International Journal of Emerging Technology and Advanced Engineering
Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 7, Issue 5, May 2017)

Geo-Hydrological Studies Along the Metro Rail Alignment in Chennai

R. Lilly[1], G. Ravikumar[2], S. Prabhakaran[3]

[1]*Research Scholar,* [2]*Professor, Department of Civil Engineering, Anna University, Chennai Tamilnadu, India.*
[3]*Associate Professor, Department of Mechanical Engineering, AMET University, Chennai, Tamilnadu, India.*

***Abstract*— Chennai Metro Rail Corporation has constructed two metro rail corridors in the underground section for the length 14.3kms and 9.7kms in the East-West (EW) and the North-South (NS) metro rail lines. Geo-hydrological studies are carried out in and around the metro rail corridors. The Studies include the inventory of well network managed by the government and the wells identified around the corridors to characterize the hydrogeology of the region. Assessing the spatial and temporal groundwater recharge and groundwater discharge patterns in the tunnel regions. Modeling and assessing the potential impacts to the groundwater system due to the metro tunnels along the East-West and North-South lines.**

***Keywords*— Metro Rail Corporation;; Modeling ; assessing; hydrogeology; groundwater**

I. INTRODUCTION

A. Sources of Data

The data sources needed to analyze the geo - hydrological studies include

- the lithology & geology,
- the topography,.
- the spatio-temporal behavior of groundwater levels, and
- the groundwater use characteristics in the project area.

The lithological data pertaining to the metro tunnel regions are collected which helps in identifying the different zones to determine the permeability of the region.The elevation data are collected to identify the slope and the topography of the land.The water levels monitored by the Government of India are identified and it is collected for the period from 1995-2015 to characterize the ground water level pattern in the study area.

B. Base Map of Study area

The base map of the study area was prepared by delineating the watershed of the tunnel region along with the metro rail corridors

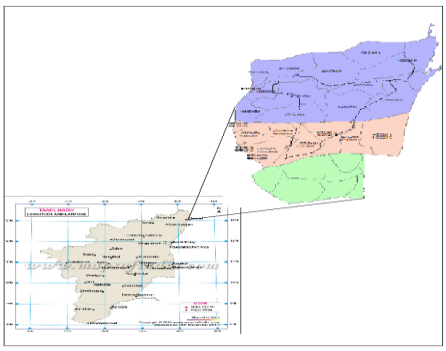


Fig 1 Base map of study area

C. Slope Map for Study area

Chennai district forms part of coastal plains of Tamil Nadu. Major part of the district is having flat topography with very gentle slope towards east. The altitudes of land surface vary from 10 m above MSL in the west to sea level in the east. Fluvial, marine and erosion landforms are noticed in the district. The statement was proved by mapping the elevation levels of the selected locations of the area and it is shown in figure 2 and the elevation values are tabulated in table 1.

Table 1
Locations With Elevation

S.No	Location	Elevation
1	Tandiarpet	12
2	Vepery	12
3	Chepauk	13
4	Lights	13
5	Saidapet	15
6	Guindy	15
7	Aminjikarai	15
8	Tirumangalam	15
9	Vadapalani	18.5
10	K.K.Nagar	16
11	Airport	15

International Journal of Emerging Technology and Advanced Engineering
Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 7, Issue 5, May 2017)

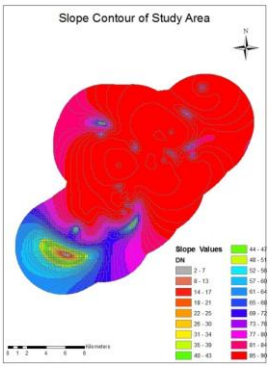
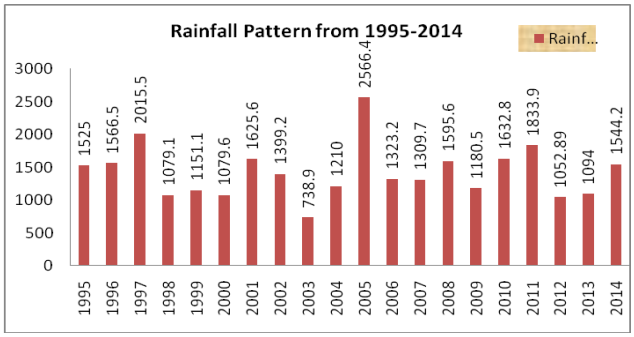


Fig 2 Slope Contour of Study Area Rainfall Pattern

Rainfall datas are collected to study the rainfall pattern in the study area. The water table levels before and after the construction was analyzed with the rainfall data. The analysis helps to determine the tunneling effect on water table levels. The rainfall datas are plotted and it is shown in the graph 1.



