Geophysical Investigation for Ground Water in Yawal Taluka of Jalgoan District, Maharashtra

Dr. S.N.Patil* and Dr.M.V.Baride**

Abstract

The present area under investigation of Yawal Taluka is located towards northeastern parts of Jalgaon district in Maharashtra State. The total geographical area under study is about 95435 hectares. The area is covered with undifferentiated Quaternary sediments and exhibits an undulating topography with southward gradient. The existing land use pattern of the area clearly shows that more than 60% of the area is utilized for agricultural sector. This area is famous for banana and sugarcane plantation. Ground water is the major source of irrigation and domestic purposes. A hydrological investigation was carried out with the help of the well inventory data and utilizing geophysical techniques.

Data obtained from resistivity in Yawal Taluka of Jalgaon district in Maharashtra State, were interpreted by the Inverse-slope method of Sanker Naraan and Ramanujachari. Resistivity, values obtained showed a variation of between 0-3 ohm-m for clay/silt,3-5 ohm-m for medium grained sandy layer, 5-7 ohm-m for loose sand and gravel bed, 7-15 ohm-m for clay with pockets of sand ,15-25 ohm-m for clay with lenses of sand, 25-45 ohm-m for compacted clay with pebbles, cobbles,gravels,40-60 ohm-m for compacted clay beds, and over 60 ohm-m for hard and compacted litho logical units, sites were recommended for dug wells/bore wells, 90% of which proved to be successful.

The litho logs from the dug wells were correlated with investigation data. The North-South cross-section of VES (Vertical Electronic Soundings) data indicates that typical behavior of alluvial, (i.e. clay beds are generally pinches out towards north direction) is discussed.

Introduction

Water is a prime necessity of life and has been the fundamental for the development of civilization from the ancient period. The beginning of our civilization was confined to the river basins. Many civilizations come into existence around perennial water resources. Presently there is a rapid development for utilizing the water resources for their increasing needs. Now days, to find out the water resources, geophysics methods are being used abundantly. Systematic hydro geological & geological investigation is carried out to locate the groundwater potential zones. We have used a DC resistivity method to investigate the hydrogeology the area under study.

Physiography

The area under study is located northeastern part of Jalgaon district of Maharashtra State Total area covered under study is about 95435 hectare. The area is included in survey of India toposheet nos. 46 0/11,0/12,0/15,0/16 and lies between 75° 36' 3"0 to 75° 53'0"N, Longitude & 21° 10' 55" to 21° 70' 5" E, latitude. The Mean Sea level (MSL) ranges in 180m to 1074m.

The area includes the undulating piedmont plains along Southern fringe of Satpuda hills, and the flood plains of Tapi River. The general gradient is southwards. Many streams/Nalas are originating from Satpuds ranges and flowing towards South and ultimately discharges to Tapi River at South. The

*Reader,School of Environmental & Earth Sciences, North Maharashtra University Jalgaon-425001(M.S.)
(Email: sanp2@rediffmail.com)
**Registarar, North Maharashtra University Jalgaon-425001(M.S.)

dendrites and parallel drainage pattern is clearly seen in the area. Hathnur Right Bank Canal is also passing towards Southern part of the area.The study area experiences a semi-arid climate. The average annual rainfall of the area is about 710 mm .The mean maximum temperature ranges from 29 ° C to 48 ° C. The mean temperature ranges from 12° C to 24° C. The high relative humidity values 83.63 % occurs in rainy month,viz June December except during monsoon months, the air is generally dry particularly in the afternoon. Summer is the driest part of the year.

Resistivity Data

Twenty-one resistivity soundings were carried out throughout the study area. The resistivity sounding were taken with the help of Aqua-II plus D.C. Resistivity meter manufactured by Minitronics, Pune. The general hydrological conditions were ascertained on the basis of geomorphologic setting and litho logical characteristics of the different alluvial beds exposed in dug wells. Representative areas of different hydrological environments were then selected for resistivity survey. The Wenner configuration of equally spaced electrode distribution was employed in the surveys.The current electrodes were placed 300 metes apart to obtain information upto a depth of 100 meters. It was interpreted by the Inverse-Slope method of Sanker Narayan and Ramanujachari (1967). The data so obtained is given in Table 2. The complete data is summarized in Table-3. The generalized ranges of resistivity values of different litho units in the present study area are determined. They are as follows in Table 1.

