International Journal of Advanced Multidisciplinary Scientific Research(IJAMSR) ISSN:2581-4281 Volume 1, Issue 7, September, 2018

https://doi.org/10.31426/ijamsr.2018.1.7.711

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

ANALYSIS OF ELECTRICAL RESISTIVITY DATA FOR THE DELINEATION OF GROUND WATER PROSPECTIVE ZONES AT KARCHANA BLOCK OF ALLAHABAD DISTRICT. U. P. INDIA.

Vinit J.Ganvir, ArjunSingh, Pushpesh Kumar, Amaresh Kr. SinghandVineetKumar

Remote Sensing Applications Center, Sector-G, Jankipuram, KursiRoad, Lucknow U.P, India

vinitjganvir@gmail.com,

VINIT J.GANVIR

ARJUN SINGH

Keywords: VES, Schlumberger configuration ,Apparent resistivity, Aquifer, GIS & water scarcity.

ABSTRACT

Electrical resistivity of sounding of Karchana block was conducted to delineating the ground water feasibility and selection of sites for installation of bore wells. The reason for choosing this area have undergone stress for the natural resources like water is continuous declining of ground water due to urbanization and industrialization also it was dark block in 2008. 2 D resistivity imaging technique was utilized. The 2 D resistivity technique/electrical resistivity technique utilized the Schlumberger electrode array configuration because this array is moderately sensitive to both vertical and horizontal structures.Twenty (20) vertical electrical resistivity soundings were acquired with ABEM resistivity Terameter in Schlumberger configuration. The electrode spacing AB/2 varied from 1.5 to maximum spread length of 150 meters. The VES location identified with the help of GPS Oregon 650, whose horizontal resolution is 1-2 Mt.

Citation: *Vinit J.Ganvir, ArjunSingh, Pushpesh Kumar, Amaresh Kr. Singhand VineetKumar (2018). Analysis Of Electrical Resistivity Data For The Delineation Of Ground Water Prospective Zones At Karchana Block Of Allahabad District. U. P. India. International Journal of Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281 Vol 1, Issue 7, September, 2018, #Art.711, pp 1-10*

Pushpesh Kumar

Amaresh Kr

Singhand VineetKumar

https://doi.org/10.31426/ijamsr.2018.1.7.711

IJAMSR

International Journal of Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

Introduction

Ground water is an important component of the water system for domestic, industrial and agricultural purpose. In Geophysics the electrical resistivity technique is the best technique for identifying ground water prospective zones and is economic as compare to other techniques like magnetic method, seismic refraction method. Geophysical studies of the earth involve taking measurements at or near the earth's surface that are influenced by internal distribution of physical properties. Geophysical method is used to identify physical properties of the earth and monitor Geotechnical properties and then cheaper to perform than drilling many sampling wells. VES is also very useful in determining risk assessment of aquifers it is also identified fresh and saline water and depth to the bedrock. In this technique the 2-dimensional (2D) resistivity data generated using multi electrode which resulted high density pseudo section with dense sampling of apparent resistivity measurement at shallow depth ranging from surface to depth of the aquifer.

Ground water is the main source for potable water supply, domestic, industrial and agricultural uses. The scarcity of ground water increases day by day due to rapid population, urbanization, industrial and agricultural related activities, natural calamities etc. The declining of the ground water is alarming with years of devastating effects on human and ecosystem. To meet out the demand of water, people are depending more on aquifers.

Ground water development, therefore, constitutes a practicable choice, where potential ground water is good. In the Indian context, the situation becomes more precarious due to continuous declining of groundwater and over exploitation because of urbanization and Industrialization. Further, low rainfall, high evaporation and runoff limit recharge to the ground water system. The feasibility of using electrical resistivity methods to determine resistivity, depth and thickness of the model earth layers, estimation of number of smooth and equivalence layers corresponding to the number of model earths layers (stratigraphic correlation). Geophysical investigation of the subsurface strata can we made either from the land surface or in a drilled hole in the formation. The surface method includes electrical resistivity, gravity, magnetic, seismic, remote sensing, etc. Among these methods, the electrical resistivity method is widely used for ground water potential identification has been applied more widely in ground water exploration studies because it is an economic and reasonable method as compared to others.

