Assessment of The Productivity of Gajulamalkapuram Village Aquifer Using Pumping Test

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Abstract: In the present paper groundwater potential is analyzed with the help of aquifer parameters like transmissivity, storage coefficient etc. The pumping test is conducted in gajulamalkapuram village which comes under. the musi basin. The demand of ground water is increasing in the study area caused deploiting of water levels below the ground. The pumping test is conducted for exisiting bore wells in agricultural fields of gajulamalkapuram. The test are conducted for 120 minutes with constant rate of pumping in single well (i.e., the pumping and drawdown is observed in the same well) The collected data was analysed by using theis and cooper and Jacob methods. from the results of pumping data, it is observed that the aquifer showing the high draw down rate due to the presence of lineaments or the structural displacements. the aquifer exhibiting the low transmissivity with moderate yield. This is due to the lack of secondary porosity, compaction of litho units and a shallower weathered layer. The Poor groundwater potential is the result of the over-exploitation of groundwater through the drilling of deeper bore wells.

Key Words: Aquifer parameters, pumping test, hydraulic conductivity, storativity

1. INTRODUCTION

The aquifer parameters like hydraulic conductivity and transmissivity are extremely important for the groundwater development and management (soupios et al., 2007). Hence the occurrence and movement of groundwater in hard rocks are mainly controlled by the extent of weathered and fracture zones, discontinuities and permeability. (Mahajan,1995). Due to the fast urbanization and shortage of surface water resources the exploitation of groundwater is increasing in India and world-wide. The subsurface characteristics like geology, structure of rocks, distribution of soil, its texture etc. control the occurrence and movement of groundwater (Dor et. al., 2011). Hydraulic conductivity, transmissivity and storativity are the major aquifer parameters involved in estimation of groundwater recharge, storage and groundwater modeling (Freeze and cherry 1979; Fitts 2002; Singh 2005). The hydraulic properties of an aquifer are measured by conducting aquifer tests such as the slug test, the constant head test, pumping test and recovery test to obtain discrete information.

Aquifer properties provide the information of the aquifer characteristics of the terrain that controls the groundwater storage and movement (kumar et al., 2016). Out of the many hydraulic study methods, pumping test is the most effective way to determine the hydraulic characteristics of water-bearing layers. This concept was rapidly developed by after introduction of Darcy's law. This test allows hydrogeologists to quantify the groundwater and the hydraulic conductivity, which mainly depend on secondary porosity in the hard rock aquifer (Jain,1977).

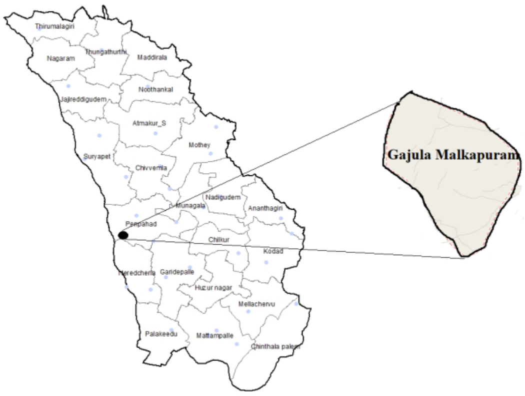
The pumping test is the field experiment in which the water from a well is pumped and observe the draw down in pumped and surrounding wells. If the pumping rate is constant through out the experiment then it is known as constant rate pumping test. The pumping well will consist of an open-ended pipe fitted with a screen in the aquifer to allow water to enter the pipe. The pumping well is equipped with a pump to lift the water to the surface.

Therefore in this paper the pumping test is conducted in gajulamalkapuram village which comes under. the musi basin. The demand of ground water is increasing in the study area caused deploiting of water levels below the ground. The pumping test is conducted for exisiting bore wells in agricultural fields of gajulamalkapuram. The test are conducted for 120 minutes with constant rate of pumping in single well (i.e., the pumping and drawdown is observed in the same well) The collected data was analysed by using theis and cooper and Jacob methods.