In some anomalous cases, however the resistivity values do not fall within the range given above. At VES Station No. 1,3,13,15,17,18,19.20,21 shows high resistivity at top portion as clay bed with lenses of sand, compacted clay with pebbles, gravels and hard and compacted clay beds, but field observations clears that there is black cotton soil and in some cases black cotton soil show high resistivity. In this case higher resistivity is attributed to the impervious nature of litho units (M. K. Zambre & S. S. Thigale, 1980). The water bearing zones occurring in the form of thin layer with wide variation in the quality of formation water are difficult to resolve from quantitive interpretation of geoelectrical resistivity data (V. A. Prakash & M. L. Gupta, 1983). Hence in the present study area, the low resistivity of clay/silty layer indicated as impervious from the study area shows 3 to 5 Ohm-m and & to 15 Ohm-m. They are granular zones. Resistivity data indicates that the thickness of clay bed with lenses of sand is varying from 5 to 68 meters.

Resistivity (Ohm-m)	Lithotypes
0-3	Clayey layer / silty layer
3-5	Medium grained sandy layer
5-7	Loose sand and gravel bed
7-15	Clay with pockets of sand.
15-25	Clay with lenses of sand.
25-45	Compacted clay with pebbles, cobbles gravels
45-60	Compacted clay beds.
Over 60	Hard and compacted rock

Thus we have prepared the cross-section along North-South direction (i.e. The cross-sections were made on the basis of topography, general trend of groundwater and Vertical Electrical Soundings (VES) data. The North-South cross-section, from the eastern parts of the area will tentatively gives us idea about clear understanding of heterogenous characters of alluvium. The data from VES station No.1,2,4,6,7, 8,911,12 is shown in the N-S cross-section (Fig. 1). The said cross-section also indicates that the overall clay beds are pinches out towards north side.

The correlation of resistivity soundings results with dug well data also suggests the clear understanding between field observations and practical results (L. Ramamohana Rao & J.R. Patel, 1990). The lithological cross-sections as well as Geophysical results variation section are shown in Fig. 2. For this we have selected the unlined dugwell near Nhavi village of VES section No.12 The discharge from the present dug well is 2650 lit/hr.

Table 2: Resistivity in Ohm-m for different Lithotypes from the study area

Sr. No.	Location	Clay/Silty clay.	Medium ground sandy layer	Loose sand & gravel beds	Dry with pockets of sand	Clay with lumes of sand	Compacts d clay bed with pockets cobbles & gravel	Compa cted clay bed	Hard & comp acted with rock
1	Marul	--	--	--	14.65	23.84	31.62	59.12	--
2	Bhorkheda	--	4.63	6.95,5.22	14.40,12.33, 11.37,10.36	--	--	--	
3	Nhavi (N)	--	4.23	6.54	14.21,9.78	--	--	--	--
4	Nhavi	1.366,1.256	--	5.233	--	16.328	25.957	--	--
5	Nhavi (s)	--	4.64	5.08	12.92,9.3,10.29,8,12.6 6	16.52	--	--	--
6	MSSK (Faizpur)	--	4.85,3.55	5.92	11.36,14.05,8.73,10.09 ,13.77	--	--	--	--
7	Amoda	--	4.61	5.56	11.15,9.67,8.66,12.56	--	--	--	--
8	Bamnod	--	--	--	7.65,5.52,11.39,7.04, 7.84	21.78,23.31	37.83	--	--
9	Mahaishwa di	--	--	6.22,6.82	11.66,9.87, 7.26	20.86,20.29,16.9 4			
10	Hatnur canal	--	--	--	8.12,7.54, 14.22	15.10,21.66	39.46	--	--
11	Hatnur canal(N)	--	--	--	11.18,12.46	15.53	33.88, 41.45	--	--
12	Anjale	--	--	--	13.80,11.89,7.91	15.12, 23.89	36.37	--	77.33
13	Yawal(N)	--	3.65	5.80	13.77,7.97,14.40	23.69	34.25	--	--
14	Bamnod(W)	2.37	--	5.47	7.63,8.78,13.58,10.96, 12.96	16.88	--	--	--
15	Bhalod	--	4.45,3.89,4.6 0	5.96,6.03	7.52,10.39,11.9,12.86	--	--	--	73.26
16	Rajora	--	--	--	8.23,8.48, 14.01,17.29,10.48	16.20,23.08	--	--	70.56
17	Korpawali	--	3.71	5.21,6.09	13.13	16.63	35.36, 26.91	--	--
18	Dlkahur	--	--	5.79,7.52	13.08,13.04,11.7,8.37	17.20	31.75	--	--
19	Sakali	--	--	--	16.16,15.8,10.17,7.53, 7.02	23.15,16.10	--	--	--
20	Dahigaon	2.69,2.07	4.5	6.71,6.42	9.23	25.02,23.33, 16.97	--	--	--
21	Sangvi	1.71	--	6.93,6.30,6. 28	17.34,16.22, 9.76	--	--	--	--

The aquifer zone resistivity is 16.320 Ohm-m. The present well is situated towards northern part of the area. The aquifer zones thickness, according to Geophysical qualitative analysis as shown in Table-3. There are two potential zones, which are exposed in the present dug wells, and they are 6 and 15 meters in thick.

