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ELECTRICAL RESISTIVITY METHOD APPLIED TO STUDY GROUNDWATER RESOURCES IN AND AROUND THE ZAHEERABAD TOWN, SANGAREDDY DISTRICT, TELANGANA, INDIA

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B.Chandrashekar [3***]

ABSTRACT

To investigate the subsurface geological and hydrological conditions around the area of the Zaheerabad Town, 16 vertical electrical soundings using Wenner array were performed to a maximum AB/2 spacing of 150 m. Quantitative and qualitative interpretations of data were carried out to determine the nature and thickness of the aquifer zone. The average resistivity in the topsoil is 33.37 Ωm with an average depth of 11.03 mts in the weathered zone the average value is 13.71 Ωm with an average depth of 30.83 mts in the semi weathered zone the average value is 34.04Ωm, with an average depth of 53.89 mts. Along this zone three bore points went dry at Hoti-B village as these points had shallow weathered zone of about 19 meters average and later was the massive basalt without any Intertrapean bed and no proximity to lineaments. Apart from Hoti-B two points at Algole village did not yield proper water as this too had little weathered zone and is within massive basalt devoid of proper recharge conditions and lack of Intertrapean bed. The basic controlling point in the region which has been observed from the geophysical survey and the study of the litho-log at the time of drilling indicate that where ever good weathered zone with proper depth and the ash bed/Intertrapean/tuff beds were encountered, there was good yield in the wells and the failure cases has only massive basalt or the clay formation. This study has revealed for this area, an average depth of the aquifer of 32 m with the average thickness of the aquifer being 22 m. The geoelectric sections of some VES stations demarcated corroborate very well with the geological description of the area.

Keywords:

Vertical Electrical Sounding; Groundwater, Aquifer; Resistivity

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1. INTRODUCTION

Land and water are two broad components on which the entire biotic community thrives. Water scarcity is not a general phenomenon but a regionally, locally, and seasonally specific problem. It is imperative that water, a scarce and precious national and natural resource, should be planned, developed, conserved and managed on an integrated and environmentally sound basis, keeping in view the socio-economic aspects and needs at sub-national levels. The available surface water resources are inadequate to the entire water requirements for all purposes. So the demand for ground water has increased over the years. Ground water is

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a renewable mineral resource and has the remarkable distinction of being highly dependable, available at the place required, safe and within the reach and control of beneficiaries. The situated at a distance of 100 kms from Hyderabad, the capital of Telangana the study area in Sangareddy district lies between $17^0 35'$ and $17^0 50'$ of north latitudes and 77^0 30′ and 77^0 40′ of east longitude falling in survey of India toposheet no.56G/9 & G/10 (Figure 1). The area comprises of several villages and the major town is Zaheerabad, which is on Hyderabad-Mumbai national highway no.9. The electrical resistivity method used is aimed at studying the horizontal and vertical discontinuities in the electrical properties of the ground. This is targeted at investigating the shallow subsurface geology of the area [1]

2. GEOLOGY OF STUDY AREA

The study area is represented monotonously by a single formation known as Deccan basalt and lateritic formations comprising nearly horizontal lava flows [2, 3] (Figure 2). These flows have been considered to be a result of fissure type of lava eruption during late Cretaceous to early Eocene period [4, 5, 6&7] Basalts occurring in and around Zaheerabad mandal of Sangareddy district form the eastern extremity of the great mass of deccan traps that extends westwards into adjacent Karnataka and Maharastra states. The Deccan traps appear as step like terraces or plateaus occupying large areas. They are exposed between the elevations of 600 to 660 meters in the study area (Figures 3 & 4). They show spheroidal weathering and columnar jointing (Figure 8). Basalts are highly weathered and are decomposed resulting in the formation of laterites which are seen to occur as cappings on top levels and also along the slopes of the hillocks and as red loamy soil in low lying areas while the out crops of the bed rock are seen exposed in deep gullies (Figure 9). Basalts are showing bluish tone with coarse texture and the laterites show greenish tone [8] (Figure 5). The geological map is shown in (Figure 1). Basalts occurring in and around Zaheerabad exhibit both vesicular and non-vesicular forms (Figure 10). The non-vesicular massive units are fine grained, dense and compact, they are dark in colour. In some places they show columnar and spheroidal structures and commonly show well-developed joints in various directions. The vesicular type of basalts is highly altered which gave rise to laterites. In the study area there are 9 flows of traps of which the first seven flows are not weathered and still they appear as basaltic in composition, whereas the 8^{th} and 9^{th} flow has been completely weathered and altered to laterites [9]. Thus laterites occur as cap rocks over basalts and form flat plateaus and tablelands at elevation range from 600 to 660 msl. Laterites have a typical reddish brown colour. They have cavities often filled with yellowish to reddish clayey material (Figure 11). A zone of lithomargic clay marks the contact between the traps and the laterites. The lithomarge is siliceous and exhibit brown to brownish green colour with soapy touch. It is slightly hard to break. It is locally called as "Sapa Murram" [10]. In the study area the different stratification types of laterites are as: 1).Vesicular laterites 3 to 8 meters. 2). Pisolitic Laterites 2 to 7 meters. 30). Compact and Massive Laterites 5 to 15 meters

