. Hydrogeological literature of the Basement Complex of Southwestern Nigeria has insufficient evidences to define cogent ground water flow system within the overburden aquifer. This study is expected to further popularise a computer-based analysis for groundwater quality, taking cognisance of bedrock compositional features. In this study, it is also desired to overlay maps for a two-dimensional model in order to clearly define general flow and the dominant factor dictating the quality of the natural groundwater.

METHOD OF STUDY

Desk and Field Studies

From the desk study, theoretical and methodological contributions to a GIS application to groundwater studies were searched for. These were followed by critical points of knowledge including substantive findings, which suits the current study within the body of literature. A geological map defining bedrock types and drainage pattern for surface water flow were prepared from a GIS source. In the field, Global Positioning System (GPS) was used to obtain records of geographical positions of wells and ground elevation at every point of well occurrence. Groundwater level at each well location was also established. Samples of raw water from 100 earmarked open wells were taken for the accurate measurement of temperature, hydrogen ion concentration (pH), salinity, Total Dissolved Solids (TDS) and specific electrical conductance using a water proof, one electrode multimeter, and an auto-ranging high accuracy conductivity cell.

Arc GIS software was used to generate the groundwater contour and spatial variability maps for groundwater physical parameters through kriging. The depth to water level were also measured at each well location, and referenced to a common datum (sea level). The data were digitally contoured to express the true configuration of groundwater table. All layers were overlaid using GIS-based model to enable understanding of the effects of hydrological changes and aquifer behavior. This further provides spatial prediction of bedrocks and variation in water quality parameters (Temperature, Hydrogen ion concentration (pH), Salinity, Total dissolved solids and Specific electrical conductance).

Bedrock Features and Profile Development

Bedrocks in the study area are typified with high degree of variability in nature and composition. These characteristics are peculiar to many Nigerian Basement Complex rocks. The landscapes had experienced protracted weathering and erosional history, through the action of surface water and other degradation agents. In this area, detailed hydrological units that classify the landscape could be based on soil/regolith and bedrock characteristics (Offodile, 2002). Gneisses and schist are the major bedrocks over which laterised profiles of soil have developed. Schist and gneiss are both metamorphic rocks, which imply that they have similar geological origin. However, they slightly differ in mineralogical composition, certain minerals present in gneiss are also present in schist, but gneiss contains more representative minerals than schist. On this overburden is the surface water flowing, and it simultaneously stores and transmits groundwater. Figure 1 is a map of the study area, showing the major bedrocks, surface water flow pattern and studied well locations.

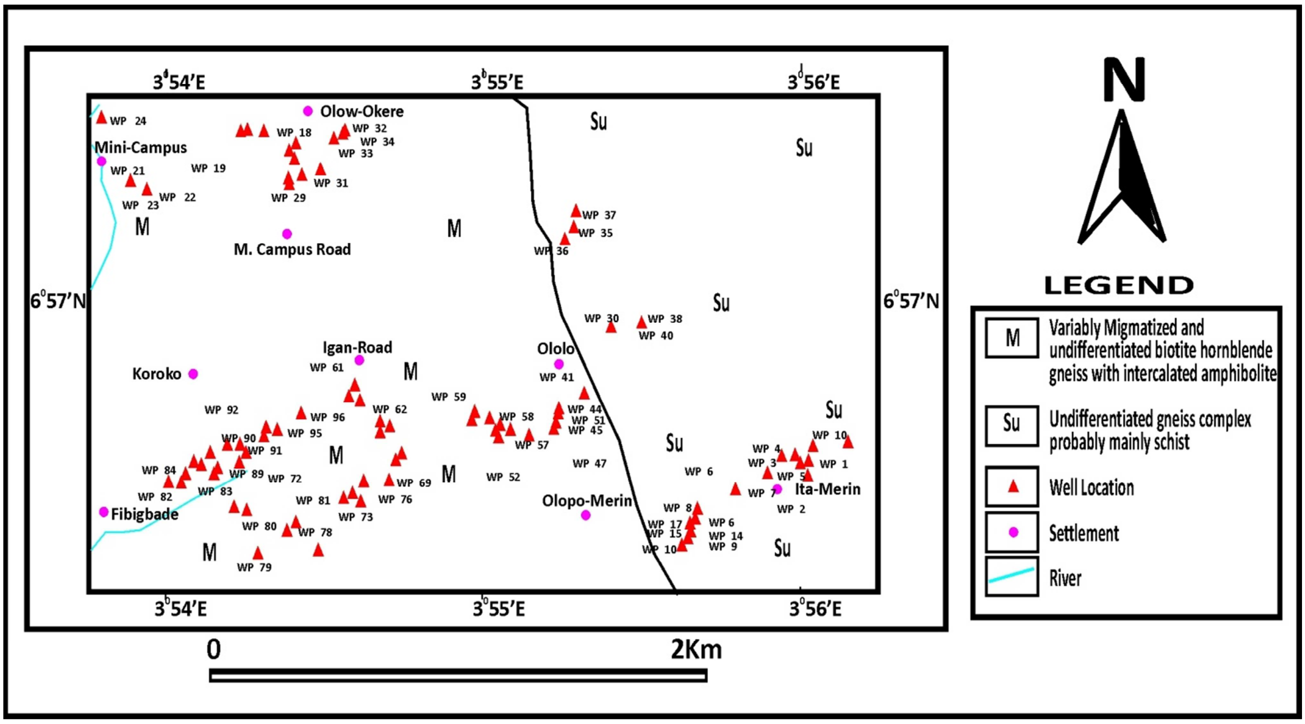
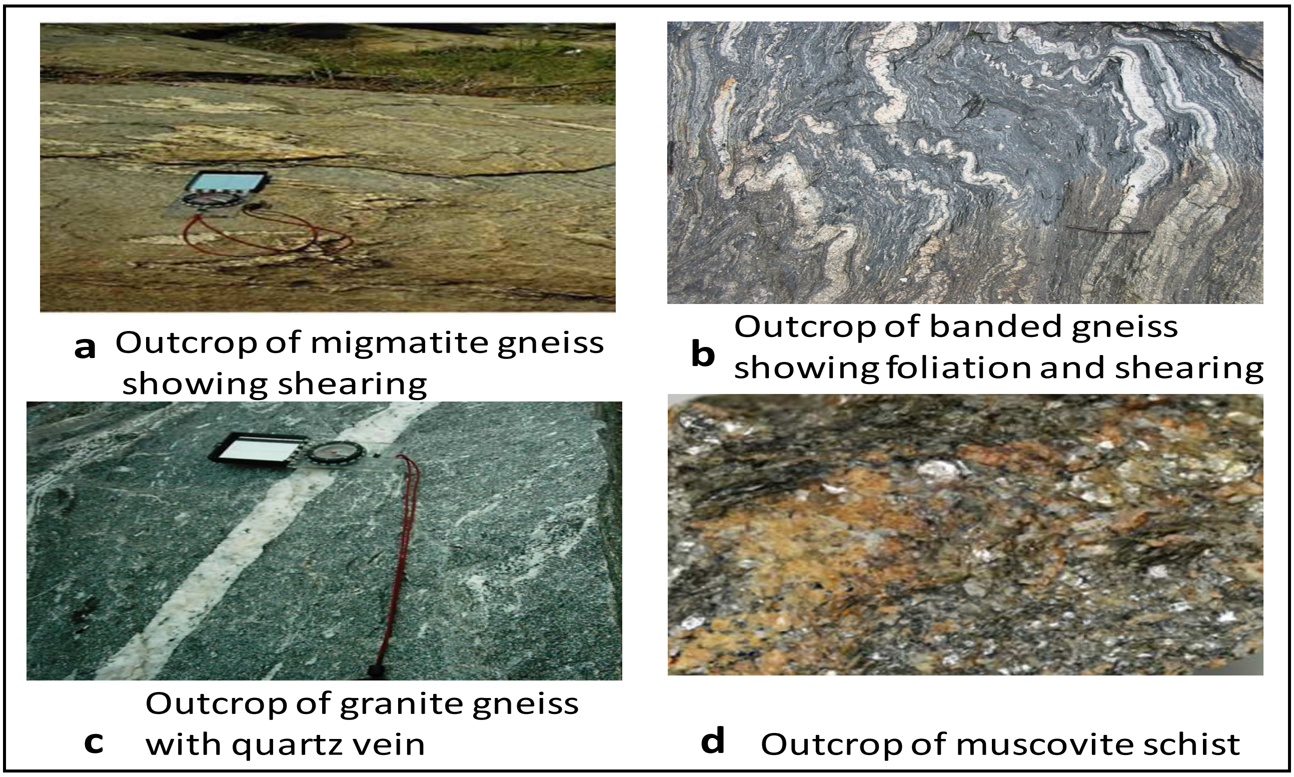


Fig 1: Map of the study area showing the bedrocks and well locations

Field observation revealed that two major rock types dominate the area; the undifferentiated gneisses and schist (Fig. 2). The schist carries few quantities of micas and other platy minerals. The gneisses are more common and much widely distributed in the area. The gneisses are largely recrystallized and foliated in some places. This is as a result of high-grade regional metamorphic processes from pre-existing formations (Frederick and Edward, 2003). According to Oyinloye (2011) the structural evolution of the area with respect to regionally widespread patterns of rock deformation reveals NE, NW, E-W and N-S fault systems. Some are folded; some are sheared, while others are foliated displaying the usual gneissic banding brought about by alternating felsic and mafic minerals. From Figure 3, it can be seen that the dominant minerals in the gneisses include biotite, hornblende, quartz, microcline and plagioclase feldspars. However, schist dominantly contains muscovite and quartz.