GRAPH 1 RAINFALL DATA FROM 1995-2014

The mean rainfall of 1995-2007 was found to be 1429.98 mm and 1419.13 mm for 2008-2014.Since the rainfall distribution variation between the two period is very less, it is clearly found that the reduction of ground water volume is not because of the decreased rainfall. The underground development leads to the change in the ground water volume.

D. Water Table Levels

Data's are collected for the period 1995-2014 from Centre Ground Water Board and Institute of Water Studies, Chennai and the data's are separated into 1995-2007 and 2008-2014 that is before and after the construction of metro rail corridor. The mean values of the water levels are calculated from 1995-2007 and 2008-2014. These values are tabulated in the Excel spread sheet with the location of observation wells in and around the metro rail corridor and it is shown in table 2(A&B) and table 3(A&B).

TABLE 2(A)
MEAN WATER TABLE LEVELS(1995-2007)

Location	Elevation	1995	1996	1997	1998	1999	2000
Tandiarpet	9.98	6.54	6.39	6.80	6.76	5.36	5.70
Vepery	10.13	9.17	7.48	6.09	5.87	7.49	5.54
Chepauk	10.43	8.39	8.60	8.47	8.36	8.33	8.19
Thousand Lights	11.52	6.77	5.37	6.79	7.11	5.39	5.70
Saidapet	13.11	10.35	9.90	9.35	9.82	9.36	8.24
Guindy	13.1	10.15	9.35	9.00	9.12	8.99	8.15
Aminjikarai	14.12	7.96	6.40	7.12	6.68	7.08	5.29
Tiruman galam	13.78	9.74	9.23	10.05	11.15	11.43	8.42
K.K.Nagar	16	13.75	12.84	13.20	13.30	13.33	12.46

TABLE 2(B)
MEAN WATER TABLE LEVELS(1995-2007)

2001	2002	2003	2004	2005	2006	2007	Mean
5.48	5.90	5.26	5.98	3.96	7.37	6.94	6.03
4.05	6.60	7.23	5.04	4.96	5.92	5.75	6.24
8.12	8.56	7.68	8.41	8.48	8.37	7.33	8.25
5.44	6.40	5.20	5.51	5.65	5.60	5.62	5.89
9.50	11.30	11.99	8.74	6.71	6.75	8.12	9.24
9.22	10.95	11.12	8.25	6.13	5.96	8.05	8.80
14.12	7.73	4.83	4.12	2.45	7.08	7.14	6.77
8.16	9.20	8.51	6.11	7.67	9.77	11.13	9.28
10.46	13.07	11.76	8.97	10.67	14.22	14.29	12.49

International Journal of Emerging Technology and Advanced Engineering
Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 7, Issue 5, May 2017)

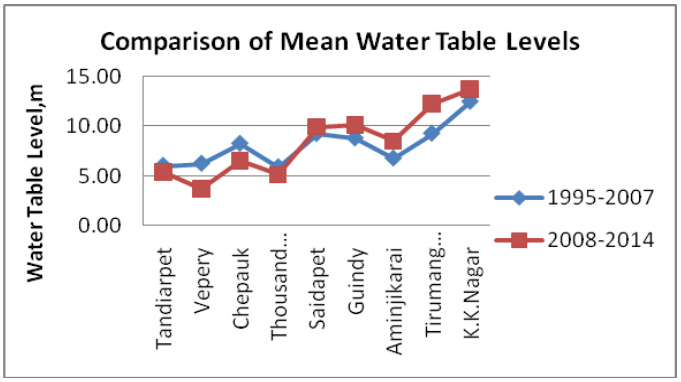
TABLE 3(A)
MEAN WATER TABLE LEVELS(2008-2014)

Location	Elevation	2008	2009	2010	2011
Tandiarpet	9.98	7.03	6.05	5.12	5.47
Vepery	10.13	4.19	3.71	3.63	4.15
Chepauk	10.43	6.67	6.45	7.08	7.09
ThousandLights	11.52	5.98	4.98	5.05	5.00
Saidapet	13.11	14.62	8.16	8.97	8.33
Guindy	13.1	8.76	10.05	11.27	11.50
Aminjikarai	14.12	8.07	7.37	7.96	8.65
Tirumangalam	13.78	11.84	11.70	12.94	12.96
K.K.Nagar	16	13.36	12.54	13.70	14.77

TABLE 3(B)
MEAN WATER TABLE LEVELS(2008-2014)

Location	Elevation	2012	2013	2014	Mean
Tandiarpet	9.98	5.01	5.46	3.78	5.42
Vepery	10.13	3.18	3.46	3.41	3.68
Chepauk	10.43	6.44	6.26	5.80	6.54
ThousandLights	11.52	4.97	5.11	4.86	5.14
Saidapet	13.11	9.86	9.92	9.85	9.96
Guindy	13.1	9.96	8.60	10.92	10.15
Aminjikarai	14.12	7.25	6.25	14.12	8.52
Tirumangalam	13.78	12.38	10.49	13.82	12.30
K.K.Nagar	16	13.85	13.54	14.75	13.79