A. Basalts

Basalts were formed from the eruption of volcanic flows from upper cretaceous to eocene period and have been spread over a large area of about 5,00,000 Sq.Km. [11] covering the north western, northern and southern parts of India along its western border occupying Madhya Pradesh, Maharastra, Gujrat and Telangana (which was earlier known as Deccan). These are horizontal flows trapping the older rocks and are mostly confined to the Deccan parts and hence they are known as Deccan traps or Deccan basalts. Basalts exhibit both vesicular and non-vesicular form. Vesicular forms are very porous and soft, while the non-vesicular forms of basalts are very compact and hard. In fact, it was the vesicular type of basalts is highly altered to give rise to laterites. The Deccan traps which basaltic in composition, are the parent rocks of laterite. In the study area there were 9 flows of deccan traps according to [12], of which the first seven flows are not weathered and still they appear as basaltic in composition, whereas the 8^{th} and 9th flows have been completely weathered and altered to laterities [13] (Figure 12). Thus the laterites under the description are the part of the ninth flow. A red or grey indurated earth of white marl with lamine of tuff indicating sub-aerial weathering separates the flows from each other.

B. Laterites

Laterites which are formed due to the weathering of traps flow no.9 have been exposed in the area which varies in thickness from 10 to 30 meters and covering over a 50 sq.km in and around Zaheerabad, Sangareddy district of Telangana. They occur as small isolated hillocks and are generally confined to the levels higher than 600 m contour. The laterites show vesicular and pisolitic forms and cube like masses at various places. The structure and textures in the laterites are nothing but affects caused during the post-sub aerial weathering stage.

C. Occurrence of ground water

The ground water in the study area occurs under unconfined and confined conditions. The unconfined conditions are attributed to the weathered portions of the aquifer and confined conditions are ascribed to the aquifers underlying the impermeable zones of basaltic formations. The depth to water table in the study area largely varies between 10.0 m to 18.0m depending upon the topographical conditions. In general, tapping the weathered and fractured zones of the aquifers makes the ground water development in this area [14].

D. Recharge and discharge of ground water

Precipitation study area is the principal source of recharge in surface water bodies such as tanks and streams also contribute some recharge to the ground water. Besides, the applied irrigation also provides some re-charge to the ground water in the study area. The discharge of the ground water in the study area is made by sinking dug wells, dug-cum-bore wells and bore wells. A part of ground water is also lost into the streams of effluent nature during lean/summer periods.

3. FIELD INVESTIGATIONS

In general, electrical investigations particularly vertical electrical soundings, conducted to determine the sources of groundwater potential zones and to identify fresh groundwater sources. Some of the significant applications are lateral differentiation of permeable formations from impermeable or less permeable formations, vertical distribution of various layers. Electrical resistivity and self potential surveys. Self potential (SP) method is applied to identify plumes of contaminations, integrating the SP anomaly with electrical resistivity and water quality data [15]. A total of 16 vertical electrical soundings (VES) were carried out at selected locations (Figure 6). In and around the study area in order to infer the subsurface conditions along the Profiles, soundings were carried out using IGIS make Resistivity meter wherein the current and potential readings are displayed for calculating the resistance. Accessories are metal electrodes, measuring tape, labelled tag (used in locating station position), hammers (used in driving the electrodes into the ground), compass, and connecting cables, cast iron stakes as current electrodes and carbon filled porous pots as potential electrodes were used to improve the ground contact. The entire VES were carried out with a maximum current electrode separation (AB/2) as started with 1.5 to maximum depth of 120 m to 150 m covering an area of 8.58 sq. km. The locations of VES were chosen such a fashion to cover the entire study area uniformly with closer to longer in meters within the study area and in kilometers around the study area distance between soundings and as per the availability of space for carrying out surveys [16].

The induced current passes through progressively deeper layers at greater electrode spacing. Apparent resistivity values calculated from measured potential differences can be interpreted in terms of overburden thickness, water table depth, and the depths and thicknesses of subsurface strata [17]. For this study, the Wenner configuration is used for prospecting arrangements of the electrodes. In the Wenner array the four collinear electrodes are placed at equal intervals. The two outer electrodes (C1, C2) are used for passing current into the ground, while the inner two (P1, P2) are used for measuring the voltage difference. Depth sounding involves moving out all the four electrodes from the centre of the array, in a series of steps. The distance between each pair of electrodes is kept equal to the distance between the other pair. Wenner array was used to acquire VES data at five (16) sounding points, one along each traverse. The electrode separation (AB/2) varied from 1.5 to maximum depth of 120 m to 150 m in the study area. Current was passed into the ground through the current electrodes, and the resulting potential was measured through the potential electrodes, and was converted to resistance [18].