Study Area

The present study area is situated in a Karchana block of Allahabad district, the area lying between Latitude 25°21’ 6.249’’ N to 25° 09’ 4.372’’ N and Longitude 81°51’ 41.809’’ E to 82° 5’ 21.389’’ E. It is bounded by Kaudhiyara in the west, Uruwan in the east, Meja block lies in the southern part whereas northern side is bounded by Bahadurpurblock. The Yamuna River follows the block boundary between Karchanaand Bahadpur block. It comprises 80 Gram Panchayat and 119 revenue villages. Karchanablock in Allahabad district forms part of great Indo-Gangetic plains and is situated almost on the bank of the area between the Yamuna and Ganga rivers. The entire block is covered by Alluvial formation (Alluvial plain) is of low relief characterized by thick deposition of clay, canker, sand, gravel and Vindhyan hills of the plateau region.

https://doi.org/10.31426/ijamsr.2018.1.7.711

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

Karchana block in Allahabad district of Uttar Pradesh lies in alluvial plain and hard rock terrain. Groundwater is available only in medium sand, weathered and fracture zones. In this area assured surface water supplies are nominal and most of the farmers depend on groundwater for drinking and irrigation purposes. Average annual rainfall is around 973.8mm which is mostly lost as surface runoff and evaporation. The age of formation of rock in this area is Proterozoic to Recent and it is characterized by Quaternary alluvium and Vindhyan Plateau.

Cultivation is the major activity in this area, monsoon water is not sufficient to fulfil the requirement for both domestic and economical purposes. As the ground storage water is the only ultimate source for all requirements. In this context of the more dependent on groundwater, as well as open wells are deepened and the creation of deep bore wells are constructed for irrigation purposes.

This work is undertaken with the following objectives

a) To delineate the occurrence of freshwater aquifer in the study area through geophysical investigation.
b) To delineate the fresh/saline zone interface by interpretation of VES results.
c) Hydro geomorphological study through interpretation of local geology.
d) As a ground water storage is only the ultimate source for all requirements. In this contest more depending on ground water, as well as open wells are deepened and the creation of deep bore wells are constructed for irrigation and drinking water purpose.

Methodology

Twenty (20) Schlumberger vertical electrical resistivity sounding were acquired at the selected location. The Schlumberger array used, with maximum current electrode separation of 1.5 meters to 150 meters. Electrodes are normally arranged in along a straight line, the potential electrode placed in AB/2<=5MN/2 between the current electrodes. This configuration is mostly used as it would provide subsurface information considering the depth of penetration. The geometrical factor k is used in Schlumberger configuration is; Kk=

whereas k is Geometric factor : A numerical value (in meter) depending on the relative spacing of electrodes.

After noting ΔV and ΔI the apparent resistivity is calculated by the fundamental eqation for resistivity survey is derived from ohm's law the voltage applied accros the cundector is directly proposal to the current flowwing through it

That is $V \alpha I$
V=RI (R=Constant and Resitivity)
R=V/I
Where, V – volatge across the cunductor
I – Current flowing through the cunductor
R – Resitance
According to ohm's law and from the primary data, the mathematical process is as follows:-
The resistivity of the soil (R) =K.V/I
K=constant (ohm's constant)
V=voltage across the cundoctor
I=current in ampere

The result is put in the double log (log-log) graph and the resultant curve is interpreted through the master's curve of (Orellana and Mooney 1966)Schlumberger

https://doi.org/10.31426/ijamsr.2018.1.7.711

IJAMSR

International Journal of Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

method and the interpretation results are calculated.

In the present study, geological mapping is done using inhance LISS-IV and Cartosat PAN merged data for preparing different thematic layers. By using Arc GIS software (10.1 version)prepare various thematic maps like Location map of study area(fig. no.-21),VES Location map of study area(fig. no.-22), Hydrogeomorphological map(fig. no.-23).