a Outcrop of migmatite gneiss showing shearing

b Outcrop of banded gneiss showing foliation and shearing

c Outcrop of granite gneiss with quartz vein

d Outcrop of muscovite schist

Fig 2: Outcrops of gneisses and schist in the study area

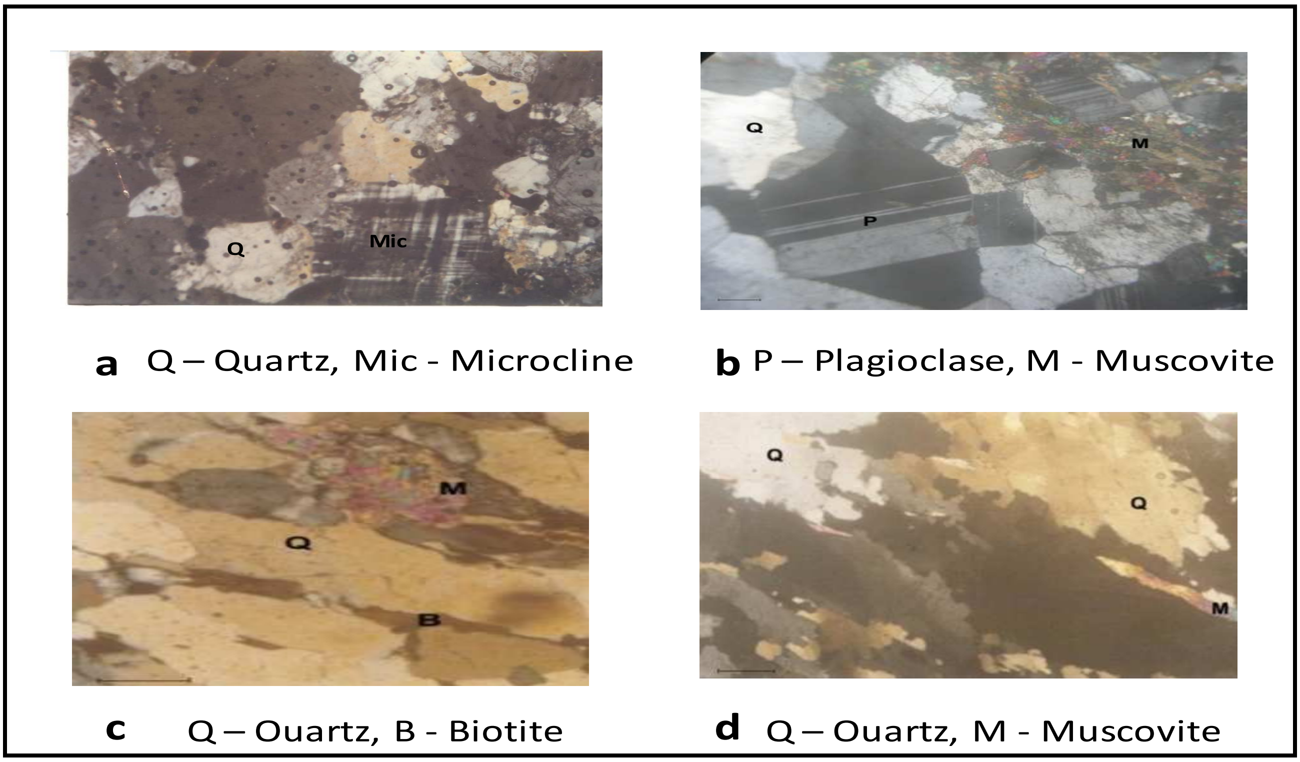


Fig. 3: Photomicrographs of gneiss and schist in transmitted light

DISCUSSION OF RESULTS

General Flow Systems

The interaction between surface water and groundwater is presented in a unified way using the actual landscape in Figure 4. This takes a form of two-dimensional (2-D) surface water/groundwater flow model representing the natural flow above and below the study area. The near-surface groundwater head distribution in the area shows connectivity between areas of recharge and discharge. Normally, the surface waters flowing will infiltrate the overburden at the areas of recharge. Booij *et al*., (1998) gives an idea of how water flowing in an aquifer is pulled by gravity through the saprolite into the underlying fractured zones of fresh bedrocks. The hydrostatic distribution in the overburden aquifer indicates a relatively uneven groundwater flow with remarkable concentration in the area underlain by gneiss. This is in agreement with findings of Hemmings and Harris, (2005) in which a scale model was used to verify the effects of hydrological changes in the behavior of the aquifer and general flow situation.

It is assumed in this study that virtually, all the groundwater comes from precipitation that soaks the laterised overburden to the fractured basement aquifer. The configuration of the water table reveals that the approximate direction of groundwater flow is from the Mini Campus and Igan road in the area of recharge to Fidigbade being the area of discharge. The source of the groundwater as earlier said, is through infiltration saturating the laterised overburden. The connections between pore spaces in the overburden soil and fractures in the bedrocks determine the depth to which the ground water could travel. Within the aquifer, groundwater moves not as an underground stream, but rather seeping between and around individual soil and rock particles.

A shallow, local pattern of groundwater flow near surface water is emphasized in this study. Unconfined aquifers dominate the area in which the upper boundary is the weathered lateritic profiles overlie the impermeable fractured-crystalline rocks. It is expected that groundwater occurs in the fractures of the rocks due to secondary porosity created. Wilford et al., (2006) noted that subsurface hydrological features such as fractures, joints and faults play an important role in groundwater occurrence. From the spatial flow map, simple inter-relationship is visible between the hydrological landscape position and geology of the area. It is noted that flow lines are very much closer to one another in the area underlain by gneiss as against the area underlain by schist, especially, at Koroko area. The implication is that greater discharge per unit of bottom area is inevitable at that location.

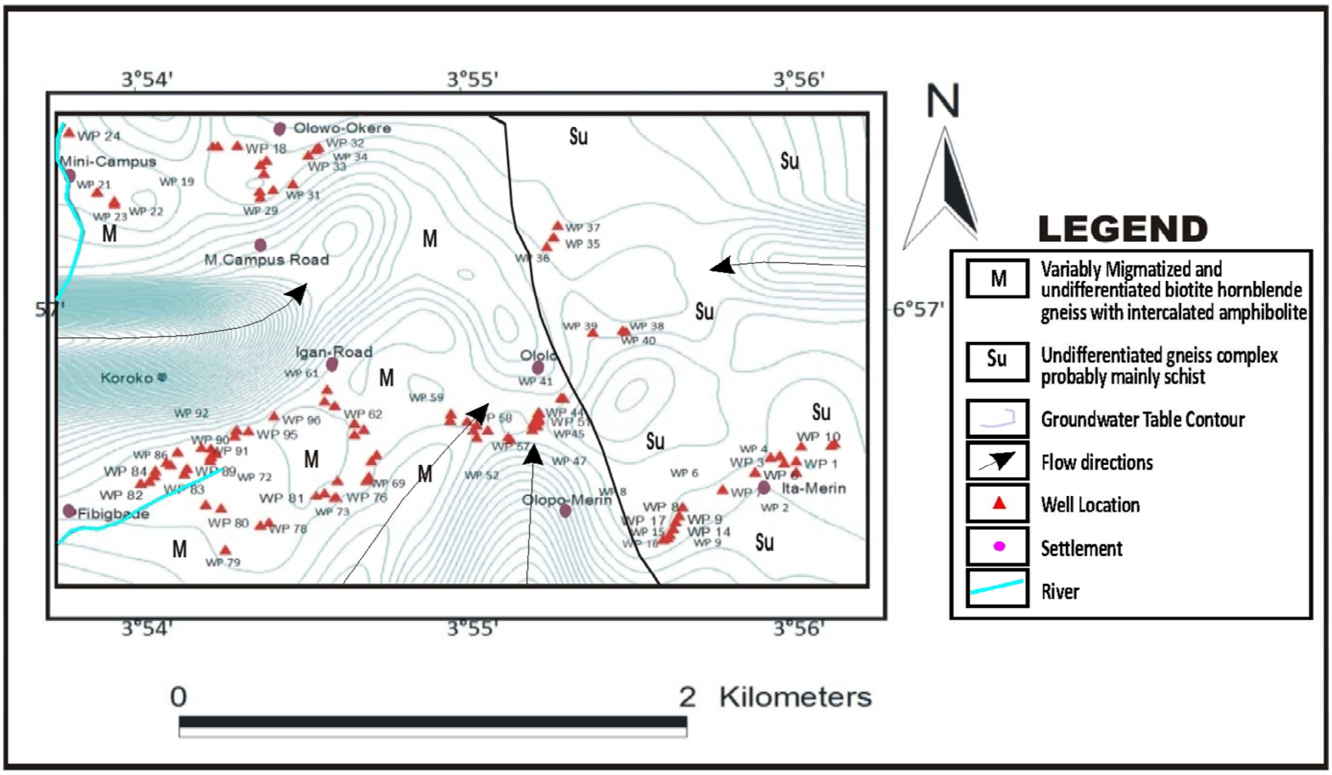


Fig 3: Spatial flow systems map for water movement and bedrock types

Groundwater Temperature

Considering heat convention caused by groundwater flow, temperature is an excellent tracer for groundwater fluxes in the subsurface environment (Taniguchi *et al.* 2003). Figure 5 is an overlay of groundwater temperature variation and the bedrock types in the area. In the area underlain by undifferentiated gneiss (M), groundwater temperature ranges between approximately 33^0 and 26^0 C, while it ranges from 25.7^0 to 28.6^0 C in the area underlain by schist (Su). There exist wider variations in temperature of groundwater in the area underlain by M than in the area underlain by Su. The maximum groundwater temperature is approximately 33°C, but less than 30°C in about 90 percent compared to others. It follows that the bedrock composition influenced the horizontal component of the studied groundwater temperature. It can be seen that gneiss underlain areas where temperature vary significantly as against the area underlain by schist.

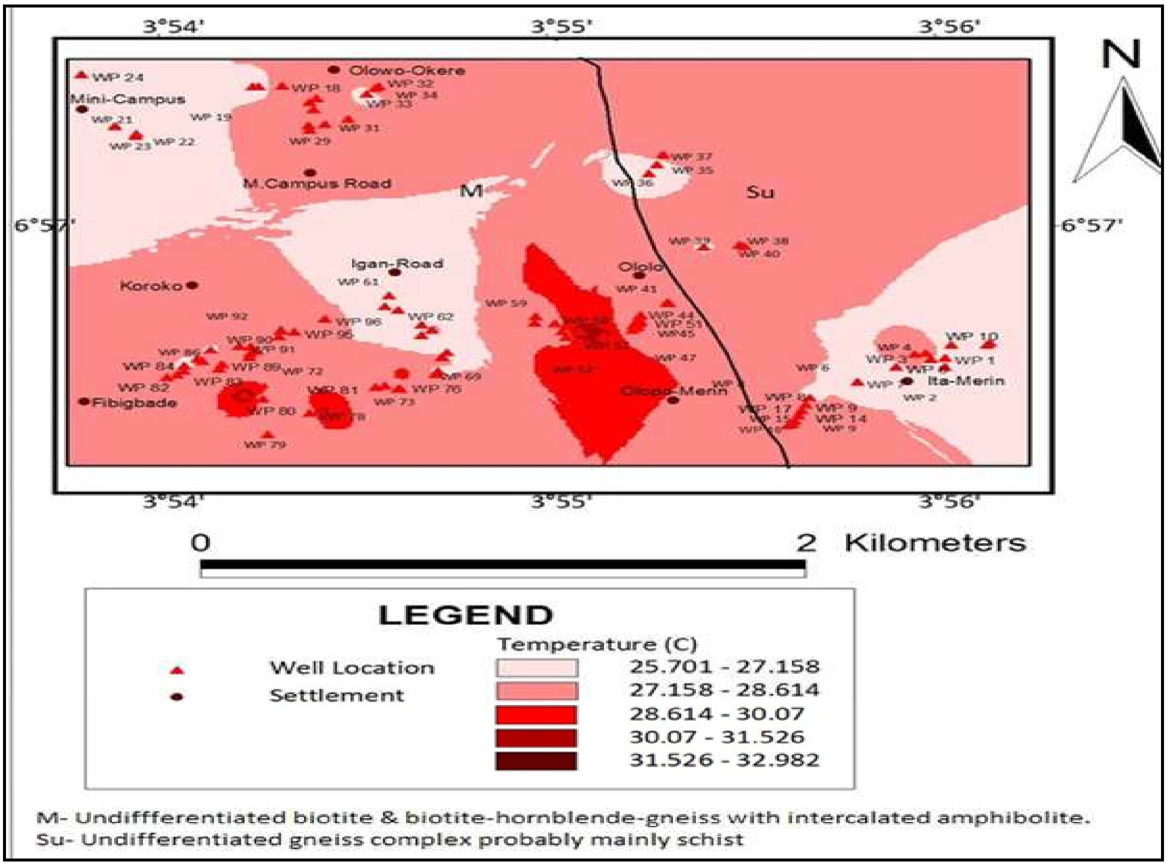


Fig 5: Overlay of groundwater temperature variation and bedrock types

AQUIFER MATERIAL COMPOSITION

The effect of mineralogical composition of the aquifer material on variation in the groundwater quality is of paramount importance (Allen and Suchy, 2001). The upper boundary of the study area constitutes the weathered lateritic profiles, an unconfined aquifer developed over the impermeable fractured-crystalline rocks. It is expected that the weathered lateritic profile will retain the mineral components of the parent rocks, which in turn play an important role in groundwater quality. The water moving through the ground tends to react with the mineral components of the hosting aquifers. These rock-water interactions dictate the chemical state of groundwater. 2D overlays of bedrocks and the major physical parameters defining water quality form the basis for the models regarding the groundwater chemical state in this study.