4. RESULTS AND DISCUSSION

In the study area in and around Zaheerabad about 16 Vertical electrical soundings have been carried out soundings presented in (Table 1 & Figure 7) and sounding have been taken in the SW-NE direction from Zaheerabad town covering the following villages: Madhulai Tanda (1), Govindpur (4), Hoti-B (2), Hyderabad (1), Zaheerabad (4), Algole (3), and Bardipur (1). The entire profile falls in laterites and basalts area. Madhulai Tanda situated at an elevation of 633-640 m (Figure 13A) is the starting point in the SW direction of the study area the VES point is situated along the lineament the rocks are laterites, the top soil is approximately 30 mts with an average resistivity of 31.73 Ωm followed by weathered zone to a depth of 51mts with a resistivity of 25.8 Ωm and from 51-93 mts is semi weathered zone, with a average resistivity of 76 ohm mts the massive basalt touch at a depth of 94 mts (Table 1 & Figure 13A), Ground water in this zone is stored at the contact of laterites-weathered basalt and the drilling was done to a depth of 90mts which yielded approximately 3500 GPH. Further north at Govindpur village five electrical sounding were taken (Table 1). At point (Figure 13B) near Govindpur Village, top soil and morrum zone is 11mts with a average resistivity of 67.25Ωm followed by weathered zone from 11-39mts which shows average resistivity of 9.51 Ωm and the semi weathered zone is around 39-50mts with a resistivity of 12.6 Ωm depth at which the massive basalt touches around 50mts the bore well drilled at this point yielded 3600GPH and the drilling was done to a depth 90mts. At point (Figure 13C) of Govindpur Village which is composed of laterities with plateau moderately dissected, the top soil is about 10 mts with a average resistivity of 14.58 Ωm followed by weathered zone from 10-40mts with a average resistivity of 17.12 ohm mts followed down by semi weathered zone from 40-63mts with a resistivity of 14.78 Ωm, the bore well yielded 3100GPH and the depth of drilling was 80mts. Point (Figure 13D) which is located at a lower elevation and near to the lineament at Govindpur Village is composed of basalts, the top soil covers from 0-7mts with a average resistivity of 17.26 Ωm and from 7-25mts is weathered zone with a resistivity of 4.84 Ωm followed by semi weathered zone from 25-63mts with a resistivity of 10.36 Ωm the bore well at this point yielded about 1200GPH at a total depth of 110 meters drilling.

At point (Figure 13E) near Govindpur Village composed of laterities, the top soil is 9mts with a average resistivity of 85.8 Ωm followed by weathered zone from 9-44.4mts which shows resistivity of 9.08 Ωm and the semi weathered zone is around 44.4-45.6mts with a resistivity of 25.5 Ωm and the massive basalt touches at an depth of 45mts, at this point the bore well was drilled to a depth of 100 mts which yielded around 3500GPH of water. Further NE at Hoti B village with an elevation of 627-633 meters at point (Figure 13F) composed of basalts with dissected region which posses 7mts of soil with a average resistivity of 46.65 Ωm from 7-13mts is weathered zone with a resistivity of 9.14 Ωm followed by semi weathered zone from 13-19mts with a resistivity of 10.1 Ωm followed by massive basalt at shallow depth and less of weathered zone the bore well drilled to a depth of 100 meters resulted in a very poor yield. Hyderabad village with an elevation of 620 to 627 meters is mostly laterites in the higher elevations and basalts along the lower reaches and the valley portions At point (Figure 13H) which is composed of basalts is situated along the lineament with 4mts of topsoil with a resistivity of 11.7 Ωm followed by weathered zone upto the depth of 25 mts with a average resistivity of 36.6 ohm mts followed by semi weathered zone to a depth of 50 mts and average resistivity of 9.25 Ωm. Further down is massive basalt the bore drilled at this point to a depth of 80 meters yielded 1200 GPH. Zaheerabad town located at an elevation of 613-620 meters is mostly composed of laterites and basalts. Point (Figure 13I) is composed of laterities in contact with basalts is situated along lineament with 9mts of topsoil with an average resistivity of 34.22 Ωm followed by weathered zone with a average resistivity of 1.81 Ωm upto 25mts followed down by basaltic rock the bore drilled to a depth of 70mts yielded 1700GPH.