Result and Discussion

Resistivity soundings in this area clearly identified the nature of the lithological depth and proved useful in identifying water-bearing zones. After interpreting resistivity data and value, of the study area is found to be changed due to subsurface strata variation. There resistivity value and layer thickness of the subject area is afforded in the table 1. It is observed at most of the locations have four layers, curves, whereas three layers, curves are noticed in location. The top soil layer of variable nature has a resistivity value between 5 to 163 ohm mt. Whose thickness is ranging from1 to 2 Mt. The Overburden thickness layer containing clay\kankar, sandy soil is identified with resistivity value ranging from 5 to 202 ohm met. whose thickness is 2 to 16 mt. The aquifer layer including (Medium sand, Weathered and Fracture zone) is identified with resistivity value ranging from 8 to 487ohm Mt. whose resistivty thickness 9 to 37 mt. After investigation, we find that all the paint is suitable for bore wells. The discharge of the bore wells depending upon thickness of the aquifer. Remote sensing and GIS is the powerful tool and cost effective method for assessing ground water potential zone based on which suitable locations for ground water withdrawal could be identified.

Table-1

Interpretation of Lithology as per their respective resistivity values

VES No.	Apparentresistivty in ohm-Mt.	Thickness in mt.	Probable Lithology	Remarks
1	56.36	1.5	Top soil	Aquifer zone
	35.31	4	Clay/Clay canker	
	22	10	Sand/weathered rock	
	114	18.5	Fractured/compact Sandstone	
2	52	2	Top soil	Aquifer zone
	10	9	Clay/Clay kankar	
	114	23	Sand/weathered rock	
	147	16	Fractured/compact Sandstone	
3	16	1.5	Top soil	Aquifer zone
	5.4	14.5	Clay/Clay kankar	
	21.57	18	Sand	
	41.01	16	weathered/fractured rock	
4	25.21	1	Top soil	Aquifer zone
	62	3	Clay/Clay kankar	
	19.1	14	Sand	
	7.1	37	Sandy clay	
5	12.4	1	Top soil	Aquifer zone
	28.69	12	Clay/Clay kankar	
	51.78	15	Sand/weathered rock	
	65.51	13	Fractured/compact Sandstone	
6	14	2	Top soil	Less Discharge Aquifer zone
	4.98	7	Clay/Clay kankar	
	59.1	19	Sand/weathered rock	
	99.56	13	Fractured/compact Sandstone	
7	59.55	1	Top soil	Aquifer zone
	23.35	7	Clay/Clay kankar	
	9	30	Sandy clay	
	20.1	17	Sand	

IJAMSR

International Journal of Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

8	27.25	2	Top soil	Aquifer zone
	17.38	16	Clay/Clay kankar	
	9.5	20	Sandy clay	
	13.5	17	Sand	
9	12.66	1.5	Top soil	Less Discharge Aquifer zone
	26.3	8.5	Clay/Clay kankar	
	152.8	10	Sand/weathered rock	
	402.5	9	Fractured/compact Sandstone	
10	4.88	2	Top soil	Less Discharge Aquifer zone
	21.5	5	Clay/Clay kankar	
	211.91	13	Sand/weathered rock	
	487.61	9	Fractured/compact Sandstone	
11	17.47	1	Top soil	Aquifer zone
	24.45	5	Clay/Clay kankar	
	35.89	19	Sand/weathered rock	
	87.41	10	Fractured/compact Sandstone	
12	10.99	1.5	Top soil	Aquifer zone
	21.08	6.5	Clay/Clay kankar	
	14.05	17	Sand/weathered rock	
	39.9	11	Fractured/compact Sandstone	
13	14.6	2	Top soil	Aquifer zone
	24.22	8	Clay/Clay kankar	
	37.93	21	Sand/weathered rock	
	87.55	14	Fractured/compact Sandstone	
14	83.89	1.5	Top soil	Aquifer zone
	16.28	6.5	Clay/Clay kankar	
	7.9	26	Sandy clay	
	26.34	16	Sand	
15	24.16	1.5	Top soil	Aquifer zone
	83.38	8.5	Clay/Clay kankar	
	41.31	35	Sand/weathered rock	
	60.33	21	Fractured/compact Sandstone	
16	66.19	1	Top soil	Aquifer zone
	93.08	4	Clay/Clay kankar	
	39.71	10	Sand/weathered rock	
	42.95	30	Fractured/compact Sandstone	
17	162.73	1	Top soil	Less Discharge Aquifer zone
	201.67	2	Clay/Clay kankar	
	72.37	12	Sand/weathered rock	
	144.96	30	Fractured/compact Sandstone	
18	16.35	1.5	Top soil	Aquifer zone
	43.76	9.5	Clay/Clay kankar	
	16.23	23	Sand/weathered rock	
	56.78	16	Fractured/compact Sandstone	
19	37.35	1	Top soil	Aquifer zone
	69.59	6	Clay/Clay kankar	
	7.3	24	Sandy clay	
	14.94	14	Sand	
20	16.35	1	Top soil	Aquifer zone
	23.34	7	Clay/Clay kankar	
	18.07	26	Sand/weathered rock	
	30.7	16	Fractured/compact Sandstone	

