International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161

Available at http://inpressco.com/category/ijcet

National Conference on Recent Advances in Civil Engineering Infrastructure (rACEi-2021)

Delineation of groundwater potential zones mapping using Remote Sensing and GIS

A. Shravika ^, Ch. Vaishnavi ^, ShaikSartaj Pasha ^, J. Swathi ^ S. JagadeeshBabu *,

^Students of civil engineering, ACE Engineering College, Ghatkesar, Hyderabad, Telangana – 501 301
*Associate Professor, Department of civil engineering, ACE Engineering College, Ghatkesar, Hyderabad, Telangana – 501 301

Received 05 Aug 2021, Accepted 10 Aug 2021, Available online 15 Aug June 2021, **Special Issue-9 (Aug 2021)**

Abstract

Today, water demand is increasing due to rapid urbanization, industrial growth and agricultural utilizations. Groundwater levels are decreasing due to all the above activities, decreasing of annual rainfall year to year due to climatic changes and increasing runoff. Hence, it is necessary to increase groundwater levels from the perspective of groundwater use for future demand. Keeping this in view, we have done a model study for a particular area. The study area consists part of the Hyderabad, Ranga Reddy, Yadadri-Bhuvanagiri and Medchal-Malkajgiri districts of Telangana, India. The area lies between 78°30' and 78°45' east longitude and 17°15' and 17°30' north latitude. In the present study, we carried out delineation of groundwater prospect zones using IRS-ID PAN and LISS-III geocoded data on a 1:50000 scale. The information on structure, geomorphology and hydrology were generated and integrated to prepare a groundwater prospect map for the study area. GIS was used to prepare database on the above layers, analysis of relationship and integrated map preparation. The study area has complex geomorphology. On the basis of geomorphic characteristics, four categories of groundwater potential zones: Very good-good, good moderate, poor-nil and nil are delineated. In the final map, we have identified the areas with less groundwater potentials.

Keywords: *Groundwater, potential zones, water prospect, study area, integrated map.*

1. Introduction

Water is an essential natural resource, which forms the basis of all life. Water is one among the foremost most essential materials in our day-to-day life. Water is a very important resource in all economic activities starting from agriculture to industry. Only a little fraction of the planet's abundant water is available to us as freshwater. About 97% is found within the oceans and is too salty for drinking, irrigation, or industry. The remaining 3% is freshwater. About 2.997% of it is locked up in ice caps or glaciers or is buried so deep that it costs excessive amount to extract. Only about 0.0035 of Earth's total volume of water is easily available to us as soil moisture, exploitable groundwater, water vapor, and lakes and streams.

Groundwater is a vital resource and a significant source of drinking water for the world's population. Groundwater is also an abundant resource and accounts more than 90% of the global freshwater resources excluding water glacial ice. Groundwater is the source of about 90% country's drinking water. In rural areas, most of the water supply comes from groundwater and more than one-third of our 100 largest cities depend on it for at least part of their supply. Historically, groundwater has been considered to be safe to drink.

In present days, usage of surface and groundwater is increasing because of rapid urbanization, industrial growth and agricultural utilizations. Consequently, rapid depletion of surface and groundwater is taking place. Compare to the conventional methods Remote Sensing is an advanced technology, because of its wide coverage and repetitive nature, to identify sub-surface water resources. Keeping this in view, the present study aims at groundwater potential mapping to increase groundwater levels at the arid and semi-arid areas using Remote Sensing and GIS.

1.1 Study area

The study area comprises part of Hyderabad, Ranga Reddy, Yadadri-Bhuvanagiri and Medchal-Malkajgiri districts of Telangana, India. The area lies between 78°30' and 78°45' east longitude and 17°15' and

17°30' north latitude as in (Fig 1).

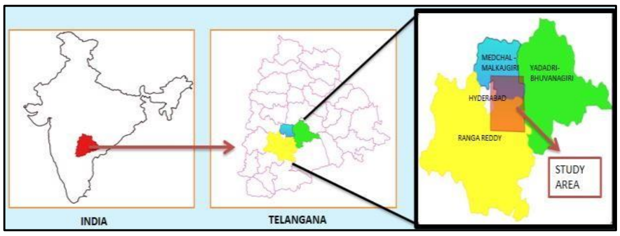

Fig.1 Location map of the study area

1.2. Literature review

In literature survey abstracts on groundwater potential zones and mapping, are collected from scientists of different institutes and universities. They have applied methods for evaluation of the study, which can be implemented in the project study presently being carried.

