Journal of Geology and Mining Research Vol. 3(6), pp. 153-160, June 2011
Available online http://www.academicjournals.org/jgmr
ISSN 2006 – 9766 ©2011 Academic Journals

Full Length Research Paper

The economics of water supply management in Obantoko area, Abeokuta, Nigeria

Ufoegbune, G. C.[1]*, Orimoloye, A. O.[1], Eruola, A. O.[1] and Ogunyemi, I. O.[2]

[1]Department of Water Resources Management and Agrometeorology, University of Agriculture, Abeokuta, Nigeria.
[2]Department of Chemical Science, Yaba College of Technology, Lagos, Nigeria.

Accepted 23 March, 2011

This paper examined the management of water supply in Obantoko area -a typical Nigerian settlement. The population of the area was determined using building count method and a satellite imagery while reports of geophysical surveys of the area done in previous works gave the indication of field of prospective boreholes in the area. These were used to determine the costs and locations of prospective boreholes that will help maximize the use of groundwater which is the most prospective water supply source in the study area. A map showing locations of boreholes to be sited and the population they will serve was produced. The study concluded that with a population of 57,750 a total volume of 4,025,500 L of water per day is needed in the study area. This volume of water could be produced from the study area, if careful management of the water resources is done.

Key words: Management, bill of engineering measures, spatial distribution.

INTRODUCTION

Water resources management helps protect the world's environment, foster economic growth and sustainable agricultural development, promote democratic participation in governance, and improve health. Effective water resources management requires an approach involving the participation of users, planners, managers, and policy makers at all levels (Ayoade, 1975). By first assessing a country's overall water supply and demand, and through improved ability of governmental and non-governmental organizations to achieve results, and a coordinated response at local, national, and international levels, effective water resources management is achievable (Oteze, 1981). Alayande (2005) explained that water supply in Nigeria is facing serious challenges and supply-oriented indefinite expansion of water supply infra-structures is stressing the available budgetary allocations to the sector to the limit with population coverage below satisfactory level.

This paper examines the problems of water supply and the prospects of water demand management in Obantoko area of Abeokuta, Nigeria (Figure 1), thereby assisting government and sector players to reappraise their approaches for a much better result. There has been reported insufficient water supply in the study area (Ufoegbune et al., 2010), especially during periods of dry season as a result of a drop in water level due to insufficient rainfall. When rain ceases completely or frequency reduces in the study area, it reduces the water quantity obtained especially in the houses with poorly constructed hand dug wells. Even during periods of rainfall, infiltration of water into the ground reaches the well, thereby causing a mixing of the well water, rendering it unusable for most domestic uses. The lack of proper geophysical survey in Obantoko to determine the best points for the location of a borehole has greatly affected the long term functioning of the borehole. Usually in Obantoko, residents sink boreholes and dig wells with the assumption that, every point in the area is suitable for ground water exploration.

Eventually, these wells or holes are abandoned after a few years since they no longer function. There is also an uncoordinated development of water supply in Obantoko. As regards this, boreholes are usually drilled without regards to minding the distance from one to another and leaving out its closeness to different sources. This paper was aimed at providing a model that will help manage water resources and co-ordinate the development of water resources in the study area, use the geophysical

*Corresponding author. E-mail: gidufoes2000@yahoo.co.uk.