Conclusion

There are four Geo-electrical layers were delineated within the study area and mostly found H, K, A types of VES curves. These includes; the top soil, caly/kankar, sandy clay, weathered and fracture zone. Interpretation of the VES tests indicates the presence of an alluvial aquifer that mainly consists of fractured/weathered Sandstone with an intermediate resistivity range between 5 to 487 ohm mt. The ground water prospects are less in hard rock areas, especially in granitic terrains. The interpretation of resistivity curve is done by Zohdy and IP2win software. Four distinct subsurface geological layers were identified, aided by bore hole litho-logical

https://doi.org/10.31426/ijamsr.2018.1.7.711

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

logs. This includes; the top soil, over burden, weathered and fractured layer. The top soil layer variable nature has a resistivity value between 5 to 163 ohm mt. Whose thickness is ranging from 1to 2 mt. The overburden thickness layer containing clay\kankar, sandy soil is identified with resistivity value ranging from 5 to 202 ohm mt. whose thickness is 2 to 16 mt. The aquifer layer is identified by the resistivity value ranging from 8 to 487 ohm mt. whose resistivty thickness 9 to 37 mt. After investigation, we find that all the paint is suitable for bore well. Most of the feasible sites are found in sand, weathered and fractured granite. Rock type of study area is Vindhyan sandstone, granite, quartzite and granite gneiss. The discharge of the bore wells depending upon thickness of the aquifer. Taking in the view of VES interpretation and the strata of exploration drilling, the Karchana block is considered for feasibility of Bore wells.

Referrnces

1) *Debabrata Nandi, IpsitaMohanta and Sandeep Ranjan Mishra, Delineation of Groundwater Prospective Zones by Schlumberger electrode array in Bangriposi block of Odisha, Int. Res. J. Earth Sci. vol. 3(4), 5-11, April (2015).*
2) *Milton B. Dobrin, Introduction to Geophysical prospecting, fourth edition, New York.*
3) *3. Todd D. K., Groundwater Hydrology. 2nd ed. New York, Wiley Press (1980).*
4) *W. M. Telford, Applied Geophysics, Cambridge University Press.*
5) *Ahilan J. and G. R. Senthil Kumar, Identification of Aquifer zones by VES method: A case study from Mangalore block, Tamil Nadu, S. India, Archives of Applied Science Research, 2011, 3 (2): 414-421.*
6) *D. Gomez-Ortiz, T. Martin-Crespo, S. Martin-Velazquez, P. Martinez-Pagan, H. Higuera's, M. Manzano, Application of ground penetrating radar (GPR) to delineate clay layers in wetlands. A case study in the Soto Grande and Soto Chico watercourses, Donana (SW Spain), journal of Applied Geophysics 72 (2010) 107-13, ELSEVIER.*
7) *Shamsuddin Shahid and Sankar Kumar Nath, GIS Integration of Remote Sensing and Electrical Sounding Data for Hydrogeological Exploration, J. of Spatial Hydrology Vol.2 No.1.*
8) *Jeyavel Raja Kumar T, Dushiyanthan C, Thiruneelakandan B, Suresh R, Vasanth Raja S, Senthilkumar M and Karthikeyan K, Evalauation of Groundwater Potential Zones using Electrical Resistivity Response and Lineament Pattern in Uppodai Sub Basin, Tambaraparani River, Tirunelveli District, Tamil Nadu, India, Kumar et al., J GeolGeophys 2016, 5:2.*
9) *Mathan Prakash and Senthil Kumar G. R., A Study on Delineation of Groundwater Potential Zones in Crystalline Terrain Using Remote Sensing and GIS Techniques, International Jr. of New Technologies in Science and Engineering, Vol 3, Issue 12, Dec 2016, ISSN 2349-0780.*
10) *Molua O. Collins, Igherighe C. Edwin and Eseka Kenneth, Analysis of electrical resistivity data for the determination of aquifer depth at Sapele RD in Benin city, Pelagia Research Library, Advance in Applied Science Research, 2013, 4(6):268-276.*
11) *Mr. Tarun Kumar Lohani, Interpretation of Hydrogeological Parameters from Vertical Electrical Sounding (A case study of Shamuka Beach in Odisha), The spark edition/IJHEPS January 2013, P-ISSN:2249-2569.*
12) *Partha C R, Swetharani V J, Dipa Malik, Prashanth V, Mallika P, Identification of Groundwater Potential Zone in Southern Part of Bangalore East Taluk using Remote Sensing and GIS, International Journal of Research and Innovation in Applied Science (IJRIAS) Vol III, Issue I, January 2018/ISSN 2454-6194.*