From the interpreted Data (VES) it is observed that there are maximum seven layers at the VES station No. 13 near Yawal and also proves the nature of alluvial.

The low resistivity from the data is due to clay/silty nature of alluvial the thickness is varying from 5 to 32 meters.

The results of the resistivity survey reveals that the litho-units having resistivity range between 5 to 7 Ohm-m and 7 to 15 Ohm-m, yield water perennially and hence act as good aquifer for ground water development such type of aquifer consists sandy formations.

Conclusions

From the foregoing discussion, it is evident that resistivity values obtained by Inverse-slope method of interpretation give satisfactory information about hydrological characters of subsurface alluvial layers. The method is particularly suitable for detection of small thickness layers, which are often missed by curve matching techniques of

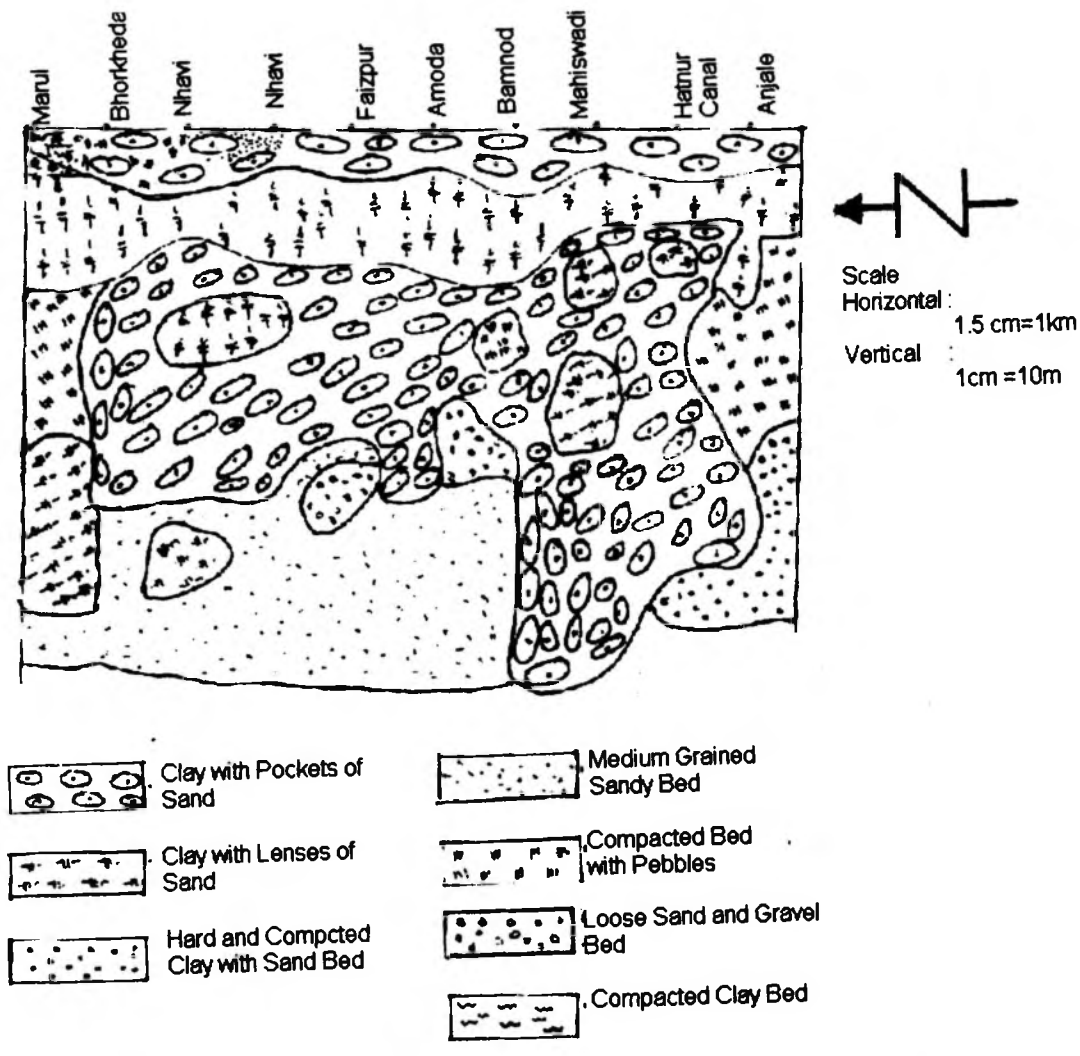

Fig. 1: North South Cross-section of VES Data from Eastern Part of the area under study

Orellana and Monney (1996). Thus inverse slope method is suitable for groundwater investigation in alluvial areas. This method is less time consuming and less tedious than others.