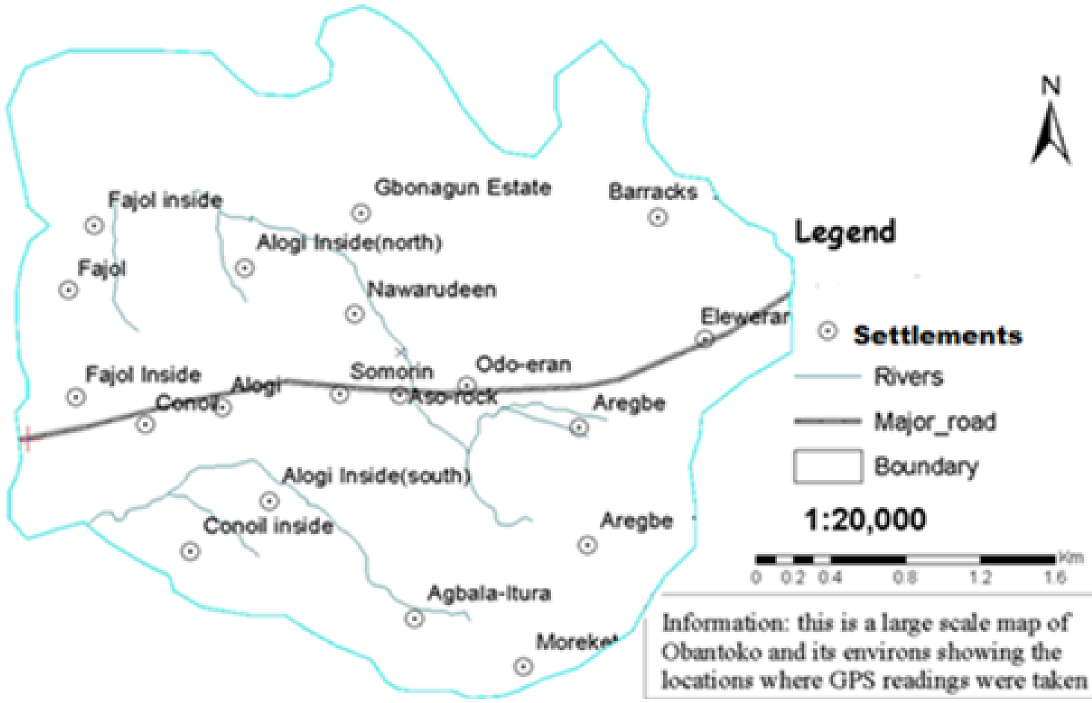


Figure 1. Obantoko Community showing the quarters.

survey report to determine the areas with adequate supply and to produce a map that shows the spatial distribution of water in relation to the arrangement of the people in Obantoko.

MATERIALS AND METHODS

The satellite images obtained from the google earth map was collected from the 2006 version. This was used to determine the population of the study area which covers from Fajol to Eleweran, using building count method. The study area falls within two different local governments that is, Odeda local government and the Abeokuta South local government, as such, the population of the study area could not be obtained from the last census statistics. Obantoko was divided into different quarters (Figure 1) to estimate concentration of people in each part which will in turn determine how many points will be sited in that location. The average depth of boreholes was obtained from various sources which include those from the Ogun Oshun River Basin Authority (OORBDA) and from past projects (Ufoegbune et al., 2009), (see appendix). These past works of geophysical survey in the study area assisted in the determination of the cost of drilling at a particular point. This is likely to vary from one point to another because of the variation in the different profiles.

The bill of engineering measures and valuation was prepared in the light of the geophysical survey report from the past works and the number of people living in the area obtained from building count method. This incorporated the cost of the project and the value (the price of something established by appraisal of its quality, condition, and desirability, or of the cost of replacement) of the project and also the time limit within which the project could be completed. The number of people in a quarter together with the daily use of each person was compared to the projected capacity of the wells which is dependent on lots of factors e.g the quantity of underground water, pump capacity, occupation of people in that area e.t.c. using the equation:

Population × Consumptive daily use = Quantity of water required for the area in one day

The volume of water the well can supply in one day was then compared with the quantity of water required for the area in one day through the equation:

Well yield for one day – Quantity of water required for that area in one day = Well efficiency

Also, the closeness of the water source to the residents is also important. A map was produced to show the projected distribution of the water source in relation to the residents and also allowances for residents that can afford pipe connection to their homes. For those that cannot afford connections to their residences, water outlets are to be provided in places close to their homes which will be up for sale at affordable prices. Those that can afford the pipe connection will pay monthly fees that will be affordable and that will balance the quantity and availability of the supply to their homes at all times and in all seasons. Areas with insufficient supply which were detected via the geophysical survey reports will be catered for by the areas with adequate quantity of water. This will be done via pipe networking.

RESULTS AND DISCUSSION

The estimate of population based on dwelling unit count which was obtained from the google earth map using Arc GIS 9.3 (Figures 2 and 3).