https://doi.org/10.31426/ijamsr.2018.1.7.711

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

13) *Y. Ratnakumari, S. N. Rai, S. Thiagarajan and Dewashish Kumar, NGRI Hyderabad, 2D Electrical Resistivity Imaging for delineation of deeper Aquifers in a part of the Chandrabhaga river basin, Nagpur District, Maharashtra, India, Current Science, Vol 102, No.1, 10 January 2012.*

14) *Ayush Mittal, Munesh Kumar, MNNIT Allahabad Uttar Pradesh, India, Ground Water Status- A Case Study of Allahabad, UP, India, International Journal of Advances in Engineering & Technology, July, 2014, ISSN: 22311963.*

15) *Robert J. Hoeksema, Calvin College, Grand Rapids, Michigan, Peter K. Kitanidis, Department of Civil and Mineral Engineering, Minneapolis, Minnesota, Analysis of the Spatial Structure of Properties of Selected Aquifers, Water Resources Research, Vol 21, No4, page 563-572, April 1985.*

16) *Dewashish Kumar, V Ananda Rao and V S Sarma, NGRI Hyderabad, Hydrogeological and geophysical study for deeper ground water resource in quartzitic hard rock ridge region from 2D resistivity data, J. Earth Syst. Sci. 123, No 3, April 2014, pp. 531-543, Indian Academy of Sciences.*