Hydrogen ion concentration

Overlay of the hydrogen ion activity (pH) of groundwater and bedrocks in the studied area is shown in Figure 6. The pH generally ranges between 5.5 and 8.4. It is obvious that groundwater from the area underlain by gneiss (M), shows wider variation in hydrogen ion activity than groundwater from the area underlain by schist (Su). The groundwater is weakly acidic around Olopomerin, while it is neutral to weakly basic in other places. The WHO (2007) standard recommends water within a pH range of 5.5 - 9 for domestic use. On the basis of hydrogen ion concentration, the water falls within the acceptable limit suitable for domestic use. In general, groundwater from the area underlain by rock type M (gneiss) has a wider pH range compared to groundwater in the area underlain by Su (schist).

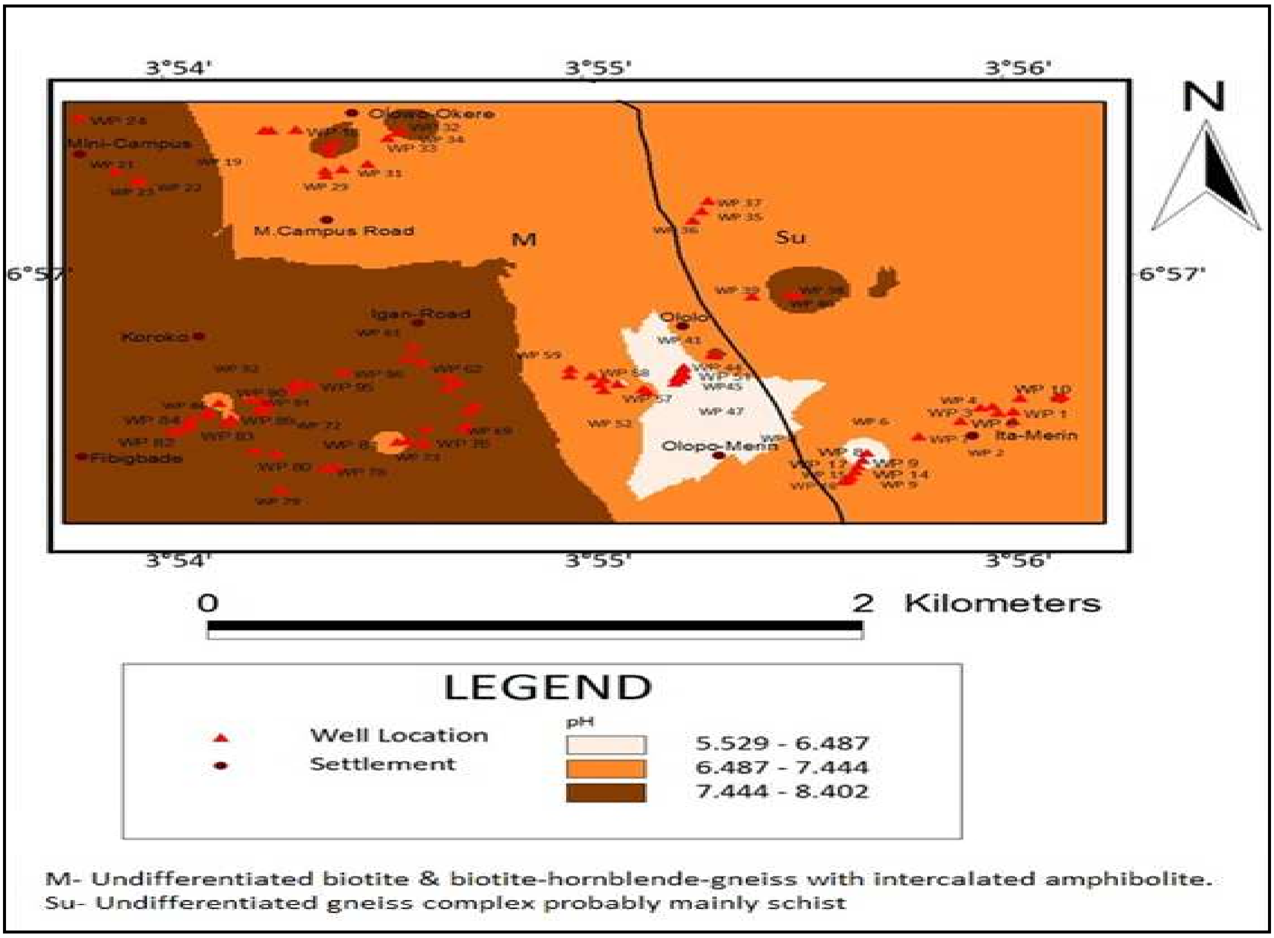


Fig 6: Overlay of groundwater pH variation and bedrock types.

Groundwater salinity

The ions produced from weathering and minerals dissolving from the rocks slightly influenced the groundwater salinity values. Figure 7, shows salinity variation range to be 0-0.05mg/l within the area underlain by rock type M (undifferentiated gneiss). The implication is that gneiss has all round influence on groundwater salinity in the study area. Relatively lower salinity values are recorded from groundwater in the area underlain by schist. The different proportion of salinity value in the area falls within the range of 0-0.01mg/l and 0.01-0.02mg/l.

Although salinity is a major water quality limitation on the potential beneficial uses of groundwater, there is limited data to support trend analysis of groundwater salinity in the Basement Complex. The compilation of available groundwater data undertaken in this research provides an indication that the dissolved salts in the water from the area underlain by both rocks is not desirable. Based on data from this research, all the groundwater samples tested have salinity values below the WHO standard recommended for human consumption. However, it is obvious that dissolved salts in the studied groundwater originate from the chemical breakdown of the crystalline bedrock components.

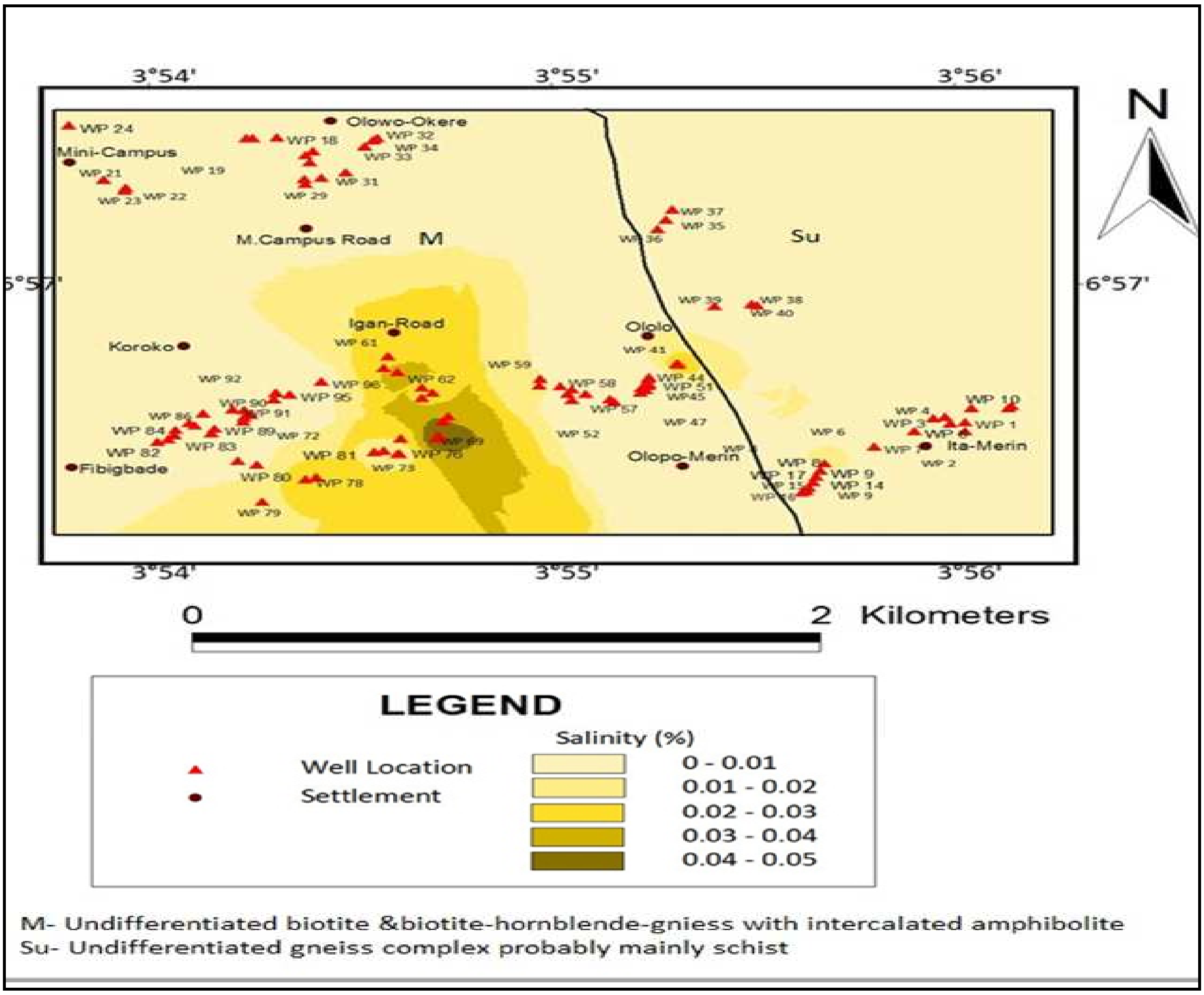


Fig 7: Overlay of groundwater salinity variation and bedrock types.