At point (Figure 13J) near Zaheerabad town the top 8mts topsoil has an average resistivity of 10.79 Ωm and from 8-21mts is weathered zone with a resistivity of 2.38 ohm mts followed by semi weathered zone upto a depth of 53mts having resistivity of 49.2 Ωm, further down is massive basalt and the bore drilled at this point yielded 1600 GPH and the depth of drilling was 60 mts. Near Zaheerabad, point (Figure 13K) comprising mostly laterities in contact with basalts is situated on the plateau region near to lineament. The topsoil layer is 6mts with a average resistivity of 36.25 Ωm followed by weathered zone with a average resistivity of 18.61 Ωm upto the depth of 25 mts further down while drilling the basaltic rock touches and an Intertrapean bed was encountered at 65mts depth and the bore yielded 3200GPH and the total depth of drilling was 70mts. Similar is the situation at Point (Figure 13L) near Zaheerabad town where the bore drilled encountered Intertrapean bed at 80 mts and the bore well yielded 3000 GPH and the drilling was done till 90 mts (Table 1). Algole village situated at an elevation of 607-613 mts points (Figure 13M) composed of basalts is situated along the lineament, at this point the topsoil is till the depth of 6 mts with a resistivity of 46.54 Ωm and weathered zone between 6-19 mts has resistivity of 16.9 Ωm further down the semi weathered zone has resistivity of 30.6 Ωm. During drilling the Intertrapean bed was encountered at 72mts and the water was struck at this point with a yield of 2400 GPH with total depth of drilling was upto 80mts. Further at point (Figure 13N) near Algole Village the topsoil is upto a depth of 8 mts with a resistivity of 8.22 Ωm and from 8-16 mts is weathered zone with a resistivity of 10.1 Ωm and further down to a depth of 16-25 mts with a resistivity of 13 Ohms mts is semi weathered zone, at this point the depth of drilling for the bore well is 110 mts and the yield of the bore well was poor because of less weathered zone and the lack of lineament and Intertrapean bed. Similar was the situation a point (Figure 13O) at Algole village with the well having poor yield. The last point along this section is Bardipur Village lying at an elevation of 620 to 627 mts., is in the dissected region and the point (Figure 13P) is located near to the lineament and the area comprising of laterites and basalts. The top soil a depth of 15 mts has an average resistivity of 14.70 ohm meters, further in the weathered zone upto a depth of 45 mts the resistivity is 9.89 ohm meters, further down was the massive basalts. The well drilled to a depth of 100 mts yielded 3500 GPH after the Intertrapean bed was encountered at 90 mts depth.

5. CONCLUSION

The geological study using remote sensing data shows that mainly Basalts and laterites cover the area. The geohydrological properties of traps are complex. Dependable ground water bodies are often confined to the near surface weathered and jointed zones. Partly weathered traps form good aquifers while in highly weathered form become red soil which is impervious. In the case of massive basalts groundwater occurs in joints and crevices. Vesicular basalts act as good aquifers when the vesicles are interconnected and are not filled with secondary minerals like calcite, zeolite, and quartz. In some areas the sheets of basaltic lava are interbedded with great masses of tuffs, which more or less open texture or the intertrappeans which may be either impure limestone or sands of loose texture. All these fragmentary rocks, tuffs and intertrappeans might be so placed as to form good aquifers. Geophysical data integrated with geology, structure and geomorphology has greatly helped in locating the groundwater potential zones in the study area. The average resistivity in the topsoil is 33.37 Ωm with an average depth of 11.03 mts in the weathered zone the average value is 13.71 Ωm with an average depth of 30.83 mts in the semi weathered zone the average value is 34.04Ωm, with an average depth of 53.89 mts. Along this zone three bore points went dry at Hoti-B village as these points had shallow weathered zone of about 19 meters average and later was the massive basalt without any Intertrapean bed and no proximity to lineaments. Apart from Hoti-B two points at Algole village did not yield proper water as this too had little weathered zone and is within massive basalt devoid of proper recharge conditions and lack of Intertrapean bed.