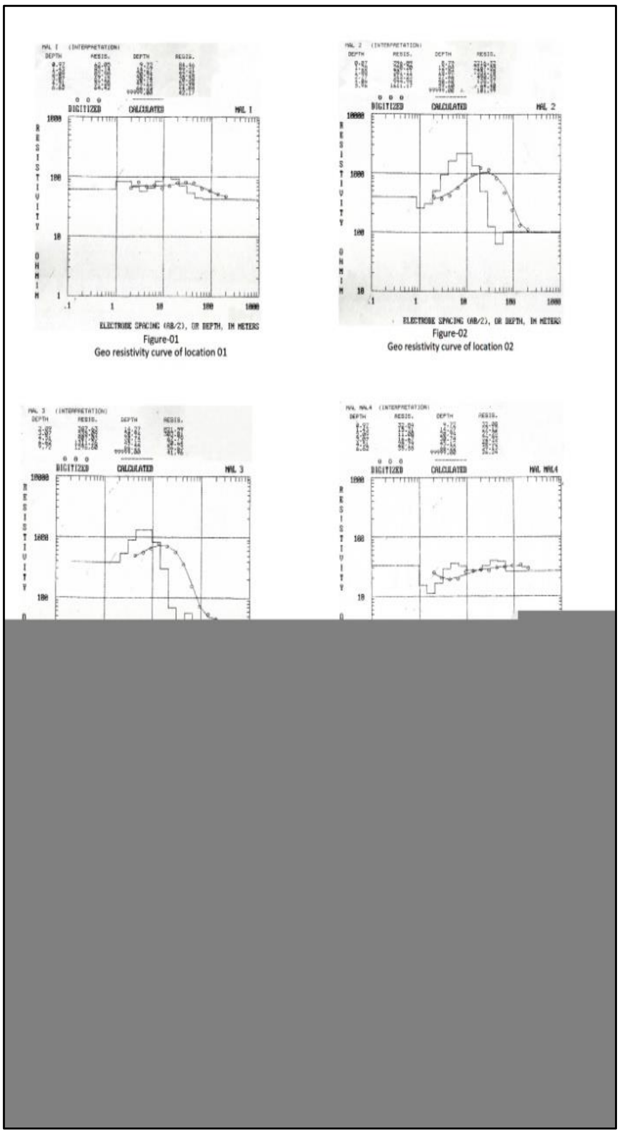

Figure-01
Geo resistivity curve of location 01

Figure-02
Geo resistivity curve of location 02

https://doi.org/10.31426/ijamsr.2018.1.7.711

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

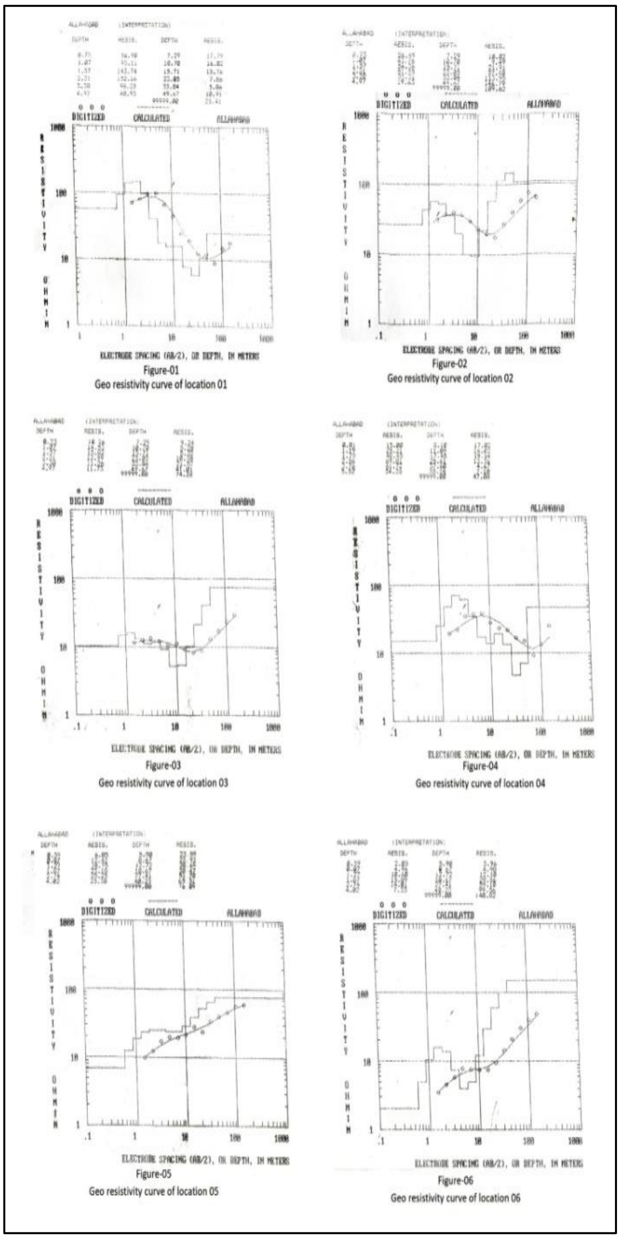

Figure-01 Geo resistivity curve of location 01

Figure-02 Geo resistivity curve of location 02

Figure-03 Geo resistivity curve of location 03

Figure-04 Geo resistivity curve of location 04

Figure-05 Geo resistivity curve of location 05

Figure-06 Geo resistivity curve of location 06