TOTAL DISSOLVED SOLIDS

From Figure 8, Total Dissolved Solids (TDS) of the groundwater under study cover a wider range (10.51 to 555.78 mg/l) in the area underlain by rock type M (undifferentiated gneiss). The area underlain by rock type Su (schist) has groundwater with relatively lower TDS value between 10.51-119.56mg/l and 119.56-228.62mg/l when compared to the area underlain by gneiss.

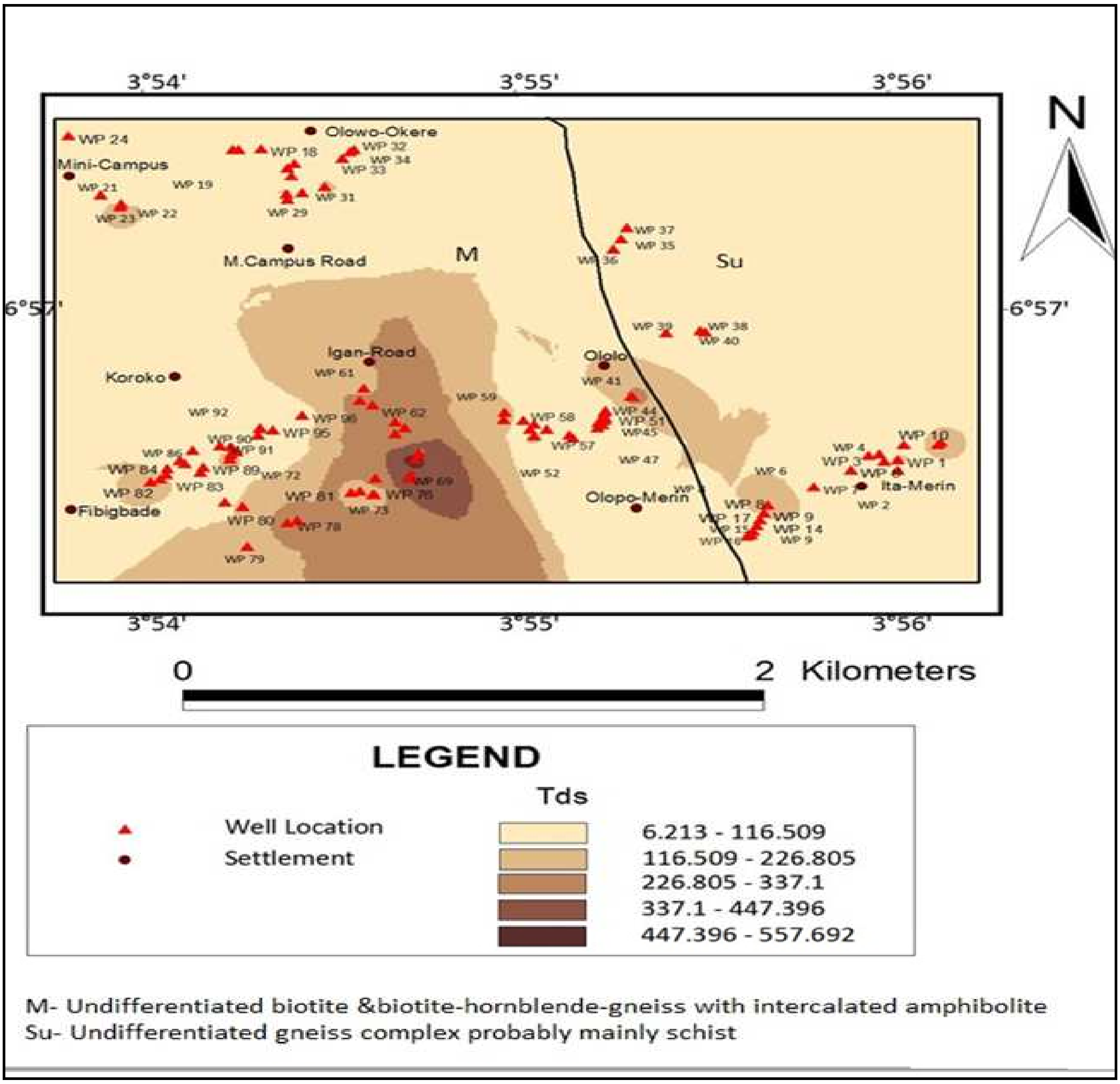


Fig 8: Overlay of groundwater TDS variation and bedrock types.

SPECIFIC ELECTRICAL CONDUCTANCE

The 2-D model for groundwater electrical conductivity is shown in figure 9. Variation in specific electrical conductance of groundwater varies between 16.17 and 855.05 µS/cm within area underlain by the rock type M (undifferentiated gneiss). The Su (schist) area has water with relatively lower electrical conductivity values (16.17-183.95 µS/cm and 183.95-351.72 µS/cm).

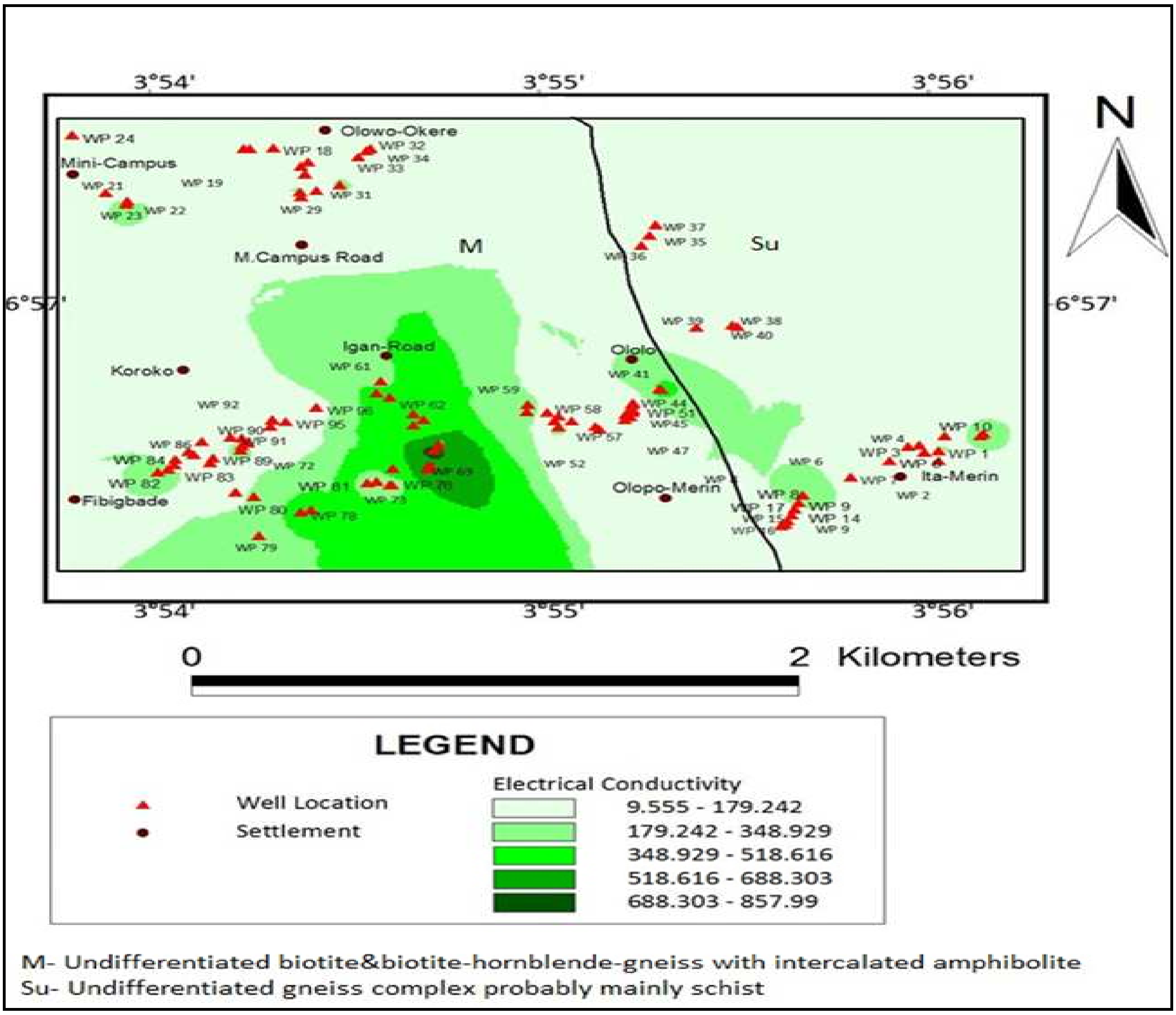


Fig 9: Overlay of groundwater conductance variation and bedrock types.

RELATIONSHIP BETWEEN DISSOLVED MATTER AND ELECTRICAL CONDUCTIVITY

As a result of dissolved matter from the weathered aquifer materials, which are important indicators for its quality assessment groundwater chemistry have geological background (Tutmez *et al.* 2006). From the GIS models acquired in this study, a similar format is displayed in the spatial variation maps of the salinity, TDS and electrical conductivity. Atekwana *et al.* (2004) and Adebisi (2010) corroborated strong positive correlation between TDS and specific electrical conductance of groundwater. Figures 10 and 11 are regression plots of salinity versus TDS, and salinity versus specific electrical conductance respectively. Very strong positive correlation (r = 0.95) generally, exists in each case. The coefficient of determination (r^2 = 0.91) revealed that more than 91% of the variation in the groundwater dissolved matter was associated with TDS and specific electrical conductance.

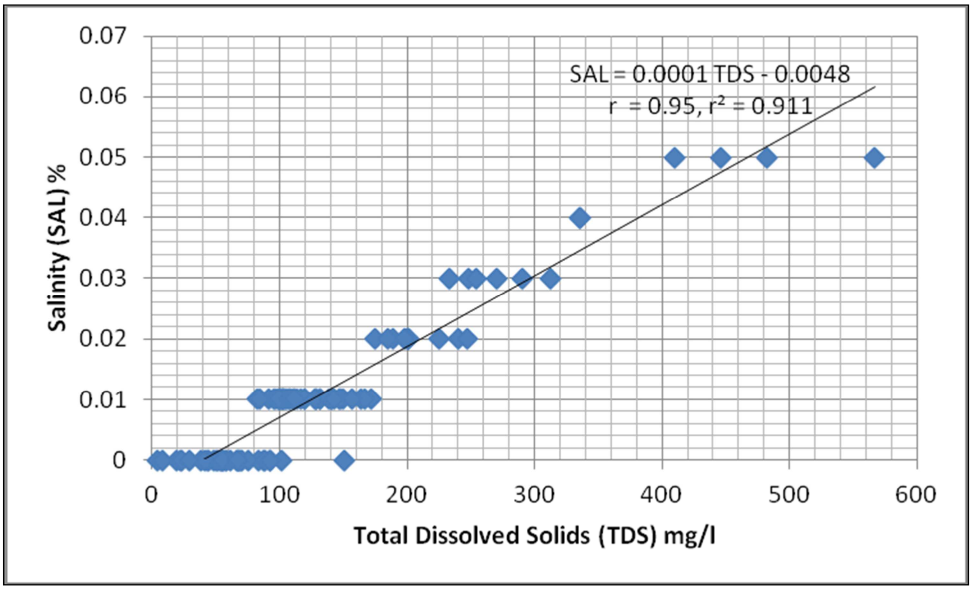


Fig 10: Regression plot of salinity against Total Dissolved Solids.