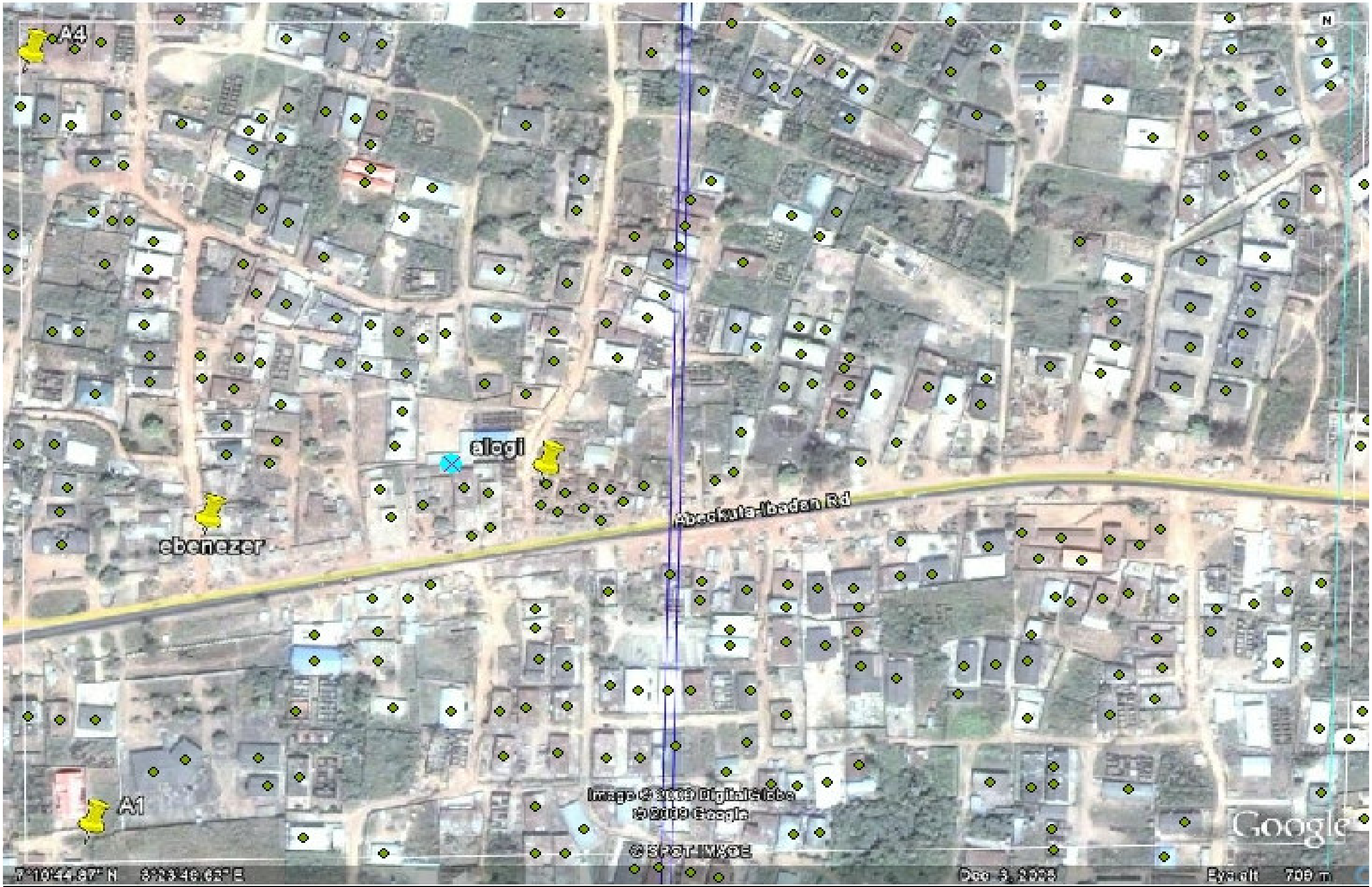


Figure 2. Cross section of the satellite image of the study area showing the tagged.