2. STUDY AREA

Gajulamalkapuram village is situated in penpahad Mandal of Suryapet District in the Telangana state of India. The study area is located at 17.1500°N 79.6167°E. The natural slope of the village is from North to South. The village is situated at the elevation of 266 metres from mean sea level. The soil of the village is hard gravel nature. 90 percent of the study area covered with Archean crystalline rocks comprising granites, gneisses, schists and intrusives. Irrigation is mainly depend on the Musi left canal and groundwater. The average ground water table is about 50 below ground level. The Waterlevel is observed 2-5mbgl in post monsoon. the deep exploratory drilling conducted by Central Ground Water Board revealed that the fractures are of vertical to sub-vertical and also of horizontal in their disposition. It has been found that about 80% of the aquifer zones are encountered within the range of 40-60 m depth. About 20% of the fractured zones are encountered beyond 60 m down to 150 m depth. In the aquifer zones, within 60m depth, the ground water occurs under semi-confined conditions, whereas in deep seated aquifers found under semi-confined to confined conditions. The general range of transmissivity varies from 10 to 60 sq.m/day in the granitic terrain(CGWB report 2007).

The study area experiences Tropical Wet and Dry Climate. The annual mean temperature is 36 °C. Monthly mean temperature varies between 19 to 43 °C. The maximum temperature is observed in may exceed 45 °C and minimum in January 15°C. The annual rainfall is 821mm. south west monsoon contribute major rainfall in the study area.



Suryapet District

Figure.1 study area

3. PUMPING TEST PERFORMANCE

In the present project work pumping test is conducted for two wells situated in hardrock terrains of Gajulamalkaram village of Suryapet district in the Telangana state of India(Fig3.2 and 3.3.). The well-I is situated in unconfined condition with static water level of 11.58m recorded from depth to ground surface. The test is conducted for 120 minutes duration with constant pumping rate of 6 m^3/s. The draw down is measured with the help of water level indicator. the obtained data is presented in the table1

Table1 pumping test data at well No.1

Aquifer type: unconfined
Well depth: 150ft
Well diameter: 0.3m
Static water level in the well- 11.58m

Time Since Pumping Began in	**Depth to water level (m)**	**Draw down(m)**	**Discharge (Q) m^3/sec**
0	11.585	0	6
6	12.957	1.372	6
12	14.055	2.470	6
18	15.244	3.659	6
24	16.494	4.909	6
30	17.561	5.976	6
36	18.720	7.135	6
42	19.878	8.293	6
48	21.006	9.421	6

54	22.088	10.503	6
60	23.210	11.625	6
66	24.244	12.659	6
72	25.183	13.598	6
78	26.186	14.601	6
84	27.168	15.583	6
90	28.186	16.601	6
96	29.354	17.769	6
102	30.354	18.769	6
108	31.482	19.897	6
114	32.470	20.885	6
120	33.506	21.921	6

The well-II is also situated in unconfined condition with static water level of 12.65m recorded from depth to ground surface. The test is conducted for 120 minutes duration with constant pumping rate of 4.8m^3/s. The draw down is measured with the help of water level indicator. The obtained data is presented in the table.2

Table2 pumping test data at well No.2

Aquifer type: unconfined
Well depth: 150ft
Well diameter: 0.3m
Static water level in the well- 11.58m

Time Since Pumping Began in	**Depth to water level (m)**	**Draw down(m)**	**Discharge (Q) m^3/sec**
0	12.652	0	4.8
6	14.055	1.403	4.8
12	15.213	2.561	4.8
18	16.372	3.720	4.8
24	17.500	4.848	4.8
30	18.628	5.976	4.8
36	19.726	7.074	4.8
42	20.884	8.232	4.8
48	22.052	9.400	4.8
54	23.244	10.592	4.8
60	24.335	11.683	4.8
66	25.384	12.732	4.8
72	26.357	13.705	4.8
78	27.381	14.729	4.8
84	28.427	15.775	4.8
90	29.518	16.866	4.8
96	30.552	17.900	4.8
102	31.585	18.933	4.8
108	32.686	20.034	4.8
114	33.704	21.052	4.8
120	34.817	22.165	4.8

Pumping test analyses are based on solutions to the basic differential equation of flow in a porous media. Each solution reflects the time dependence (or lack of it) of the flow, the nature of the aquifer and the type of boundary conditions applied to the system. The problem can become impossibly difficult if the mathmatical model attempts to incorporate all of the complexities *(i.e.,* inhomogeneous and anisotropic media, unsteady flow, and complicated boundary geometry and conditions) of the real aquifer system. Hence, idealized models including only one or possibly two features which are considered significant *(e.g.,* unsteady flow with barrier or recharge boundaries or with anisotropy, or with leakage, or with delayed yield, or with partial penetration of the well, etc.) are constructed and the corresponding solution obtained. The solution or solutions which best fit the conditions of the problem at hand must then be selected. In this study, three solutions or "methods" have been applied. They are Theis method, Cooper-Jacob method, Hantush method.