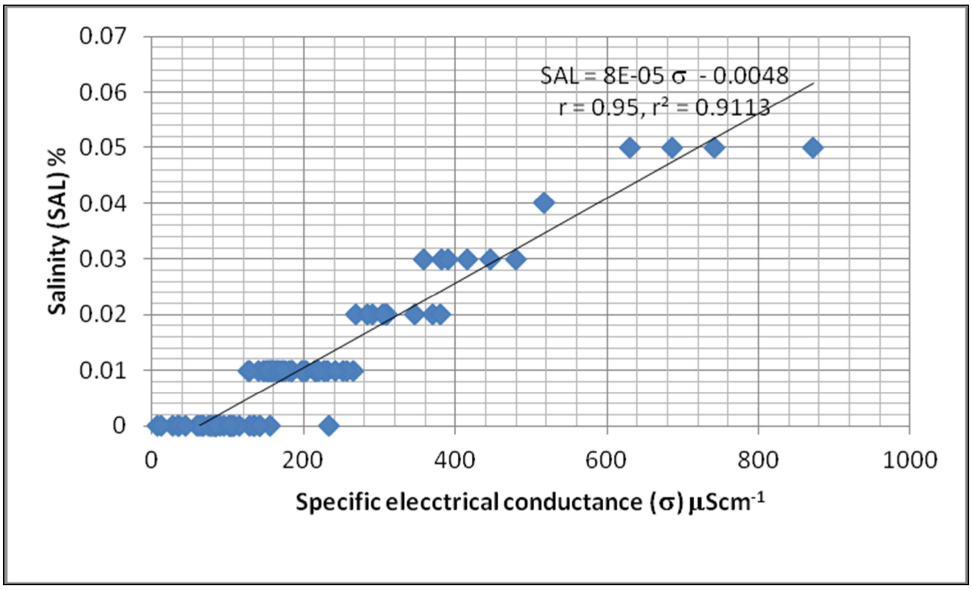


Fig 11: Regression plot of salinity against specific electrical conductance.

CONCLUSIONS

The surface water which infiltrates the laterised overburden aquifer in parts of Southwestern Nigeria reacts with the aquifer material make-up in weathering reactions. There exists a significant difference in mineralogical composition of the bedrocks which serve as parent materials to the overburden aquifer. The surface water flow pattern does not conform to the water pathways of flow at depth. The groundwater varies greatly in composition in the area underlain by gneiss compared to the area underlain by schist. These two bedrock types from the Gneiss Complex gave rise to the laterised overburden aquifer material. In this case, it is convenient to explain the relatively high and low amount of physical parameters governing water quality. There is no doubt that the mineralogical composition of the parent rocks (gneiss and schist) is responsible for groundwater quality trends in the area in the laterised overburden aquifer.

Variations in the water's chemical state in the area are not due to anthropogenic causes. From the area underlain by gneiss, flow and quality of groundwater are more broadly distributed compared to the area underlain by schist. The difference in compositional features of the bedrocks is therefore ratified as the basis for changes in the chemical state of the groundwater. Physical properties governing water quality, i.e., temperature, hydrogen ion concentration, salinity, total dissolved solids and specific electrical conductance, attest to variations deduced from this study are as a result of geogenic causes.

Programs and action plans on groundwater flow and quality management could be better accomplished for a geographically large area like the Southwestern Nigeria with diverse bedrocks using a GIS.

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GEOGRAPHICAL LOCATIONS AND GROUNDWATER DATA

LOCATION	ELEVATION (m)	ATITUDE	LONGITUDE	WELL DEPTH (m)	WATER LEVEL (m)	WELL HEAD (m)	WELL CONDITIONS	COLOUR	TEMP (°C)	pH	TDS	SALINITY (%)	ELECTRICAL CONDUCTIVITY
ITAMERIN	73.00	06°55'36.8?	003°55'43.6?	4.60	1.22	3.38	COVERED/ UNCASED	COLOURLESS	26.60	7.16	151.00	0.00	232.31
ITAMERIN	72.00	06°56'35.2?	003°55'43.6?	6.70	1.63	5.07	UNCOVERED/ CASED	WHITISH	26.60	7.45	43.00	0.00	66.15
ITAMERIN	63.00	06°56'36.5?	003°55'42.1?	7.03	3.28	3.75	COVERED/ CASED	COLOURLESS	26.90	6.65	68.00	0.00	104.62
ITAMERIN	61.00	06°56'37.6?	003°55'41.6?	8.75	3.87	4.88	COVERED/ CASED	COLOURLESS	27.80	7.36	67.00	0.00	103.08
ITAMERIN	67.00	06°56'37.4?	003°55'40.4?	7.60	1.74	5.86	COVERED/ CASED	COLOURLESS	28.00	6.93	53.00	0.00	81.54
ITAMERIN	62.00	06°56'35.2?	003°55'38.4?	6.37	4.01	2.36	COVERED/ CASED	COLOURLESS	27.10	6.64	104.00	0.01	160.00
ITAMERIN	56.00	06°56'32.7?	003°55'34.2?	4.22	2.58	1.64	COVERED/ UNCASED	WHITISH	26.30	6.82	102.00	0.01	156.92
ITAMERIN	64.00	06°56'30.0?	003°55'29.1?	5.10	1.57	3.53	UNCOVERED/ UNCASED	COLOURLESS	26.70	6.35	201.00	0.02	309.23
ITAMERIN	62.00	06°56'28.7?	003°55'28.7?	6.60	2.12	4.48	COVERED/UN CASED	WHITISH	27.60	6.05	132.00	0.01	203.07
ITAMERIN	72.00	06°56'39.0?	003°55'44.3?	7.97	4.14	3.83	COVERED/ CASED	COLOURLESS	26.50	7.26	87.00	0.00	133.85
ITAMERIN	69.00	06°56'39.1?	003°55'48.1?	8.23	4.51	3.72	COVERED/ UNCASED	BROWNISH	27.10	7.51	150.00	0.01	230.77
ITAMERIN	71.00	06°56'39.4?	003°55'48.5?	7.05	4.37	2.68	COVERED/ UNCASED	COLOURLESS	26.90	7.43	111.00	0.01	170.77
OLOPOMERIN	63.00	06°56'27.8?	003°55'28.3?	7.43	2.49	4.94	COVERED/ UNCASED	WHITISH	27.70	6.42	101.00	0.00	155.38
OLOPOMERIN	65.00	06°56'26.9?	003°55'27.9?	7.10	1.85	5.25	COVERED/ UNCASED	COLOURLESS	28.10	6.73	48.00	0.00	73.85
OLOPOMERIN	68.00	06°56'26.0?	003°55'27.5?	8.44	2.37	6.07	COVERED/ CASED	BROWNISH	27.50	7.09	102.00	0.01	156.92
OLOPOMERIN	67.00	06°56'25.5?	003°55'27.3?	8.50	3.25	5.25	COVERED/ UNCASED	BROWNISH	27.50	7.10	101.00	0.01	164.62
OLOPOMERIN	69.00	06°56'25.3?	003°55'26.8?	8.68	2.61	6.07	COVERED/ UNCASED	COLOURLESS	27.60	6.63	50.00	0.00	76.92
OLOWO OKERE	62.00	06°57'23.3?	003°54'32.5?	2.20	2.58	9.62	COVERED/ CASED	COLOURLESS	27.40	6.77	103.00	0.01	158.46
OLOWO OKERE	66.00	06°57'23.2?	003°54'30.0?	8.15	5.15	3.00	COVERED/ CASED	BROWNISH	27.00	7.44	54.00	0.00	83.08
OLOWO OKERE	67.00	06°57'23.2?	003°54'29.4?	10.70	7.65	3.05	COVERED/ CASED	BROWNISH	26.90	7.36	112.00	0.01	172.31
MINI CAMPUS	40.00	06°57'16.4?	003°54'14.7?	5.68	4.02	1.66	COVERED/ CASED	COLOURLESS	26.80	7.83	105.00	0.01	161.54
MINI CAMPUS	46.00	06°57'15.1?	003°54'16.9?	3.50	2.28	1.22	COVERED/ CASED	COLOURLESS	26.80	8.06	92.00	0.00	141.54
MINI CAMPUS	41.00	06°57'14.7?	003°54'16.8?	3.75	2.85	0.90	COVERED/ CASED	BROWNISH	26.00	7.92	148.00	0.01	227.69
MINI CAMPUS	44.00	06°57'25.2?	003°54'11.1?	5.48	3.95	1.53	COVERED/ CASED	COLOURLESS	25.70	7.46	61.00	0.00	93.85