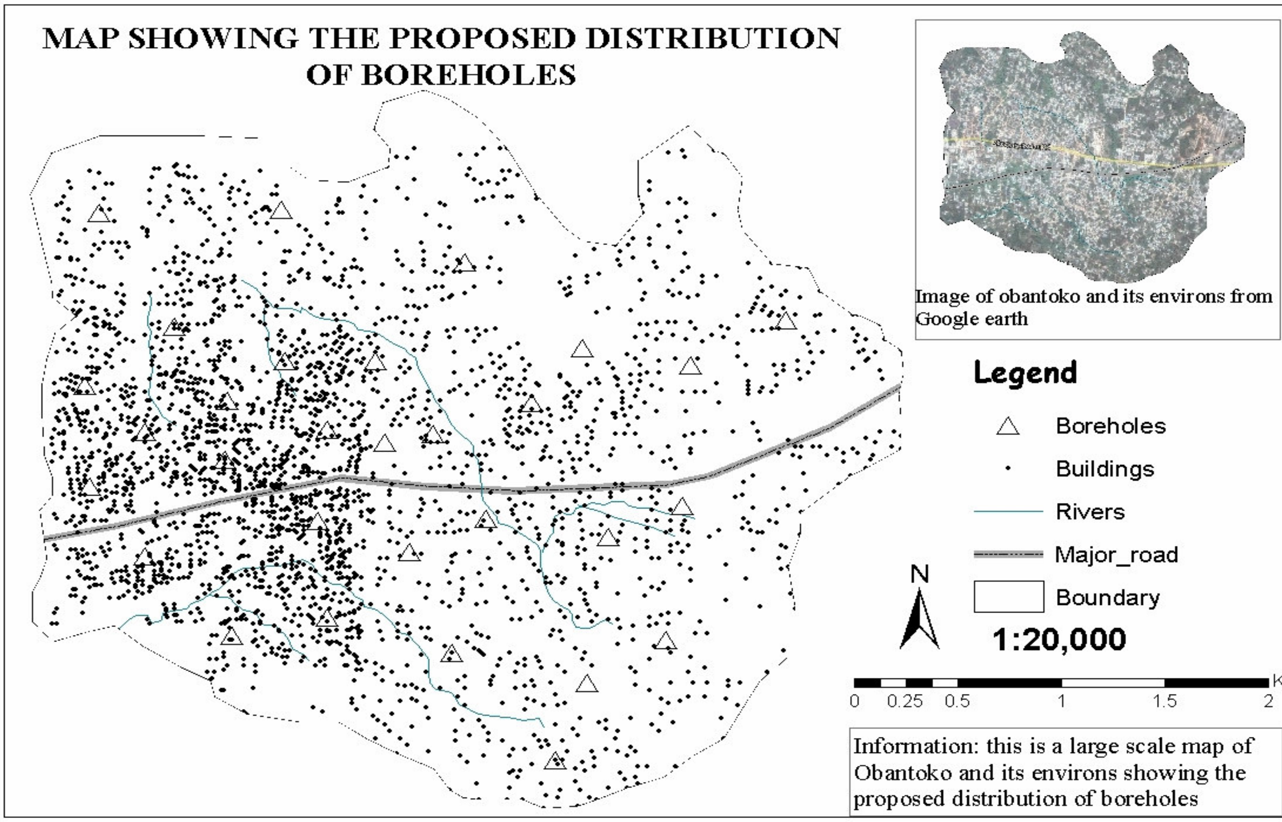


Figure 3. Map of the study area showing the spatial distribution of rooftops and proposed borehole locations.

Rooftops

The total number of rooftops counted is 4,125 and from the reconnaissance survey carried out on the study area, an average of 14 persons per house was estimated. This brought the total estimated population to 57,750 people in the study area. Based on the WHO standard for the quantity of water required by an individual in one day (70 L per person per day), the volume of water required in the study area was calculated to 4,025,500 L. The bill of engineering measures that was prepared to determine the cost of this project which was based on an up-to-date market price of materials and services is given in Tables 1a and 1b. Excluding the cost indicated in the bill of engineering measures, there are other recurrent costs such as the cost of fuelling the generating set that should provide electricity, since the public source of electricity is very unreliable. It should be noted that this is exclusive of the cost of generating set. Also, the management of the proposed borehole location will be handled by individuals that will be paid monthly salary. Other recurrent cost such as pump maintainance e.t.c will also be considered.