4. RESULTS AND DISCUSSION

The pumping test data is analyzed by using Theis method developed in 1935 using AQTESOLV software. This provides visual and automatic methods for matching the Theis residual drawdown solution to pumping test data is given in Fig.2and 3 and the obtained Transmissivity (T) and Storage coefficient (S) is given in table 3.

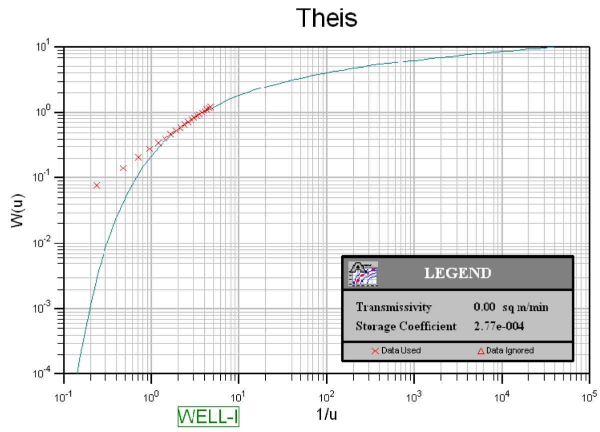


Figure.2 Theis method of solution for pumping data well-I

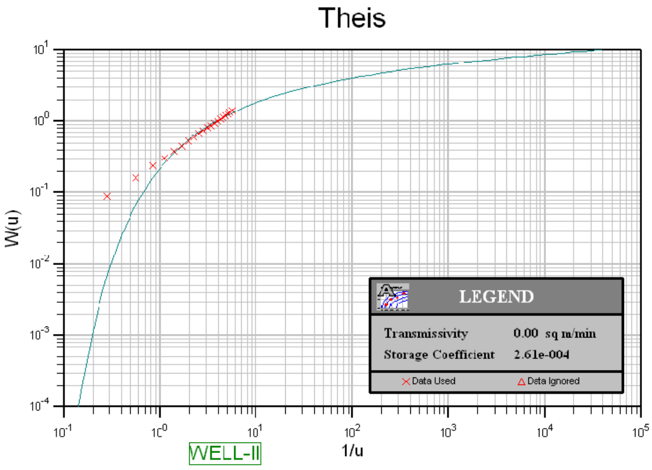


Figure.3 Theis method of solution for pumping data well-II

For **Constant pumping rate tests,** the implementation of the Cooper and Jacob solution in **AQTESOLV** is equivalent to the method of Birsoy and summers (1980) which applies the principle of superposition to the Cooper-Jacob approximation of the Theis equation.The best fit for the pumping wells I & II for cooper Jacob method is given in fig.4 and 5. The analysed Transmissivity and Storage coefficient of pumping wells I & II are given in Table 3