Hydro geological and geophysical investigation study reveals that, the area is facing a major problem of groundwater depletion especially in summer season. Therefore, there is a urgent need to launch comprehensive groundwater management practices in the area and there is a lot of scope of recharging the thirsty aquifers.

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Table 3: Resistivity and anticipated litho- types (ref table 1) and thickness for area under study.

Sr no.	VES station	Layers thickness from top to bottom (m)	Resistivity Ohm-M	Sr no.	VES station	Layers thickness from top to bottom (m)	Resistivity Ohm-M
1	Marul	4	89.2	7	Amoda	8	1.15
		6	12.32			8	18.66
		20	23.84			14	12.56
		15	31.62			20	9.67
		25	21.12			20	5.56
						20	24.61
2	Bhorkheda	10	14.4				
		10	12.30	8	Bamnod	14	7.65
		15	11.37			6	21.85
		15	10.31			10	8.52
		10	6.95			10	37083
		15	5.22			20	11.39
		30	4.43			5	7.04
						15	23.31
3	Nhavi 1	12	18.08			20	7.84
		8	14.21				
		20	16.43	9	Maishwadi	8	6.22
		30	9.78			6	6.82
		10	6.54			6	11.66
		20	4.23			10	20.86
						20	20.19
4	Nhavi 2	14	1.34			15	16.94
		6	5.23			15	9.87
		10	1.25			10	7.26
		15	25.45				
		15	16.32	10	Hatnur canal 1	10	8.12
						8	7.54
5	Nhavi 3	8	12.92			7	15.10
		8	9.30			15	14.22
		9	10.29			15	21.68
		10	16.52			25	39.66
		25	8.00				
		5	12.66	11	Hatnur canal 2	14	11.18
		15	5.08			6	15.53
		20	4.64			15	33.88
						5	12.86
6	MSSK Site(Faizpur)	10	1.36			20	41.45
		6	14.05				
		9	8.73	12	Anjale	8	12.4
		15	10.09			10	13.8
		15	13.77			12	23.84
		15	5.92			15	36.77
		10	4.85			10	11.89
		10	3.55			10	7.91
						25	71.57
Sr no.	VES station	Layers thickness from top to bottom (m)	Resistivity Ohm-m	Sr no.	VES station	Layers thickness from top to bottom (m)	Resistivity Ohm-m
13	Yawal (N)	10	34.25	18	Dongakathora	10	31.75
		6	23.69			6	21.20
		14	13.77			4	13.08
		10	7.97			15	13.04
		15	5.80			20	11.7
		15	3.70			15	8.37
		10	3.65			10	5.79
		10	14.40			10	7.52

14	Bamnod (N)	8	12.9	19	Sakali	8	16.16
		4	10.9			17	23.15
		13	13.5			15	15.8
		20	8.76			5	10.71
		10	16.88			15	7.33
		15	7.63			30	7.02
		10	5.47	20	Dahigaon	14	25.02
		10	2.37			11	23.33
15	Bhalod	8	73.2			20	16.97
		12	7.5			15	9.23
		5	10.39			10	6.71
		15	5.96			10	6.42
		5	4.45			10	2.69
		5	11.9			10	4.5
		5	3.89			5	2.07
		25	6.03	21	Sangli	16	17.54
		10	4.60			14	16.32
		10	12.86			20	9.76
16	Rajora	10	8.23			10	6.93
		4	16.20			10	6.30
		6	8.48			10	1.71
		5	14.01			20	6.28
		10	23.08				
		25	17.29				
		10	10.48				
		30	70.56				
17	Korpawali	6	35.36				
		8	16.63				
		6	26.91				
		20	13.13				
		20	5.21				
		10	3.53				
		10	6.09				
		10	3.71				

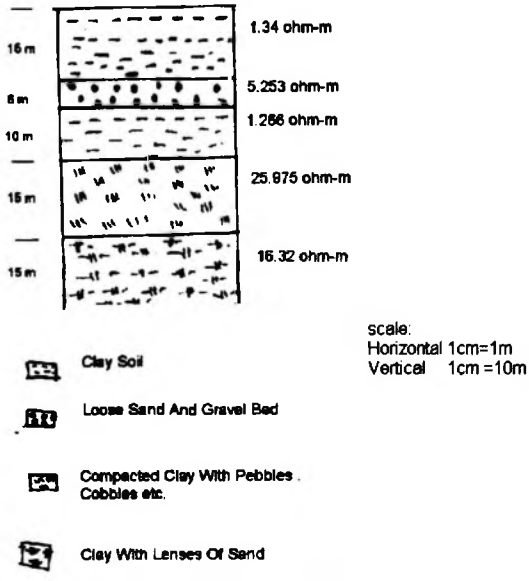

Fig. 2: Correlation of Resistivity Sounding Results with Dug Well near Nhavi Village

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