Apart from the provision of adequate water supply, the closeness of the water source to the homes of the residents is of paramount importance. The location of building and the population derived from building count method was used to determine the location of boreholes in the area. A map showing the spatial analysis of the proposed borehole location and the rooftops which indicate the houses of the people in the study area is produced. This is done by estimating the quantity of water required and from the map allocating more points to the densely populated areas

SUMMARY AND CONCLUSIONS

The economics of water supply in Obantoko is aimed at providing effective planning, development and operation of water supply in this area. This is a systematic process that first involves the determination of the population. For the purpose of this study, this was done using the building count method. Satellite images of the study area was obtained from the google earth map, it was then taken to a GIS environment and then digitized to count the number of rooftops in the area. An estimate of the number of persons per house based on a reconnaissance survey is used to multiply the number of rooftops which summed up to the estimated population. The volume of water required in the study area is estimated according to the WHO standard of water quantity. The ground water potential from previous works

Table 1a. Bill of engineering measures and valuation.

Item	Description	Qty	Unit	Rate	Amount
	Bill no. 1				
A	Preliminaries				
B	Mobilization of men, equipment including the drilling rig, compressor, water tanks, generator and pump and materials to and fro site and construct temporary store at the site.		Sum		150,000.00
C	Preparation of drilling mud and excavation of concrete floor.		Sum		100,000.00
	Bill no. 1			**N**	**250,000.00**
	Preliminaries carried to summary				
	Bill no. 2				
	Drilling of borehole				
A	Drill semi - manual (means it is motorized, that is the use of electrical motor to power the rig and use manual jack to with draw the rig from the hole, the optimum dept is determined through geological survey) 120ft through clay and sand (that is, it is different unit of 12ft long each, but interlocked at each end.		Sum		350,000.00
B	Supply and install of 6'' UPVC casing and screen	1	Nr	120,000.00	120,000.00
C	Use of chemical (Antisol: polyanionisches cellulose polymer 1 ½(one and half) bags of 25kg each, Newdrill: anionic polyacrylamide ½ bag of 25kg each, and Beutouite 20bags of 20kg each) for drilling		Sum		110,000.00
D	Construction of sizeable concrete base		Sum		160,000.00
E	Develop borehole to its optimum yield		Sum		135,000.00
F	Raw water tank	1	Nr	125,000.00	125,000.00
G	Supply and install 1HP submersible pump capable of high yield with pump starter cable safety rope rise pipes,(UPVC - TIGER HEAD) including linking to raw water tank	1	Nr	150,000.00	150,000.00
	Bill no. 2				
	Drilling of borehole carried to summary				**1,150,000.00**

(Ufoegbune et al., 2009, see appendix) was assumed. This helped to determine the number of boreholes that should be drilled in the study area.

A map is produced to this effect showing the spatial distribution of proposed borehole locations and buildings.

After this, a bill of engineering measures is prepared as regards this project to be able to put a figure to the total monetary value for providing

Table 1b. Bill of engineering measures and valuation.

Summary	
Preliminaries page 1	250,000.00
Drilling of borehole Page 2	1,150,000.00
Total estimate for borehole to form tender	1,400,000.00

sufficient portable water to the study area. Using the population estimate which is 57,750 persons, a total volume of 4,025,500 L of water per day is needed in the study area. From a reconnaissance survey of yield, a borehole in Obantoko will be able to yield close to 15,000 L of water in one day. Mathematically, over 250 boreholes will be needed to supply the study area with adequate water; but if efforts are made to locate boreholes with reference to the population it will serve, fewer boreholes would then have to be sunk and the usage of these boreholes would then be maximised.

REFERENCES

Alayande AW (2005). Water Demand Management. Delivered At Thethe Urban Water Supply Facilities Maintenance Course Held At National Water Resources Institute, Kaduna. November 7th -18th.

Ayoade JO (1975). Water Resources Andand Their Development in Nigeria: Nigeria in Maps. Department Of Geography University Of Ibadan Press. Nigeria.

Oteze GE (1981). Water Resources in Nigeria Department of Geology, University of Benin. Environ. Geol., 3(4): 177-184(C) 1981: Springer-Verlag New York Inc.