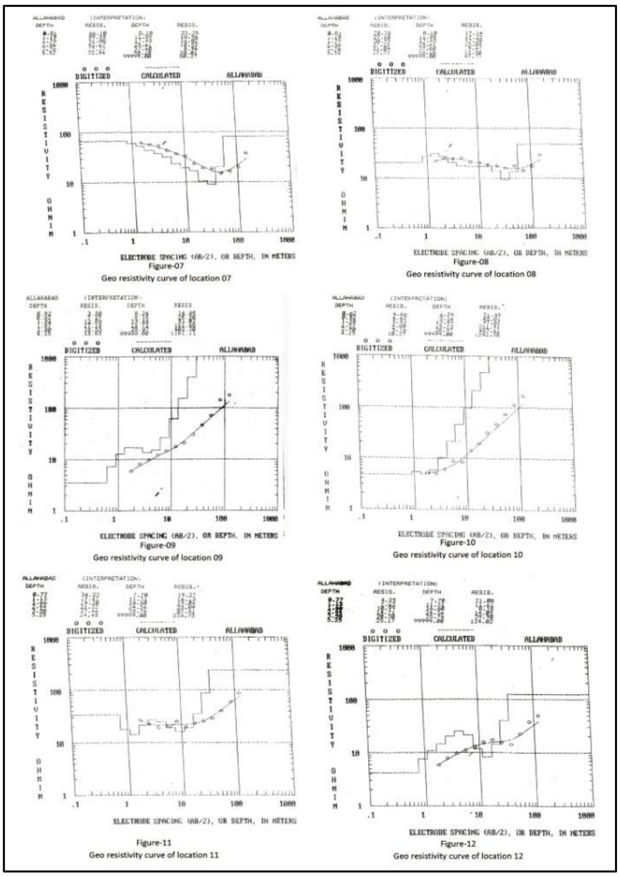

Figure-07 Geo resistivity curve of location 07

Figure-08 Geo resistivity curve of location 08

Figure-09 Geo resistivity curve of location 09

Figure-10 Geo resistivity curve of location 10

Figure-11 Geo resistivity curve of location 11

Figure-12 Geo resistivity curve of location 12

https://doi.org/10.31426/ijamsr.2018.1.7.711

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

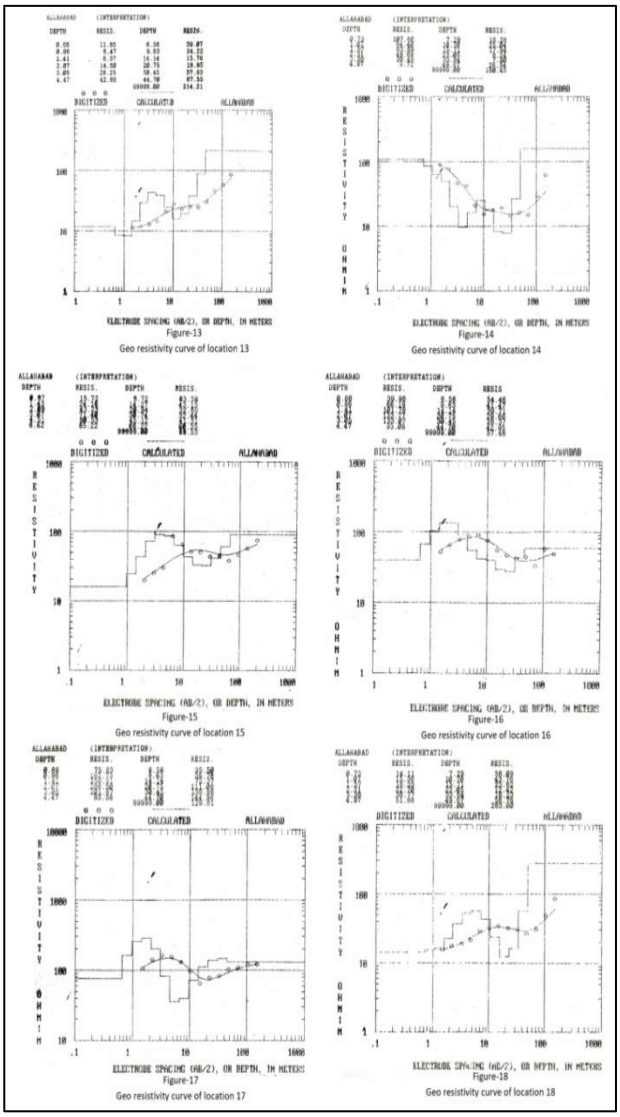

Figure-13
Geo resistivity curve of location 13

Figure-14
Geo resistivity curve of location 14

Figure-15
Geo resistivity curve of location 15