LOCATION	ELEVATION (m)	ATITUDE	LONGITUDE	WELL DEPTH (m)	WATER LEVEL (m)	WELL HEAD (m)	WELL CONDITIONS	COLOUR	TEMP (°C)	pH	TDS	SALINITY (%)	ELECTRICAL CONDUCTIVITY
MINI CAMPUS ROAD	63.00	06°57'21.1?	003°54'36.2?	6.29	3.29	3.00	COVERED/ CASED	BROWNISH	28.00	7.94	96.00	0.01	147.69
MINI CAMPUS ROAD	62.00	06°57'20.4?	003°54'35.5?	7.15	3.95	3.20	COVERED/ CASED	BROWNISH	27.50	7.70	114.00	0.01	175.38
MINI CAMPUS ROAD	53.00	06°57'19.2?	003°54'35.9?	5.10	1.50	3.60	COVERED/ CASED	BROWNISH	27.60	7.51	120.00	0.01	184.62
MINI CAMPUS ROAD	55.00	06°57'16.5?	003°54'35.4?	5.40	1.50	3.90	COVERED/ CASED	COLOURLESS	27.70	6.62	141.00	0.01	216.92
MINI CAMPUS ROAD	55.00	06°57'15.7?	003°54'35.5?	7.40	5.20	2.20	COVERED/ CASED	WHITISH	27.10	6.56	83.00	0.00	127.69
MINI CAMPUS ROAD	60.00	06°57'16.7?	003°54'37.1?	6.95	5.63	1.32	COVERED/ CASED	BROWNISH	27.20	7.16	44.00	0.00	67.69
MINI CAMPUS ROAD	57.00	06°57'17.6?	003°54'39.8?	8.21	14.05	4.16	COVERED/ CASED	COLOURLESS	27.20	7.45	129.00	0.01	198.46
MINI CAMPUS ROAD	63.00	06°57'22.8?	003°54'42.5?	11.05	3.05	8.00	COVERED/ CASED	COLOURLESS	27.30	7.45	129.00	0.01	184.46
MINI CAMPUS ROAD	60.00	06°57'21.8?	003°54'41.6?	9.97	5.07	4.90	COVERED/ CASED	COLOURLESS	26.70	7.04	38.00	0.00	58.46
MINI CAMPUS ROAD	68.00	06°57'23.1?	003°54'42.9?	10.70	2.45	8.25	COVERED/ CASED	COLOURLESS	27.60	7.76	99.00	0.01	152.31
MINI CAMPUS ROAD	74.00	06°57'09.8?	003°55'12.8?	13.72	3.60	10.12	COVERED/ UNCASED	COLOURLESS	26.70	7.47	51.00	0.00	78.46
MINI CAMPUS ROAD	83.00	06°57'08.3?	003°55'11.9?	15.00	7.57	7.43	COVERED/ UNCASED	COLOURLESS	26.80	7.05	69.00	0.00	106.15
MINI CAMPUS ROAD	72.00	06°57'11.5?	003°55'13.4?	13.40	1.19	12.21	COVERED/ CASED	COLOURLESS	27.80	7.10	70.00	0.00	107.69
OLOLO	68.00	06°56'55.9?	003°55'22.1?	11.80	3.55	8.25	COVERED/ CASED	COLOURLESS	28.10	7.76	57.00	0.00	82.61
OLOLO	69.00	06°56'56.1?	003°55'21.6?	13.22	4.92	8.30	COVERED/ CASED	COLOURLESS	28.00	7.54	19.00	0.00	27.54
OLOLO	77.00	06°56'55.8?	003°55'17.8?	12.50	1.50	11.00	COVERED/ CASED	COLOURLESS	27.00	7.36	22.00	0.00	33.85
OLOLO	66.00	06°56'46.2?	003°55'13.8?	12.90	4.98	7.92	COVERED/ CASED	COLOURLESS	27.70	7.71	201.00	0.02	309.23
OLOLO	72.00	06°56'46.1?	003°55'14.1?	11.50	3.25	8.25	COVERED/ CASED	COLOURLESS	27.90	7.65	336.00	0.04	516.92
OLOLO	71.00	06°56'44.0?	003°55'11.0?	8.90	2.10	6.80	COVERED/ UNCASED	COLOURLESS	28.60	6.30	75.00	0.00	115.38
OLOLO	68.00	06°56'43.9?	003°55'10.9?	9.03	2.03	7.00	COVERED/ UNCASED	COLOURLESS	28.10	6.15	88.00	0.00	135.38
OLOLO	69.00	06°56'43.0?	003°55'11.0?	7.73	1.73	6.00	COVERED/ UNCASED	COLOURLESS	28.10	5.82	58.00	0.00	89.23
OLOLO	66.00	06°56'42.7?	003°55'10.9?	7.25	1.45	5.80	COVERED/ UNCASED	COLOURLESS	28.10	5.93	55.00	0.00	84.62
OLOLO	65.00	06°56'42.0?	003°55'10.7?	5.75	1.35	4.40	COVERED/ UNCASED	COLOURLESS	28.50	6.01	41.00	0.00	63.08
OLOLO	64.00	06°56'42.3?	003°55'10.2?	7.23	1.38	5.85	COVERED/ UNCASED	COLOURLESS	27.80	5.56	132.00	0.01	203.08
OLOLO	62.00	06°56'42.7?	003°55'10.4?	7.60	1.78	5.82	COVERED/ UNCASED	COLOURLESS	27.80	5.44	117.00	0.01	180.00

LOCATION	ELEVATION (m)	ATITUDE	LONGITUDE	WELL DEPTH (m)	WATER LEVEL (m)	WELL HEAD (m)	WELL CONDITIONS	COLOUR	TEMP (°C)	pH	TDS	SALINITY (%)	ELECTRICAL CONDUCTIVITY
OLOLO	65.00	06°56'42.3?	003°55'10.2?	6.37	1.22	5.15	COVERED/ UNCASED	COLOURLESS	27.60	5.46	175.00	0.02	269.23
OLOLO	65.00	06°56'41.5?	003°55'10.1?	5.55	1.00	4.55	COVERED/ UNCASED	COLOURLESS	27.50	6.05	23.00	0.00	35.38
OLOLO	53.00	06°56'40.0?	003°55'07.4?	8.90	5.05	3.85	COVERED/ CASED	COLOURLESS	27.70	6.66	100.00	0.01	153.85
OLOLO	57.00	06°56'40.4?	003°55'07.0?	5.40	1.60	3.80	COVERED/ CASED	BROWNISH	33.00	7.07	82.00	0.01	126.15
OLOLO	54.00	06°56'41.3?	003°55'04.4?	12.20	6.55	5.65	COVERED/ CASED	BROWNISH	33.10	6.23	91.00	0.01	140.00
OLOLO	55.00	06°56'42.1?	003°55'03.0?	7.48	1.48	6.00	COVERED/ UNCASED	COLOURLESS	29.10	6.85	4.00	0.00	6.15
OLOLO	55.00	06°56'41.3?	003°55'02.6?	5.30	1.18	4.12	COVERED/ UNCASED	COLOURLESS	27.70	7.04	120.00	0.01	184.62
OLOLO	54.00	06°56'40.3?	003°55'03.0?	6.40	3.08	3.32	COVERED/ CASED	COLOURLESS	27.70	7.20	147.00	0.01	226.15
OLOLO	51.00	06°56'42.7?	003°55'01.8?	5.75	1.85	3.90	COVERED/ UNCASED	BROWNISH	28.20	7.20	29.00	0.00	44.62
OLOLO	52.00	06°56'43.8?	003°54'59.8?	8.80	5.73	3.07	COVERED/ CASED	BROWNISH	28.40	7.24	128.00	0.01	196.92
OLOLO	54.00	06°56'42.8?	003°54'59.6?	6.20	3.00	3.20	COVERED/ CASED	COLOURLESS	27.60	7.36	189.00	0.02	290.77
IGAN ROAD	73.00	06°56'47.4?	003°54'44.0?	5.50	3.50	2.00	COVERED/ UNCASED	BROWNISH	26.10	7.54	185.00	0.02	284.62
IGAN ROAD	51.00	06°56'44.9?	003°54'45.0?	3.33	1.68	1.65	UNCOVERED/ CASED	COLOURLESS	25.70	7.76	336.00	0.04	516.92
IGAN ROAD	50.00	06°56'45.6?	003°54'43.6?	4.56	2.34	2.22	COVERED/ CASED	COLOURLESS	26.60	7.71	248.00	0.03	381.54
IGAN ROAD	54.00	06°56'42.4?	003°54'47.5?	3.90	0.50	3.40	COVERED/ UNCASED	COLOURLESS	27.20	7.71	233.00	0.03	358.46
IGAN ROAD	50.00	06°56'41.5?	003°54'48.6?	3.35	2.03	1.32	COVERED/ UNCASED	COLOURLESS	27.40	7.60	240.00	0.02	369.23
IGAN ROAD	53.00	06°56'40.7?	003°54'47.5?	2.65	1.45	1.20	COVERED/ CASED	COLOURLESS	25.90	8.04	254.00	0.03	390.77
IGAN ROAD	47.00	06°56'37.7?	003°54'50.3?	3.35	2.45	0.90	UNCOVERED/ CASED	COLOURLESS	26.40	8.05	312.00	0.03	480.00
IGAN ROAD	49.00	06°56'36.8?	003°54'49.7?	3.50	1.90	1.60	COVERED/ CASED	COLOURLESS	27.50	7.92	567.00	0.05	872.31
IGAN ROAD	60.00	06°56'34.4?	003°54'49.3?	3.75	1.77	1.98	COVERED/ CASED	COLOURLESS	26.90	7.96	410.00	0.05	630.77
IGAN ROAD	54.00	06°56'34.0?	003°54'49.0?	3.70	2.90	0.80	COVERED/ CASED	COLOURLESS	27.20	8.02	446.00	0.05	686.15
IGAN ROAD	50.00	06°56'34.5?	003°54'49.3?	3.18	2.01	1.17	COVERED/ UNCASED	COLOURLESS	27.20	7.85	482.00	0.05	741.54
IGAN ROAD	50.00	06°56'34.0?	003°54'45.3?	2.39	0.51	1.88	COVERED/ UNCASED	COLOURLESS	29.30	8.16	247.00	0.02	380.00
IGAN ROAD	55.00	06°56'31.5?	003°54'45.2?	3.38	1.05	2.33	COVERED/ UNCASED	COLOURLESS	26.90	7.76	172.00	0.01	264.62
IGAN ROAD	57.00	06°56'31.5?	003°54'45.0?	3.71	1.64	2.07	COVERED/ UNCASED	COLOURLESS	28.60	7.79	200.00	0.02	307.69