Ufoegbune GC, Lamidi KI, Awomeso JA, Eruola AO, Eruola AO, Idowu OA, Adeofun CO (2009). Hydro-geological characteristics and groundwater quality assessment in some selected communities of Abeokuta, Southwest Nigeria. J. Environ. Chem. Ecotoxicol., 1(1): 11-22

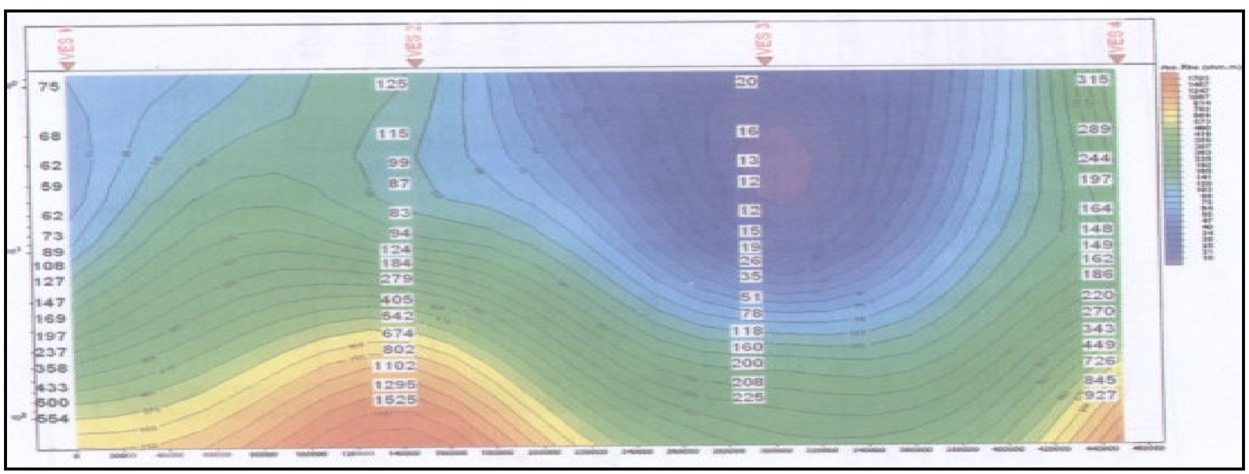
Ufoegbune GC, Oyedepo J, Awomeso JA, Eruola AO (2010). Spatial Analysis of Municipal Water Supply in Abeokuta Metropolis, South Western Nigeria, REAL CORP 2010 Proceedings/Tagungsband Vienna, 18-20 May 2010 – ttp://www.corp.

APPENDIX

Summary of location description, layer resistivity and thickness, depth of hand dug wells and lithology at Obantoko (Ufoegbune et al., 2009).

VES Locations	Layer 1		Layer 2		Layer 3		Layer 4		Layer 5		Average depth of hand dug wells
	Resistivity (Ωm)	Thickness (m)	Resistivity (Ωm)	Thickness (m)	Resistivity (Ωm)	Thickness (m)	Resistivity (Ωm)	Thickness (m)	Resistivity (Ωm)	Thickness (m)	
1	303.1	0.7	305.4	2.0	253.9	15.3	61.2	22.8			6.7
	Top soil		Sandy soil		Lateritic sand		Weathered basement		Fresh basement		
2	60.3	1.8	3.7	1.5	21.0	1.2	960.2	4.2			5.6
	Top soil		Clay soil		Lateritic sand		Weathered basement		Fresh basement		
3	706.0	0.8	41.3	2.0	463.9	39.5	749.4				4.9
	Top soil		Highly weathered basement		Highly weathered basement		Weathered basement/fracture		Fresh basement		
4	687.6	0.8	37.6	1.8	459.1	12.4	502.2	40.1	735.7		5.8
	Top soil		Sandy soil		Lateritic soil		Weathered basement		Massive bedrock		

Resistivity variation with elevation at Obantoko (Ufoegbune et al., 2009).



The geophysical survey report collected from the archives of the Ogun Oshun river basin was analysed to determine the ground water potential of the study area. Below is the summary of the result from VES measurement.

Summary of VES measurement at Obantoko.

	Layer	Resistivity (Ω)	Thickness (m)	Depth (m)	Inferred lithology
VES 01	1	303.1	0.7	0.7	Top soil
	2	305.4	2.0	2.7	Sandy soil
	3	253.9	15.3	18.0	Clayey soil
	4	61.3	22.8	40.7	Clay
	5	609.0	-		Fresh basement
VES 02	1	60.3	1.8	1.8	Top soil
	2	3.7	1.5	3.3	Clay
	3	21.0	1.2	4.5	Clay
	4	960.2	4.2	8.7	Fresh basement
	5	16653.6	-	-	Fresh basements