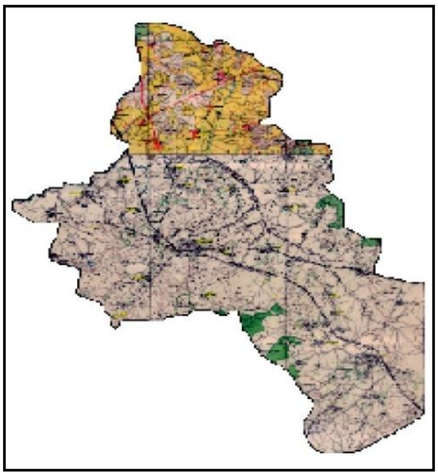

Figure 1. Toposheet of the study area

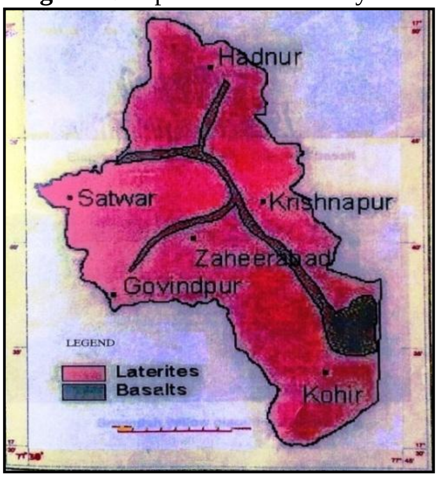

Figure 2. Geological map of the study area

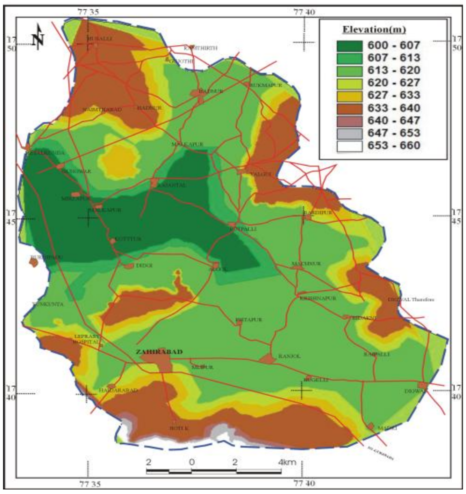

Figure 3. Elevation distribution map of the study area

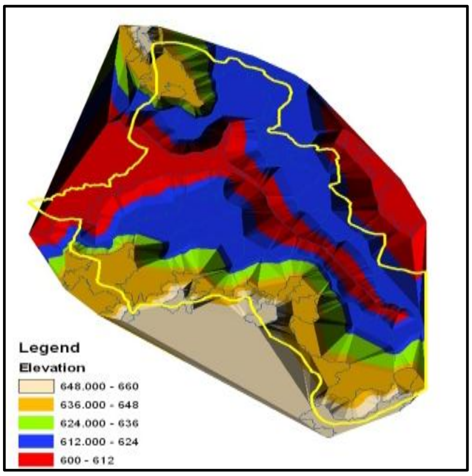

Figure 4. Triangulated irregular network map of the study area

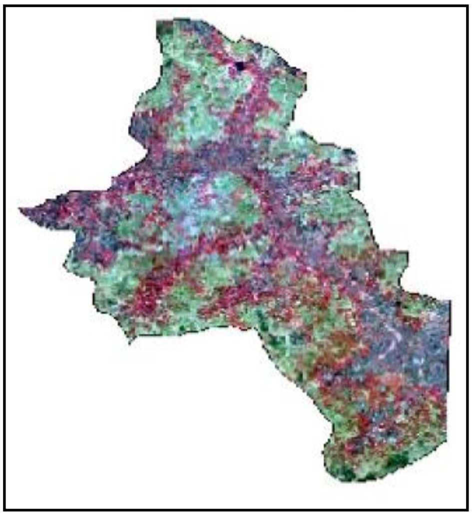

Figure 5. Satellite image of the study area

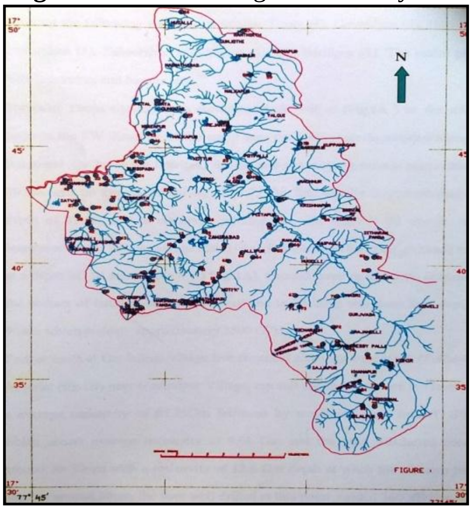

Figure 6. Drainage and geophysical sounding points in the study area

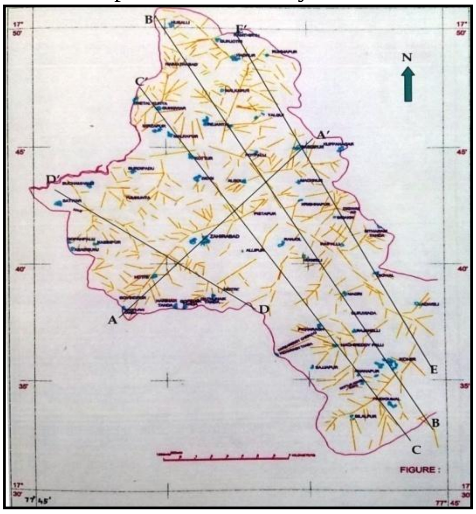

Figure 7. Geophisical sounding traverses along with lianements in the study area

Figure 8. Elephant skin spheroidal weathered basalt

Figure 9. Typical reddish brown vesicular laterites

Figure 10. Highly weathered vesicular basalt

Figure 11. Brownish yellow pisolitic laterites

Figure 12. Laterites occur as cap rocks over basalts and form flat plateaus and tablelands at elevation range from 600 to 660 msl