Figure-16
Geo resistivity curve of location 16

Figure-17
Geo resistivity curve of location 17

Figure-18
Geo resistivity curve of location 18

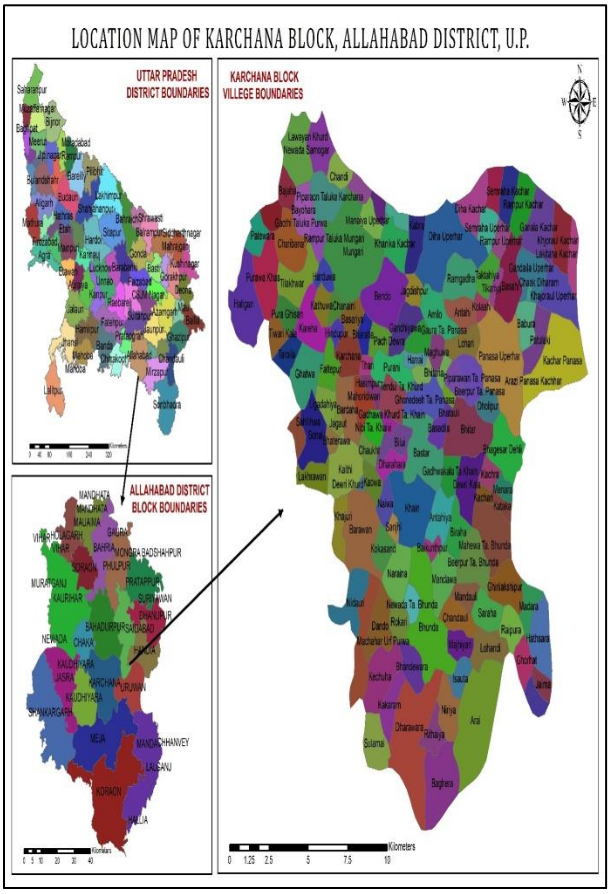

Fig. No. 21 Location map of Study area

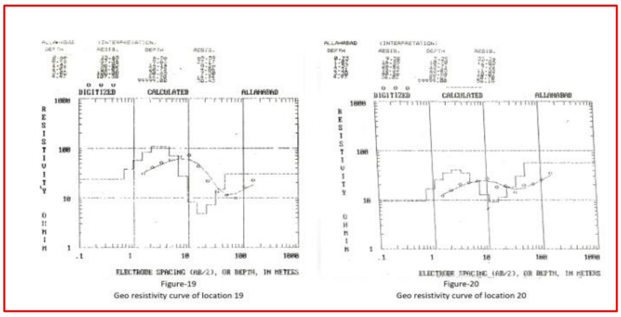

Figure-19
Geo resistivity curve of location 19

Figure-20
Geo resistivity curve of location 20

https://doi.org/10.31426/ijamsr.2018.1.7.711

IJAMSR

**International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281**

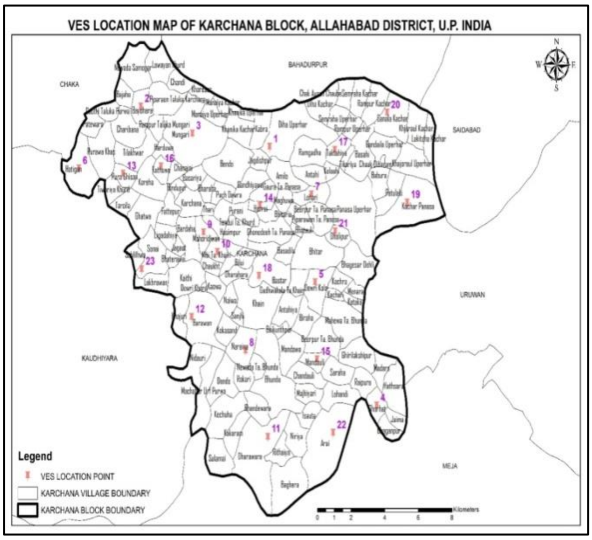

Fig. No. 22 VES Location map of Study area