LOCATION	ELEVATION (m)	ATITUDE	LONGITUDE	WELL DEPTH (m)	WATER LEVEL (m)	WELL HEAD (m)	WELL CONDITIONS	COLOUR	TEMP (°C)	pH	TDS	SALINITY (%)	ELECTRICAL CONDUCTIVITY
IGAN ROAD	52.00	06°56'32.1?	003°54'43.6?	3.61	2.25	1.36	COVERED/ UNCASED	COLOURLESS	27.40	7.72	164.00	0.01	252.31
IGAN ROAD	52.00	06°56'31.8?	003°54'42.6?	3.58	0.68	2.90	COVERED/ UNCASED	COLOURLESS	28.70	6.71	225.00	0.02	346.15
FIBIGBADE	51.00	06°56'27.7?	003°54'36.6?	6.25	3.90	2.35	COVERED/ CASED	COLOURLESS	31.00	7.80	290.00	0.03	446.15
FIBIGBADE	53.00	06°56'27.3?	003°54'35.5?	5.46	4.18	1.28	COVERED/ CASED	COLOURLESS	26.60	7.75	270.00	0.03	415.38
FIBIGBADE	49.00	06°56'23.7?	003°54'31.0?	4.42	1.45	2.97	COVERED/ UNCASED	COLOURLESS	27.30	7.61	198.00	0.02	304.62
FIBIGBADE	49.00	06°56'29.8?	003°54'30.5?	7.51	4.67	2.84	COVERED/ CASED	COLOURLESS	27.70	7.75	167.00	0.01	256.92
FIBIGBADE	53.00	06°56'30.4?	003°54'28.5?	5.75	3.96	1.79	COVERED/ CASED	COLOURLESS	31.70	8.41	8.00	0.00	12.31
FIBIGBADE	52.00	06°56'33.5?	003°54'20.2?	7.05	4.35	2.70	COVERED/ CASED	COLOURLESS	27.50	7.82	141.00	0.01	216.92
FIBIGBADE	51.00	06°56'33.9?	003°54'21.3?	7.47	4.37	3.10	COVERED/ CASED	COLOURLESS	27.00	7.53	139.00	0.01	213.85
FIBIGBADE	52.00	06°56'35.4?	003°54'22.1?	7.16	3.27	3.89	COVERED/ CASED	COLOURLESS	26.90	7.65	102.00	0.01	156.92
FIBIGBADE	52.00	06°56'34.6?	003°54'22.0?	7.07	4.16	2.91	COVERED/ CASED	COLOURLESS	27.30	7.44	100.00	0.01	153.85
FIBIGBADE	55.00	06°56'36.6?	003°54'23.5?	6.18	2.99	3.19	COVERED/ CASED	WHITISH	27.00	7.56	95.00	0.01	146.15
FIBIGBADE	51.00	06°56'36.2?	003°54'24.0?	6.53	3.45	3.08	COVERED/ CASED	WHITISH	27.50	7.49	98.00	0.01	150.77
FIBIGBADE	52.00	06°56'34.9?	003°54'25.8?	7.10	6.50	0.60	COVERED/ CASED	COLOURLESS	28.80	7.56	108.00	0.01	166.15
FIBIGBADE	48.00	06°56'35.7?	003°54'26.1?	6.71	5.43	1.28	COVERED/ CASED	COLOURLESS	27.10	7.30	102.00	0.01	156.92
FIBIGBADE	56.00	06°56'38.1?	003°54'24.9?	7.50	5.41	2.09	COVERED/ CASED	COLOURLESS	27.00	7.18	99.00	0.01	152.31
FIBIGBADE	53.00	06°56'38.8?	003°54'28.0?	4.75	3.68	1.07	COVERED/ CASED	COLOURLESS	26.80	7.22	108.00	0.01	166.15
KOROKO	56.00	06°56'41.5?	003°54'32.4?	9.86	6.98	2.88	COVERED/ CASED	COLOURLESS	27.40	8.42	84.00	0.01	129.23
KOROKO	58.00	06°56'41.4?	003°54'32.4?	7.20	4.73	2.49	COVERED/ CASED	BROWNISH	26.60	8.07	55.00	0.00	84.62
KOROKO	59.00	06°56'40.5?	003°54'32.2?	8.08	5.41	2.67	COVERED/ CASED	COLOURLESS	28.80	7.93	109.00	0.01	167.69
KOROKO	47.00	06°56'41.2?	003°54'33.9?	6.28	3.77	2.51	COVERED/ CASED	COLOURLESS	27.30	7.85	112.00	0.01	172.31
KOROKO	56.00	06°56'43.4?	003°54'37.2?	7.91	4.59	3.32	COVERED/ CASED	COLOURLESS	27.60	8.06	92.00	0.00	141.54
KOROKO	48.00	06°56'37.9?	003°54'29.8?	6.47	4.10	2.37	COVERED/ CASED	WHITISH	26.30	7.85	66.00	0.00	101.54
KOROKO	53.00	06°56'38.7?	003°54'29.2?	7.55	5.49	2.06	COVERED/ CASED	COLOURLESS	28.60	8.26	67.00	0.00	103.08
KOROKO	53.00	06°56'37.5?	003°54'29.2?	6.06	3.91	2.15	COVERED/ CASED	COLOURLESS	28.10	7.84	157.00	0.01	241.54
KOROKO	51.00	06°56'36.9?	003°54'29.0?	6.71	4.41	2.30	COVERED/ CASED	COLOURLESS	27.90	7.93	143.00	0.01	220.00

DATA USED FOR ARC GIS

NOTATION	ELEVATION (m)	X	Y	WELL DEPTH (m)	WATER LEVEL (m)	WELL HEAD (m)	WELL CONDITIONS	COLOUR	TEMP (°C)	pH	TDS	SALINITY (%)	ELECTRICAL CONDUCTIVITY
WP 1	73.00	6.92689	3.92878	4.60	1.22	3.38	COVERED/ UNCASED	COLOURLESS	26.60	7.16	151.00	0.00	232.31
WP 2	72.00	6.94311	3.92878	6.70	1.63	5.07	UNCOVERED/ CASED	WHITISH	26.60	7.45	43.00	0.00	66.15
WP 3	63.00	6.94347	3.92836	7.03	3.28	3.75	COVERED/ CASED	COLOURLESS	26.90	6.65	68.00	0.00	104.62
WP 4	61.00	6.94378	3.92822	8.75	3.87	4.88	COVERED/ CASED	COLOURLESS	27.80	7.36	67.00	0.00	103.08
WP 5	67.00	6.94372	3.92789	7.60	1.74	5.86	COVERED/ CASED	COLOURLESS	28.00	6.93	53.00	0.00	81.54
WP 6	62.00	6.94311	3.92733	6.37	4.01	2.36	COVERED/ CASED	COLOURLESS	27.10	6.64	104.00	0.01	160.00
WP 7	56.00	6.94242	3.92617	4.22	2.58	1.64	COVERED/ UNCASED	WHITISH	26.30	6.82	102.00	0.01	156.92
WP 8	64.00	6.94167	3.92475	5.10	1.57	3.53	UNCOVERED/ UNCASED	COLOURLESS	26.70	6.35	201.00	0.02	309.23
WP 9	62.00	6.94131	3.92464	6.60	2.12	4.48	COVERED/UN CASED	WHITISH	27.60	6.05	132.00	0.01	203.07
WP 10	72.00	6.94417	3.92897	7.97	4.14	3.83	COVERED/ CASED	COLOURLESS	26.50	7.26	87.00	0.00	133.85
WP 11	69.00	6.94419	3.93003	8.23	4.51	3.72	COVERED/ UNCASED	BROWNISH	27.10	7.51	150.00	0.01	230.77
WP 12	71.00	6.94428	3.93014	7.05	4.37	2.68	COVERED/ UNCASED	COLOURLESS	26.90	7.43	111.00	0.01	170.77
WP 13	63.00	6.94106	3.92453	7.43	2.49	4.94	COVERED/ UNCASED	WHITISH	27.70	6.42	101.00	0.00	155.38
WP 14	65.00	6.94081	3.92442	7.10	1.85	5.25	COVERED/ UNCASED	COLOURLESS	28.10	6.73	48.00	0.00	73.85
WP 15	68.00	6.94056	3.92431	8.44	2.37	6.07	COVERED/ CASED	BROWNISH	27.50	7.09	102.00	0.01	156.92
WP 16	67.00	6.94042	3.92425	8.50	3.25	5.25	COVERED/ UNCASED	BROWNISH	27.50	7.10	101.00	0.01	164.62
WP 17	69.00	6.94036	3.92411	8.68	2.61	6.07	COVERED/ UNCASED	COLOURLESS	27.60	6.63	50.00	0.00	76.92
WP 18	62.00	6.95647	3.90903	2.20	2.58	9.62	COVERED/ CASED	COLOURLESS	27.40	6.77	103.00	0.01	158.46
WP 19	66.00	6.95644	3.90833	8.15	5.15	3.00	COVERED/ CASED	BROWNISH	27.00	7.44	54.00	0.00	83.07
WP 20	67.00	6.95644	3.90817	10.70	7.65	3.05	COVERED/ CASED	BROWNISH	26.90	7.36	112.00	0.01	172.31
WP 21	40.00	6.95456	3.90408	5.68	4.02	1.66	COVERED/ CASED	COLOURLESS	26.80	7.83	105.00	0.01	161.54
WP 22	46.00	6.95419	3.90469	3.50	2.28	1.22	COVERED/ CASED	COLOURLESS	26.80	8.06	92.00	0.00	141.54
WP 23	41.00	6.95408	3.90467	3.75	2.85	0.90	COVERED/ CASED	BROWNISH	26.00	7.92	148.00	0.01	227.69
WP 24	44.00	6.95700	3.90308	5.48	3.95	1.53	COVERED/ CASED	COLOURLESS	25.70	7.46	61.00	0.00	93.85

NOTATION	ELEVATION (m)	X	Y	WELL DEPTH (m)	WATER LEVEL (m)	WELL HEAD (m)	WELL CONDITIONS	COLOUR	TEMP (°C)	pH	TDS	SALINITY (%)	ELECTRICAL CONDUCTIVITY
WP 25	63.00	6.95586	3.91006	6.29	3.29	3.00	COVERED/ CASED	BROWNISH	28.00	7.94	96.00	0.01	147.69
WP 26	62.00	6.95567	3.90986	7.15	3.95	3.20	COVERED/ CASED	BROWNISH	27.50	7.70	114.00	0.01	175.38
WP 27	53.00	6.95533	3.90997	5.10	1.50	3.60	COVERED/ CASED	BROWNISH	27.60	7.51	120.00	0.01	184.62
WP 28	55.00	6.95458	3.90983	5.40	1.50	3.90	COVERED/ CASED	COLOURLESS	27.70	6.62	141.00	0.01	216.92
WP 29	55.00	6.95436	3.90986	7.40	5.20	2.20	COVERED/ CASED	WHITISH	27.10	6.56	83.00	0.00	127.69
WP 30	60.00	6.95464	3.91031	6.95	5.63	1.32	COVERED/ CASED	BROWNISH	27.20	7.16	44.00	0.00	67.69
WP 31	57.00	6.95489	3.91101	8.21	14.05	4.16	COVERED/ CASED	COLOURLESS	27.20	7.45	129.00	0.01	198.46
WP 32	63.00	6.95633	3.91181	11.05	3.05	8.00	COVERED/ CASED	COLOURLESS	27.30	7.45	129.00	0.01	198.46
WP 33	60.00	6.95606	3.91156	9.97	5.07	4.90	COVERED/ CASED	COLOURLESS	26.70	7.04	38.00	0.00	58.46
WP 34	68.00	6.95642	3.91192	10.70	2.45	8.25	COVERED/ CASED	COLOURLESS	27.60	7.76	99.00	0.01	152.31
WP 35	74.00	6.95272	3.92022	13.72	3.60	10.12	COVERED/ UNCASED	COLOURLESS	26.70	7.47	51.00	0.00	78.46
WP 36	83.00	6.95231	3.91997	15.00	7.57	7.43	COVERED/ UNCASED	COLOURLESS	26.80	7.05	69.00	0.00	106.15
WP 37	72.00	6.95319	3.92039	13.40	1.19	12.21	COVERED/ CASED	COLOURLESS	27.80	7.10	70.00	0.00	107.69
WP 38	68.00	6.94886	3.92281	11.80	3.55	8.25	COVERED/ CASED	COLOURLESS	28.10	7.76	57.00	0.00	82.61
WP 39	69.00	6.94892	3.92267	13.22	4.92	8.30	COVERED/ CASED	COLOURLESS	28.00	7.54	19.00	0.00	27.54
WP 40	77.00	6.94883	3.92161	12.50	1.50	11.00	COVERED/ CASED	COLOURLESS	27.00	7.36	22.00	0.00	33.85
WP 41	66.00	6.94617	3.92050	12.90	4.98	7.92	COVERED/ CASED	COLOURLESS	27.70	7.71	201.00	0.02	309.23
WP 42	72.00	6.94614	3.92058	11.50	3.25	8.25	COVERED/ CASED	COLOURLESS	27.90	7.65	336.00	0.04	516.92
WP 43	71.00	6.94556	3.91972	8.90	2.10	6.80	COVERED/ UNCASED	COLOURLESS	28.60	6.30	75.00	0.00	115.38
WP 44	68.00	6.94552	3.91969	9.03	2.03	7.00	COVERED/ UNCASED	COLOURLESS	28.10	6.15	88.00	0.00	135.38
WP45	69.00	6.94528	3.91972	7.73	1.73	6.00	COVERED/ UNCASED	COLOURLESS	28.10	5.82	58.00	0.00	89.23
WP 46	66.00	6.94519	3.91969	7.25	1.45	5.80	COVERED/ UNCASED	COLOURLESS	28.10	5.93	55.00	0.00	84.62
WP 47	65.00	6.94500	3.91964	5.75	1.35	4.40	COVERED/ UNCASED	COLOURLESS	28.50	6.01	41.00	0.00	63.08
WP 48	64.00	6.94508	3.91950	7.23	1.38	5.85	COVERED/ UNCASED	COLOURLESS	27.80	5.56	132.00	0.01	203.08
WP 49	62.00	6.94519	3.91956	7.60	1.78	5.82	COVERED/ UNCASED	COLOURLESS	27.80	5.44	117.00	0.01	180.00
WP 50	65.00	6.94508	3.91950	6.37	1.22	5.15	COVERED/ UNCASED	COLOURLESS	27.60	5.46	175.00	0.02	269.23