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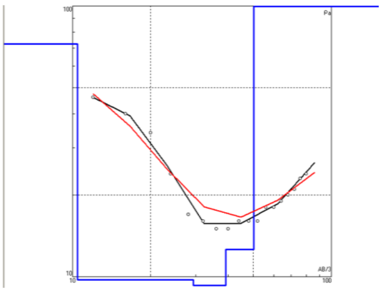
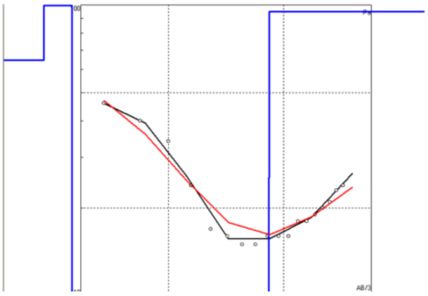


VES-1

p	h	d
76.6	12	12
19.5	7.2	19.2
15.4	4.32	23.5
15.4	6.48	30
25.8	20.8	50.8
86.6	19.9	70.7
65.2	22.9	93.6
26.7		

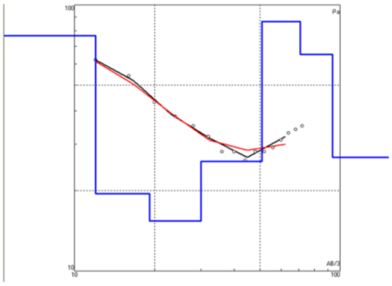
Figure 13 A. Madhulai Tanda village (3500GPH Yield Depth of Drilling 90 mts)



VES-6

p	h	d
60.8	4.66	4.66
64.6	2.8	7.46
132	1.87	9.33
9.08	14.6	23.9
9.08	20.5	44.4
25.5	0.19	44.6
94.9		

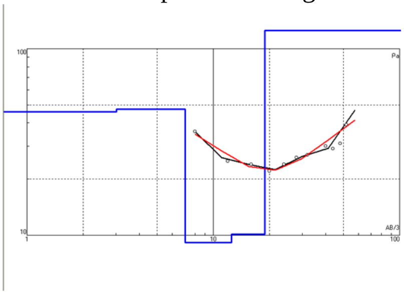
Figure 13E. Govindpur village (1200GPH Yield –Depth of Drilling 110 mts)



VES-2

p	h	d
62.1	4.4	4.4
72.4	2.49	6.89
72.4	3.55	10.4
9.74	18.8	29.2
9.28	3.92	33.2
9.28	5.88	39
12.6	4.43	43.5
12.6	6.65	50.1
109	133	183
109		

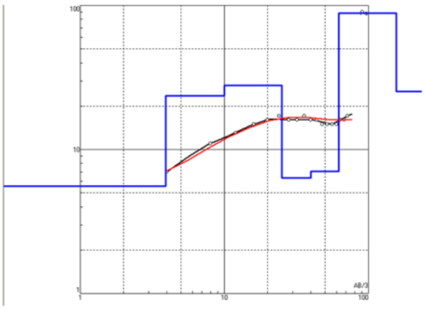
Figure 13 B. Govindpur village (3600 GPH- Depth of drilling 90 mts)



VES-8

p	h	d
45.9	3.01	3.01
47.4	4.05	7.06
9.14	5.44	12.5
10.1	2.37	14.9
10.1	4.03	18.9
125		

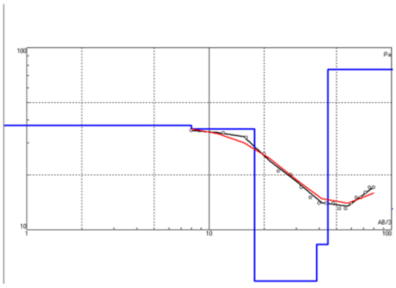
Figure 13F. Hoti B village (No Yield Depth of Drilling 100 mts)



VES-4

p	h	d
5.56	3.92	3.92
23.6	6.08	10
27.9	15	25
6.34	15	40
7.05	22.5	62.5
88.5	93.8	156
25.3		

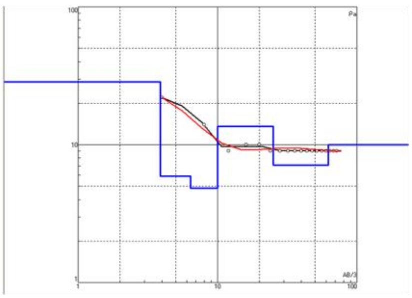
Figure 13C. Govindpur village (3100GPH Yield –Depth of Drilling 80 mts)



VES-10

p	h	d
37.4	8	8
35.7	9.73	17.7
5.09	21.1	38.8
8.3	5.91	44.7
75.8	66.7	111
13		

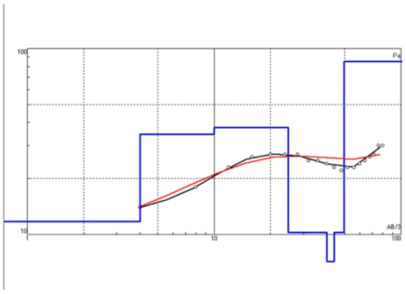
Figure 13G. Hoti B village (2800GPH Yield – Depth of Drilling 80 mts)