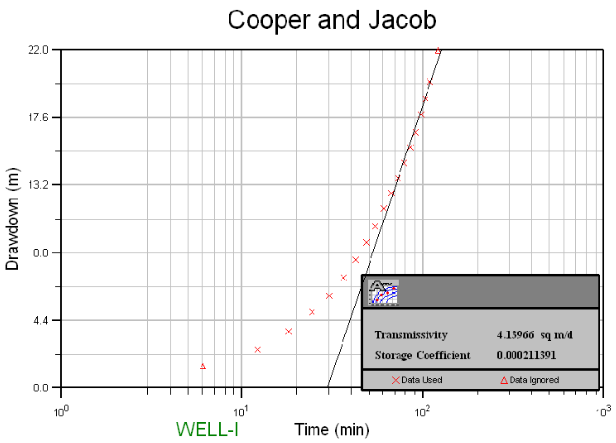


Figure.3 Cooper and Jacob solution for pumping data well-I

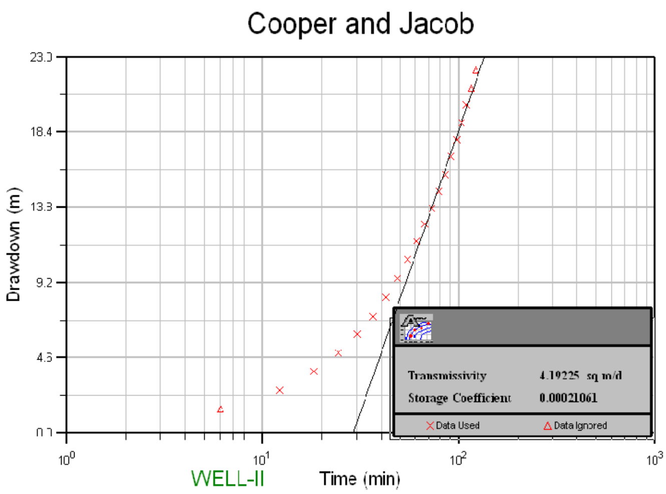


Figure.4 Cooper and Jacob solution for pumping data well-II

Table. 3 Transmissivity And Storage Coefficients

S.No	Name	Theis		Cooper-Jacob	
		T m^2/d	S	T m^2/d	S
1	WELL-I	3.80	0.000276	4.139	0.000211
2	WELL-II	3.87	0.000261	4.192	0.000210

5. CONCLUSIONS

Groundwater potential is analyzed with the help of aquifer parameters like transmissivity, storage coefficient etc. from the results of pumping data, it is observed that the aquifer showing the high draw down rate due to the presence of lineaments or the structural displacements. the aquifer exhibiting the low transmissivity with moderate yield. This is due to the lack of secondary porosity, compaction of litho units and a shallower weathered layer. The Poor groundwater potential is the result of the over-exploitation of groundwater through the drilling of deeper bore wells.

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6. REFERENCES

[1]. Birsoy, Y.K. and W.K. Summers, 1980. Determination of aquifer parameters from step tests and intermittent pumping, Ground Water, vol. 18, no. 2, pp. 137-146.
[2]. Dor N., Syafalni S., Abustan I., Rahman M.T.A., Nazri M.A.A., Mostafa R., Mejus L., 2011. Verification of surface groundwater connectivity in an irrigation canal using geophysical, water balance and stable isotope approaches. Water Resour. Manag., vol. 25, pp.2837–2853

[3]. Fetter, C.W., 1988. Applied Hydrology. 2 nd Edition, Macmillan Publishing Company, London,
[4]. Fitts C.R., 2002., Groundwater Science. Elsevier, Netherlands, pp.167–175.
[5]. Freeze R.A., Cherry J.A., 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs.
[6]. Jain JK, 1977. Under groundwater resources of India. Trans R Soc London B 278:504–507.
[7]. Kumar R., Singh RD, Sharma KD, 2005. water resources of India, current sci89(5) pp.794-811.
[8]. Kumar, T.J.R., Balasubramanian, A., Kumar, R.S. 2016. Assessment of groundwater potential based on aquifer properties of hard rock terrain in the Chittar–Uppodai watershed, Tamil Nadu, India. *Appl Water Sci* **6,** 179–186 https://doi.org/10.1007/s13201-014-0216-4
[9]. Singh K.P., Non linear estimation of aquifer parameters from surficial resistivity measurements. Hydrol. Earth Sys. Sci., 2005, 2, 917–938.
[10]. Soupios P.M., Kouli M., Valliantos F., Vafidis A., Stavroulakis G., Estimation of aquifer hydraulic parameters from surficial geophysical methods: a case study of Keritis Basin in Chania (Crete-Greece). J. Hydrol., 2007, 338, 122–131.
[11]. Mahajan, G, 1995. Groundwater surveys and investigation. Ashish Publishing House, New Delhi, p 543.
[12]. Kumar R, Singh RD, Sharma KD (2005) Water resources of India.
[13]. Curr Sci 89(5):794–81

Kumar R, Singh RD, Sharma KD (2005) Water resources of India.
Curr Sci 89(5):794–81