NOTATION	ELEVATION (m)	X	Y	WELL DEPTH (m)	WATER LEVEL (m)	WELL HEAD (m)	WELL CONDITIONS	COLOUR	TEMP (°C)	pH	TDS	SALINITY (%)	ELECTRICAL CONDUCTIVITY
WP 51	65.00	6.94486	3.91947	5.55	1.00	4.55	COVERED/ UNCASED	COLOURLESS	27.50	6.05	23.00	0.00	35.38
WP 52	53.00	6.94444	3.91872	8.90	5.05	3.85	COVERED/ CASED	COLOURLESS	27.70	6.66	100.00	0.01	153.85
WP 53	57.00	6.94456	3.91861	5.40	1.60	3.80	COVERED/ CASED	BROWNISH	33.00	7.07	82.00	0.01	126.15
WP 54	54.00	6.94481	3.91789	12.20	6.55	5.65	COVERED/ CASED	BROWNISH	33.10	6.23	91.00	0.01	140.00
WP 55	55.00	6.94503	3.91750	7.48	1.48	6.00	COVERED/ UNCASED	COLOURLESS	29.10	6.85	4.00	0.00	6.15
WP 56	55.00	6.94481	3.91739	5.30	1.18	4.12	COVERED/ UNCASED	COLOURLESS	27.70	7.04	120.00	0.01	184.62
WP 57	54.00	6.94453	3.91750	6.40	3.08	3.32	COVERED/ CASED	COLOURLESS	27.70	7.20	147.00	0.01	226.15
WP 58	51.00	6.94519	3.91717	5.75	1.85	3.90	COVERED/ UNCASED	BROWNISH	28.20	7.20	29.00	0.00	44.62
WP 59	52.00	6.94550	3.91661	8.80	5.73	3.07	COVERED/ CASED	BROWNISH	28.40	7.24	128.00	0.01	196.92
WP 60	54.00	6.94522	3.91656	6.20	3.00	3.20	COVERED/ CASED	COLOURLESS	27.60	7.36	189.00	0.02	290.77
WP 61	73.00	6.94650	3.91222	5.50	3.50	2.00	COVERED/ UNCASED	BROWNISH	26.10	7.54	185.00	0.02	284.62
WP 62	51.00	6.94581	3.91250	3.33	1.68	1.65	UNCOVERED/ CASED	COLOURLESS	25.70	7.76	336.00	0.04	516.92
WP 63	50.00	6.94600	3.91211	4.56	2.34	2.22	COVERED/ CASED	COLOURLESS	26.60	7.71	248.00	0.03	381.54
WP 64	54.00	6.94511	3.91319	3.90	0.50	3.40	COVERED/ UNCASED	COLOURLESS	27.20	7.71	233.00	0.03	358.46
WP 65	50.00	6.94486	3.91350	3.35	2.03	1.32	COVERED/ UNCASED	COLOURLESS	27.40	7.60	240.00	0.02	369.23
WP 66	53.00	6.94464	3.91319	2.65	1.45	1.20	COVERED/ CASED	COLOURLESS	25.90	8.04	254.00	0.03	390.77
WP 67	47.00	6.94381	3.91397	3.35	2.45	0.90	UNCOVERED/ CASED	COLOURLESS	26.40	8.05	312.00	0.03	480.00
WP 68	49.00	6.94356	3.91380	3.50	1.90	1.60	COVERED/ CASED	COLOURLESS	27.50	7.92	567.00	0.05	872.31
WP 69	60.00	6.94289	3.91369	3.75	1.77	1.98	COVERED/ CASED	COLOURLESS	26.90	7.96	410.00	0.05	630.77
WP 70	54.00	6.94278	3.91361	3.70	2.90	0.80	COVERED/ CASED	COLOURLESS	27.20	8.02	446.00	0.05	686.15
WP 71	50.00	6.94292	3.91369	3.18	2.01	1.17	COVERED/ UNCASED	COLOURLESS	27.20	7.85	482.00	0.05	741.54
WP 72	50.00	6.94278	3.91258	2.39	0.51	1.88	COVERED/ UNCASED	COLOURLESS	29.30	8.16	247.00	0.02	380.00
WP 73	55.00	6.94208	3.91256	3.38	1.05	2.33	COVERED/ UNCASED	COLOURLESS	26.90	7.76	172.00	0.01	264.62
WP 74	57.00	6.94208	3.91250	3.71	1.64	2.07	COVERED/ UNCASED	COLOURLESS	28.60	7.79	200.00	0.02	307.69
WP 75	52.00	6.94225	3.91211	3.61	2.25	1.36	COVERED/ UNCASED	COLOURLESS	27.40	7.72	164.00	0.01	252.31

NOTATION	ELEVATION (m)	X	Y	WELL DEPTH (m)	WATER LEVEL (m)	WELL HEAD (m)	WELL CONDITIONS	COLOUR	TEMP (°C)	pH	TDS	SALINITY (%)	ELECTRICAL CONDUCTIVITY
WP 76	52.00	6.94217	3.91183	3.58	0.68	2.90	COVERED/ UNCASED	COLOURLESS	28.70	6.71	225.00	0.02	346.15
WP 77	51.00	6.94103	3.91017	6.25	3.90	2.35	COVERED/ CASED	COLOURLESS	31.00	7.80	290.00	0.03	446.15
WP 78	53.00	6.94092	3.90986	5.46	4.18	1.28	COVERED/ CASED	COLOURLESS	26.60	7.75	270.00	0.03	415.38
WP 79	49.00	6.93992	3.90861	4.42	1.45	2.97	COVERED/ UNCASED	COLOURLESS	27.30	7.61	198.00	0.02	304.62
WP 80	49.00	6.94161	3.90847	7.51	4.67	2.84	COVERED/ CASED	COLOURLESS	27.70	7.75	167.00	0.01	256.92
WP 81	53.00	6.94178	3.90792	5.75	3.96	1.79	COVERED/ CASED	COLOURLESS	31.70	8.41	8.00	0.00	12.31
WP 82	52.00	6.94264	3.90561	7.05	4.35	2.70	COVERED/ CASED	COLOURLESS	27.50	7.82	141.00	0.01	216.92
WP 83	51.00	6.94275	3.90592	7.47	4.37	3.10	COVERED/ CASED	COLOURLESS	27.00	7.53	139.00	0.01	213.85
WP 84	52.00	6.94317	3.90614	7.16	3.27	3.89	COVERED/ CASED	COLOURLESS	26.90	7.65	102.00	0.01	156.92
WP 85	52.00	6.94294	3.90611	7.07	4.16	2.91	COVERED/ CASED	COLOURLESS	27.30	7.44	100.00	0.01	153.85
WP 86	55.00	6.94350	3.90653	6.18	2.99	3.19	COVERED/ CASED	WHITISH	27.00	7.56	95.00	0.01	146.15
WP 87	51.00	6.94339	3.90667	6.53	3.45	3.08	COVERED/ CASED	WHITISH	27.50	7.49	98.00	0.01	150.77
WP 88	52.00	6.94303	3.90717	7.10	6.50	0.60	COVERED/ CASED	COLOURLESS	28.80	7.56	108.00	0.01	166.15
WP 89	48.00	6.94325	3.90725	6.71	5.43	1.28	COVERED/ CASED	COLOURLESS	27.10	7.30	102.00	0.01	156.92
WP 90	56.00	6.94392	3.90692	7.50	5.41	2.09	COVERED/ CASED	COLOURLESS	27.00	7.18	99.00	0.01	152.31
WP 91	53.00	6.94411	3.90778	4.75	3.68	1.07	COVERED/ CASED	COLOURLESS	26.80	7.22	108.00	0.01	166.15
WP 92	56.00	6.94486	3.90900	9.86	6.98	2.88	COVERED/ CASED	COLOURLESS	27.40	8.42	84.00	0.01	129.23
WP 93	58.00	6.94483	3.90900	7.20	4.73	2.49	COVERED/ CASED	BROWNISH	26.60	8.07	55.00	0.00	84.62
WP 94	59.00	6.94458	3.90894	8.08	5.41	2.67	COVERED/ CASED	COLOURLESS	28.80	7.93	109.00	0.01	167.69
WP 95	47.00	6.94478	3.90942	6.28	3.77	2.51	COVERED/ CASED	COLOURLESS	27.30	7.85	112.00	0.01	172.31
WP 96	56.00	6.94539	3.91033	7.91	4.59	3.32	COVERED/ CASED	COLOURLESS	27.60	8.06	92.00	0.00	141.54
WP 97	48.00	6.94386	3.90828	6.47	4.10	2.37	COVERED/ CASED	WHITISH	26.30	7.85	66.00	0.00	101.54
WP 98	53.00	6.94408	3.90811	7.55	5.49	2.06	COVERED/ CASED	COLOURLESS	28.60	8.26	67.00	0.00	103.08
WP 99	53.00	6.94375	3.90811	6.06	3.91	2.15	COVERED/ CASED	COLOURLESS	28.10	7.84	157.00	0.01	241.54
WP 100	51.00	6.94358	3.90806	6.71	4.41	2.30	COVERED/ CASED	COLOURLESS	27.90	7.93	143.00	0.01	220.00