International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979; Impact Factor: RJIF 5.72
Received: 23-05-2019; Accepted: 27-06-2019
www.allsubjectjournal.com
Volume 6; Issue 8; August 2019; Page No. 114-117

Reliability test on existing ground water mapping in relation to performance in south western Nigeria: A case study of Abe Babalola University (ABAUD)

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Abstract
This research was carried out with the aim to obtain a usable groundwater potential mapping of Afe Babalola University. Ado Ekiti. (ABUAD), using the performances rating of the drilled boreholes spread across the institution to validate an un-used groundwater potential map. Forty (40) boreholes that were drilled in the institution were subjected to evaluation and their coordinates were serially numbered and inserted into the existing Groundwater potential mapping. From the results obtained, Twenty- One (21) active boreholes were observed to have their site in locations that were designated as having good to moderate groundwater yield, Eleven (11) failed/dry boreholes had their site in locations that were considered as having good to moderate groundwater potential, Four (4) Active boreholes were also observed to be sited in area designated as having poor groundwater yield, while Four (4), were observed to be cited in areas designated as having poor groundwater yield. This results give a 66% approval rating that the groundwater potential mapping can serve as a useful guide for the purpose of site selection for groundwater exploitation.

Keywords: groundwater potential map, evaluation, moderate yield, poor yield

1. Introduction
Afe Bablola University Ado Ekiti (ABUAD), is underlain by the Basement Complex Rocks of Southwestern Nigeria. The groundwater in a typical Basement Complex environment is usually contained in the weathered and/or fractured basement rocks or alluvial deposits within flood plains. This discontinuous nature of the basement aquifer system makes detailed knowledge of the subsurface geology, its weathering depth and structural disposition through geologic and geophysical investigations inevitable Ademilua, (2013) [1]. In the past years, many groundwater exploration exercises have been carried out in Afe Babalola University Ado Ekiti (ABUAD), all in a bid to delineate the subsurface sequence. Their efforts had resulted into borehole site selections of an estimated numbers of Forty (40) boreholes spread across the entire length and breadth of the institution. Closer examinations of the boreholes showed an over whelming numbers of abandoned boreholes littering the landscape of the institution and as yet the combined productive efforts of the active boreholes are not able to meet the daily water sustainable target of the university, which ultimately refers to it that more boreholes will still be sunk in the nearest future. Given the economic loss and social deprivation associated with failed groundwater supply system, there is the need for a verifiable groundwater mapping that can be followed through to identify the localized aquifer units and map the lateral and depth extent into areas of moderate groundwater potential. Raji, (2014).

1.1 Site Description and Geology
1.1.1 Location
Afe Babalola University, Ado Ekiti (ABUAD), a Federal Government-licensed Private University is located in Ado-Ekiti along Ijan road, opposite The Federal Polytechnics. The institution has an estimated total population of 11,100 i.e., students population of 8,850 and Administrative staff (Teaching and Non-Teaching) of 2,255. (Wikipedia, the free encyclopedia).

1.1.2 Geology, Climate and Hydrogeological Frameworks
The geology of ABUAD belongs to the basement complex, igneous rock, rock of South-Western, Nigeria. The lithological rock units are basically crystalline basement rocks which include coarse grained charnockite (the most abundant in Ado Ekiti), fine grained granite, medium grained granite and porphyritic biotite, medium grained granite and quartzite. ABUAD, experiences a tropical climate with distinct wet and dry seasons. These seasons are associated with the prevalence of maritime south westerly monsoon winds from the Atlantic Ocean and the dry continental north easterly harmattan winds from the Sahara Desert. The community therefore enjoys rainwater surplus between May and October with substantial rainwater deficit between November and April. Hydro geologically, like in other typical basement complex terrain, unweathered or fresh crystalline rocks have, on their own, hardly any potential in terms of groundwater occurrence and flow.
However, the mode of groundwater occurrence in the study area is through the development of secondary porosities or permeabilities as a result of fracturing, jointing, shearing and deep weathering Obasi *et al*. (2013). The fractures might have probably developed from transpressive forces during tectonic movement, pressure relief due to erosion of overburden rock, shrinking during cooling of the rock mass and the compression and tensional forces caused by regional tectonic stresses

2. Materials and Methods
The Forty (40) boreholes that were drilled and spread across the University Campus were physically examined and their performances were rated as either to be moderate, i.e. (Can support continuous discharge for 3 hours non-stop) or poor.