VES

p
28.
28.
28.
5.9
4.8
4.8
4.8
13.
7.1

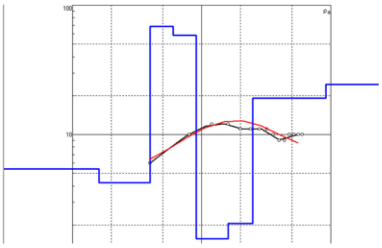
Figure 13D. Govindpur village (3100GPH Yield –Depthof Drilling 80 mts)



VES-12

N	p	h
1	11.7	1.6
2	11.7	2.4
3	34.6	6
4	37.6	6
5	37.6	9
6	10.3	15
7	7.16	3.84
8	10.3	5.76
9	85.1	107
10	85.1	

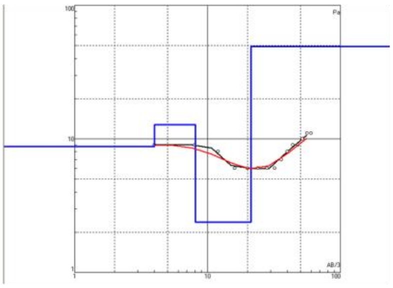
Figure 13H. Hyderabad village (1200GPH Yield –Depth of Drilling 80 mts)



VES-13

N	p	h	d
1	5.42	1.6	1.6
2	4.24	0.96	2.56
3	4.24	1.44	4
4	68.6	0.81	4.81
5	68.6	1.22	6.03
6	58.6	3.05	9.08
7	1.56	6.92	16
8	2.05	8.86	24.9
9	19.1	66.8	91.7

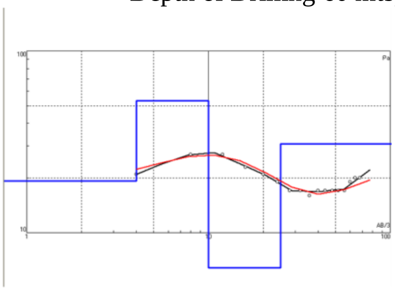
Figure 13I. IOC Zaheerabad village (1700GPH Yield –Depth of Drilling 70 mts)



VES-16

p	h	d
19.3	1.6	1.6
19.3	2.4	4
53.2	2.4	6.4
6.42	3.6	10
30.8	15	25

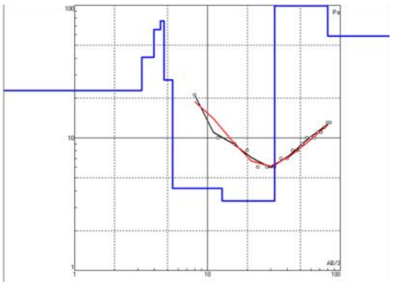
Figure 13J. Zaheerabad (1600GPH Yield – Depth of Drilling 60 mts)



VES-15

p	h	d
8.77	1.6	1.6
8.77	2.4	4
12.8	1.79	5.79
12.8	2.32	8.11
2.38	13.1	21.2
49.2	31.8	53
49.2		

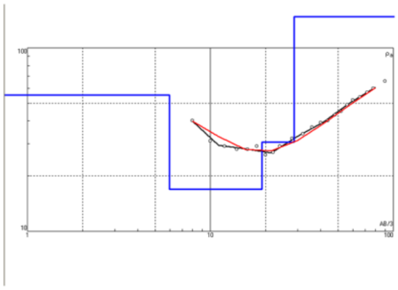
Figure 13K. Zaheerabad (3200GPH Yield – Depth of Drilling 70 mts)



VES-17

P	h	D
22.8	3.2	3.2
40.6	0.77	3.97
65.7	0.46	4.43
76.2	0.28	4.7
76.2	0.005	4.71
27.4	0.76	5.57
4.17	7.39	12.9
3.35	19.3	32.2
118	48.2	80.4
586		

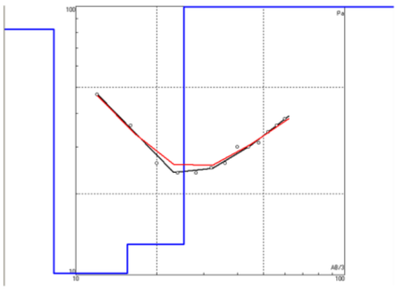
Figure 13L. Zaheerabad (3000GPH Yield –Depth of Drilling 90 mts)