The Comparison of mean water table levels for the observation wells for the period 1995-2007 and 2008-2014 was plotted and shown in the graph 2.The graph clearly shows that in Tondiarpet, Vepery, Chepauk and Thousand Lights the water table level has gone down after the construction. In Saidapet, Guindy, Amnijikarai, Tirumangalam and K.K.Nagar the water table level has got increased.This scenario of rise and fall of the ground water table is purely due to the underground development.



Graph 2 Comparison of Mean Water Table Values

II. SOIL MAP

The soil map of the Chennai was collected and it was georeferenced and digitized for the study area. Within the study area eight polygons were digitized for different types of soils present in the study area. The digitized soil map of the study area with types of soil available in the study area is shown in figure 3.

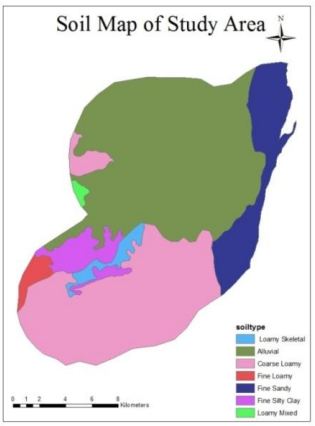


Fig 3 Soil Map of Study Area

A. Specific Yield

Specific yield is defined as the ratio of the volume of water that a saturated rock or soil will yield by gravity to the total volume of the rock or soft. Specific yield is usually expressed as a percentage.

The value is not definitive, because the quantity of water that will drain by gravity depends on variables such as duration of drainage, temperature, mineral composition of the water, and various physical characteristics of the rock or soil under consideration. Specific yield values for the various types of soils were identified and assigned to the respective polygons. The table 4 lists outs the type of soil and its specific yield values.

TABLE 4
SOIL TYPE AND THEIR SPECIFIC YIELD

S.No	Soil Type	Specific yield (%)
1	Coarse loamy	22%
2	Alluvial	26%
3	Fine Sandy	21%
4	Loamy mixed	19.6%
5	Fine loamy	16.4%
6	Fine Silty Clay	18%
7	Loamy skeletal	11.2%

III. CONCLUSIONS

Groundwater levels show decline due to the effect of proposed tunnels, groundwater recharge practices may have to be taken up during monsoon season. In addition, better management practices are to reduce the current level of groundwater pumping, thereby mitigating any effects due to the tunnels.

Groundwater system in the vicinity tunnels shows minor effects of groundwater rises and groundwater declines (in either case ± 2m) due to the proposed metro tunnels. In the region of groundwater rises, improvements in the groundwater drainage should be taken up.

REFERENCES

[1] J. Wei, G. Wang, C. Li, and J. Shao, "Application of GIS in groundwater research, " Hydrogeology and Engineering Geology, 2003, pp. 94-97.

[2] Jiajia Wang, Kunlong Yin1, Jian Chen,"Research and Realization of the Groundwater Analyze Module Based on MapGIS", Search

[3] Ravikumar, G., Shahidhar, T., Krishnaveni, M. and Karunakaran, K(2005)," GIS Based Ground Water Quantity Assessment Model", International Journal of Civil and Environmental Engineering, vol 1, no 2, pp: 21-30.

[4] 4.Mahesh K. Jat, Deepak Khare and P. K. Garg (2009)," Urbanization and its impact on groundwater: a remote sensing and GIS-based assessment approach", Environmentalist , vol 29, pp: 17-32. DOI: 10.1007/s10669-008-9176-2

[5] MAO Xiaomin,SHANG Songhao,LIU Xiang (2002),"Groundwater Level Predictions Using Artificial Neural Networks",Tsinghua Science and Technology ISSN 1007 - 0214 , 04/20,vol7, Number 6 pp:574 – 579, december.

[6] A. K. Saraf and P.R.Choudhury (1998)," Integrated Remote Sensing and GIS for Groundwater exploration and Identification of Artificial Recharge Sites", International Journal of Remote Sensing", vol. 19,Issue 10, pp: 1825-1841.http://dx.doi.org/10.1080/014311698215018.

[7] Md. Marufur Rahman and A. Q. M. Mahbub (2012)," Groundwater Depletion with Expansion of Irrigation in Barind Tract: A Case Study of Tanore Upazila", Journal of Water Resource and Protection, vol 4,pp: 567-575. http://dx.doi.org/10.4236/jwarp.2012.48066