These were serially numbered accordinging to their coordinates, using a handheld Universal Positioning System (GPS) and inserted into the Groundwater potential mapping. Twenty- One (21) active boreholes were observed to have their site location in the areas that were designated as having good to moderate groundwater yield, Eleven (11) failed boreholes were observed to be sited in areas designated as having good to moderate groundwater potential, Four (4) Active boreholes were also observed to be sited in areas designated as having poor groundwater yield, while Four (4), were observed to be sited in areas designated as having poor groundwater yield.

3. Results and Discussion

3.1 Groundwater Potential Map

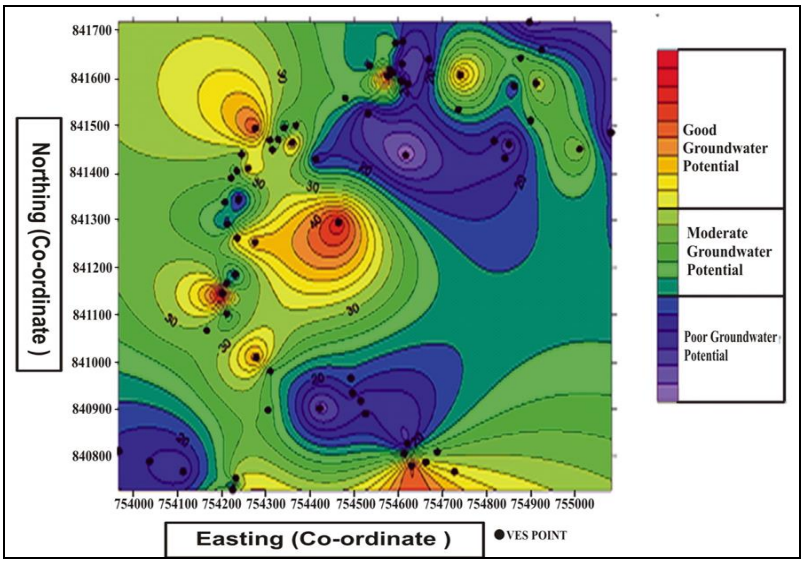


Fig 1: Groundwater Potential Map, Generated by Ademilua (2013) [1] resistivities, overburden thickness and bed topography to generate this groundwater potential

Table 1: Summary table showing Borehole locations and current status

S/N	Location	Status	Co-ordinate (UTM)		
			Longitude	Latitude	Elevation(m)
1.	ABUAD Guest House	Moderate	0753985	0840921	369.3
2.	Opp Fidelity Bank	Moderate	0754195	0840984	364.6
3.	B/H Babana Hostel	Moderate	0754298	0841448	362.8
4.	Frnt Babana Hostels	Poor	0754308	0841362	372.0
5.	Wema Girl/Babana Hostel	Moderate	0754337	0841471	366.0
6.	Senate Building (Left Side)	moderate	0754375	0841196	372.2
7.	Opp Bababa Hostel	Non-Functional	0754377	0841397	368.3
8.	Senate Building(Inside)	Moderate	0754402	0841121	368.7
9.	Senate Building (Right)	Poor	0754441	0841120	362.0
10.	Bk of Wema	Moderate	0754448	0841524	358.5
11.	L/B of College 1	Non-Functional	0754453	0841106	371.0
12.	Talent discovery Centre	Moderate	0754487	0840904	368.0
13.	Front of TDC	Moderate	0754491	0840905	370.7
14.	B/s Wema Hostel	Moderate	0754500	0841532	362.0
15.	Second gate	Moderate	0754514	0840816	371.5
16.	Bk of College 1	Non-Functional	0754544	0841157	368.6
17.	Engineering Building	Moderate	0754550	0841320	371.7
18.	Frnt of College 1	Non-Functional	0754561	0841149	378.00
19.	B of College 2	Moderate	0754563	0841181	379.0
20.	Engineering Building	Moderate	0754565	0841286	371.6
21.	Fire Station	Moderate	0754684	0840970	364.1
22.	B/H Wema Hostel	Moderate	0754590	0841541	365.5
23.	Engineering Building	Moderate	0754593	0841286	371.6
24.	P.G School	Moderate	0754620	0840572	374.0
25.	Back of Boys Hostel	Non-Functional	0754657	0840988	360.6
26.	Behind Alfa Belgore Hall	Non-Functional	0754807	0841461	366.1
27.	Founder's Lodge	Moderate	0754868	0841437	371.1
28.	Ventures Local Kitchen	Non-Functional	0754876	0841239	367.8
29.	Back of Water plant	Non-Functional	0754934	0841290	377.1
30.	Teaching Hospital	Non-Functional	0754944	0840924	368.7
31.	Staff Quarters Block C	Moderate	0754969	0841495	364.5
32.	Staff Quarters Block N	Moderate	0754999	0841366	362.7