VES-19

P	h	D
55.3	5.98	5.98
16.9	13.2	19.2
30.6	9.57	28.8
148		

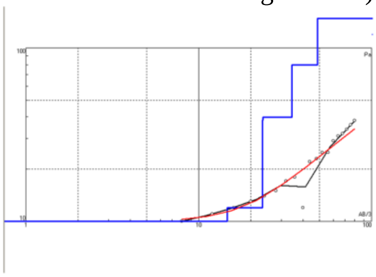
Figure 13M. Algole village (2400GPH Yield – Depth of Drilling 80 mts)



VES-20

p	h	d
8.22	8.29	8.29
10.1	7.28	15.6
13	9.69	25.3
108	26.4	51.7
103		

Figure 13N. Algole village (Poor Yield –Depth of Drilling 110 mts)



VES-21

p	h	d
10	14.6	14.6
12	8.76	23.4
38.4	0.15	23.5
39.9	11.1	34.6
79.8	14.1	48.7
148	73	122
120		

Figure 13O. Algole village (Poor Yield –Depth of Drilling 110 mts)

Table-1 Electrical resistivity in different litho units in the study area

S.No.	Name of the Village	Topsoil			Weathered Zone			Semi-Weathered Zone			Massive Rock			Remarks
		Ωm	H (m)	D (m)	*Ωm*	H (m)	D (m)	*Ωm*	H (m)	D (m)	*Ωm*	H (m)	D (m)	
A	Madhulai Tanda	76.6	12	12	25.8	20.8	50.8	86.6	19.9	70.7				Depth of Drilling 90 mts. Yield 3500 GPH.
		19.5	7.2	19.2				65.2	22.9	93.6				
		15.4	10.8	30										
B	Govindpur	62.1	4.4	4.4	9.74	18.8	29.2	12.6	11.08	50.1	109	133	183	Depth of Drilling 90 mts. Yield 3600 GHP
		72.4	6.04	10.4	9.28	9.8	39							
C	Govindpur	5.56	3.92	3.92	27.9	15	25	7.05	22.5	62.5	88.5	93.8	156	Depth of Drilling 80 mts. Yield 3100 GHP
		23.6	6.08	10	6.34	15	40	22.5			25.3			
D	Govindpur	28.6	3.88	3.88	4.84	18.6	25	13.6	37.5	62.5				Depth of Drilling 110mts.Yield 1200 GHP
		5.91	2.52	6.40				7.11						
E	Govindpur	60.8	4.66	4.66	9.08	35.1	44.4	25.5	0.19	44.6				Depth of Drilling 100mts.Yield 3500 GHP
		64.6	2.8	7.46										
		132	1.87	9.33										
F	Hoti-B	45.9	3.01	3.01	9.14	5.44	12.5	10.1	6.4	18.9				Depth of Drilling 100mts No Yield. Poor Weathered Zone
		47.4	4.05	7.06										
G	Hoti-B	37.4	8	8	5.09	21.1	38.8	8.3	5.91	44.7	75.8	66.7	111	Depth of Drilling 80mts.Yield 2800 GHP
		35.7	9.73	17.7							13			
H	Hyderabad	11.7	4	4	34.6	6	10	10.3	15	40	85.1	107	157	Depth of Drilling 80mts.Yield 1200 GHP
					37.6	15	25	7.16	3.84	43.8				
								10.3	5.76	49.6				
I	Zaheerabad	5.42	1.6	1.6	1.56	6.92	16	19.1	66.8	91.7				Depth of Drilling 70mts.Yield 1700 GHP
		4.24	2.4	4.0	2.05	8.86	24.9							
		68.6	2.03	6.03										
		58.6	3.05	9.08										
J	Zaheerabad	8.77	4	4	2.38	13.1	21.2	49.2	31.8	53				Depth of Drilling 60mts.Yield 1600 GHP
		12.8	4.11	8.11										
K	Zaheerabad	19.3	4	4	6.42	3.6	10							Depth of Drilling 70mts.Yield 3200 GHP
		53.2	2.4	6.4	30.8	15	25							
L	Zaheerabad	22.8	3.2	3.2	4.17	7.39	12.9	118	48.2	80.4				Depth of Drilling 90mts.Yield 3000 GHP
		40.6	0.77	3.97	3.35	19.3	32.2							
		65.7	0.46	4.43										
		76.2	0.33	4.71										
		27.4	0.76	5.57										
M	Algole	55.3	5.98	5.98	16.9	13.2	19.2	30.6	9.57	28.8	148			Depth of Drilling 80mts.Yield 2400 GHP
N	Algole	8.22	8.29	8.29	10.1	7.28	15.6	13	9.69	25.3	108	26.4	51.7	Depth of Drilling 110mts.Poor Yield
O	Algole	10	14.6	14.6	38.4	0.15	23.5	79.8	14.1	48.7	148	73	122	Depth of Drilling 110mts.Poor Yield
		12	8.76	23.4	39.9	11.1	34.6				120			
P	Bardipur	8.19	4.8	4.8	9.89	30.3	45				4018	45		Intertrapean Bed, at 70 mts. 3500GPH
		21.2	9.9	14.7										

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