33.	Staff Quarters Block F	Moderate	0754999	0841614	360.7
34.	Teaching Hospital	Non-Functional	0755123	0840826	372.6
35.	Teaching Hospital	Non-Functional	0755144	0840821	373.0
36.	Staff Quarters Block J	Moderate	0755150	0841397	367.7
37.	Staff Quarters Block K	Non-Functional	0755159	0841421	379.7
38.	Staff Quarters Block L	Moderate	0755159	0841395	380
39.	Teaching Hospital	Moderate	0755222	0840897	371.5
40.	Teaching Hospital	Non-Functional	0765084	0840809	372.9

From the table 1 above, it shows all the location, present status of functionalities the geographical locations and Elevations of all the boreholes in Afe Babalola University as at January, 2019

3.2 Groundwater Potential Map containing the Geographical locations of all Boreholes sited in Afe Babalola University Ado Ekiti

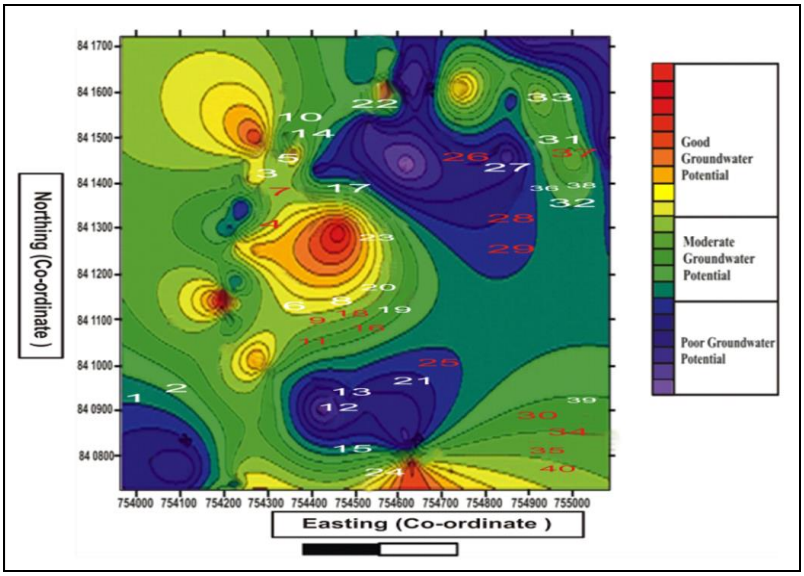
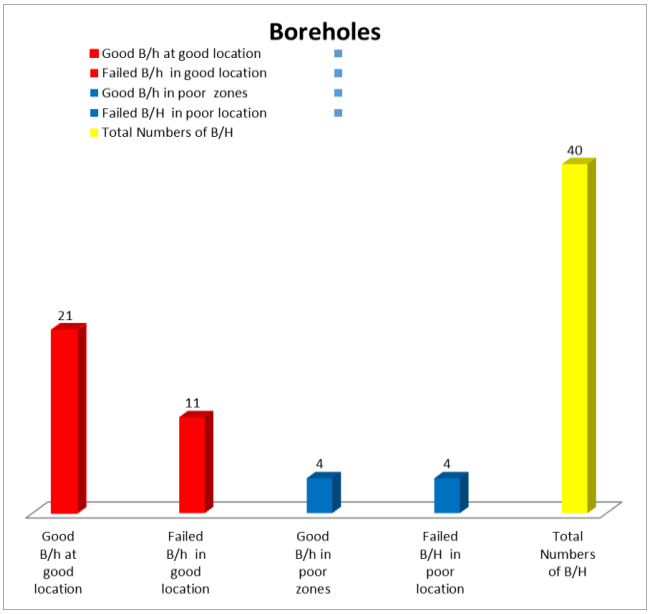


Fig 2: Groundwater Potential Map containing the physical locations of all Boreholes sited in Afe Babalola University Ado Ekiti as depicted in Numbers

Groundwater Potential Map containing Boreholes that have been evaluated and serially numbered according to the geographical locations (white figures indicate active boreholes, while red, indicate failed Boreholes).

3.3 Pattern of Behaviour of Boreholes on the Map



Graph 1: Pattern of Behaviours of Boreholes on the Map

The graph consist of the actual behavior of the boreholes in their respective sites, total numbers of Boreholes are Forty (40). Active boreholes sited in zones designated as Moderate to good are Twenty-one (21) in numbers, those that have failed but were sited in zones, designated as good to moderate are Eleven (11), Good/active boreholes site in zones designated as poor are Four (4),while failed boreholes sited in zones designated as poor are Four (4) numbers.

Table 2: Borehole Performances on the Groundwater Potential Map

S/No	Description	Numbers of Borehole	Reliability Test	
1	Active Boreholes that were sited at locations designated as having moderate to good zone	21	$\frac{21}{32} \times 100 = 66\%$	100%
2	Failed Boreholes that are sited in zones designated having moderate to good	11	$\frac{11}{32} \times 100 = 34\%$	
3	Active Boreholes that are sited locations that were designated having poor zones	4	$\frac{4}{8} \times 100 = 50\%$	100%
4	Failed Boreholes that are sited at locations that were designated having poor zones	4	$\frac{4}{8} \times 100 = 50\%$	
Total Borehole in Afe Babalola University		40		

The above results, describes the dependability coefficient of the existing groundwater potential map, 66% dependability is observed as the result of active boreholes situated in zones designated as moderate, 34% depedendabilty on failed boreholes situated in areas designated as moderate, while 50% dependability on active boreholes in area designated as poor zones and 50% dependability on failed boreholes sited in area designated as poor zone.

4. Conclusion

The existing groundwater potential map was generated from the combination of aquifer resistivity, aquifer thickness and bedrock topography maps. These maps were combined to form a composite entity from which the groundwater potential of ABUAD was designed.

The groundwater potential map was subsequently used to classify the study area into good, moderate and poor groundwater zones.

The reliability test conducted on the map in relation to the performance of existing boreholes showed a significant correlation with the description provided by the ground water map.

Hence, based on the information provided by the Map, it can serve as a useful guide for future borehole locations in the study area as well as serve as good reference materials for research work in the areas of geophysical approaches to hydrogeology studies.

5. Acknowledgments

Huge gratitude goes to the following persons who assisted greatly in the research, Dr. (Ms) Bukola Afolabi, Geology Department, (ABUAD); Mr. Dare Akintoye and Mr. Caleb Ogundipe (Maintenance and Service Department, ABUAD); Mr. Bukky Ogungbade (Geophysicist), Mr. Olumide Oladepo (Geophysict) and lastly to the duo of the Dr. Admilua. A.L and Dr. Eluwole, A.B, for their excellent and extensive research work in ABUAD.

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