(S.Chakraborty, *et al*, 2004) have done a project study on 'Identification of Groundwater Potential Zones in the Baghmundi Block of Purulia District of West Bengal Using Remote Sensing and GIS'. Remote sensing techniques with an emphasis on lineament identification, lays a great role in groundwater prospecting and applied on hard rock areas of Purulia district. In this work, Morphometric and

Hydrogeomorphic analysis has been done to determine the potential water-bearing zone in the study area. The result obtained from the study area is mainly in the form of maps, which show different thematic expressions. Identification of groundwater potential zones is generated from hydrogeomorphological map.

(M.A.Khan, *et al*, 2002) have done a project study on 'Use of Remote Sensing and Geographical Information System in the Delineation and Characterization of Ground Water Prospect Zones'. The present study was carried out to delineate and characterize groundwater prospect zones using IRS-ID LISS-III geocoded data on a 1:50000 scale. The information on lithology, structure, geomorphology and hydrology were generated and integrated to prepare groundwater prospect map for a region in western Rajasthan. (V.Jothiprakash, *et al*, 2003) has done a project on 'Delineation of potential zones for artificial recharge using GIS '. In this study, potential zones for artificial recharge in Agniar-Ambuliar-Southvellar river basins in Tamilnadu, India has been delineated through integration of various thematic maps using arc view GIS. A map showing four different potential zones for artificial recharge has been prepared for the study area in Tamilnadu, India. The final map was prepared by integrating various thematic maps, viz., physiography, geology, permeability, water holding capacity, soil texture, effective soil depth, and drainage intensity.

(Y.Srinivasa Rao, *et al*, 1997) have done a project study on 'Hydrogeomorphological studies by Remote Sensing application in Niva river basin, Chittor District, A.P'. To evaluate the hydrogeomorphological conditions of Niva river basin Chittoor district, Andhra Pradesh, geological, hydrogeological and geomorphological studies were carried out, through visual interpretation of Land sat 5, FCC with adequate ground truth 10. All the conventional information such as geological, hydrogeological, well inventory data and also the information collected during field checks was used in the finalization of the hydrogeomorphological map.

2. Material and methods

In this study QGIS software and data is used to prepare different thematic maps. The data includes OpenStreetMap layer, DEM data, Satellite image and data from groundwater department of Telangana.

The broad methodology (Fig 2) for preparing the groundwater prospects map is,

1) Preparation of base map from OpenStreetMap layer available in QGIS software, and lithological, structural, geomorphological and hydrological maps based on the visual interpretation of satellite image in conjunction with the existing maps/literature.
2) Incorporation of available field observations in the lithological, structural, geomorphological, hydrological and base map overlays.
3) Preparation of groundwater prospects map by combining the lithological, structural, geomorphological and hydrological map overlays and transferring the details on to the base map and preparation of legend indicating hydrogeomorphic unit-wise groundwater prospects.
4) Identification of sites having less groundwater potentials.

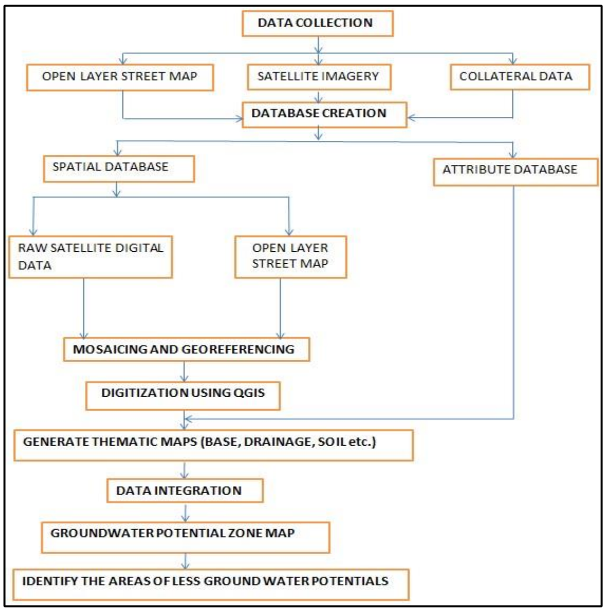

Fig.2 Flow chart showing the methodology adopted for the present study

3.Results and discussion

3.1. Transportation

An intense road network is observed at NW part of the study area, which is occupied, by part of Hyderabad. The remaining part of the study area is having less intense road network. As road network between dwelling units have reduced surface area, thus, the area for infiltration of water is reduced. Thus, the places where the road network is more could be less groundwater potentials shown in (Fig 3).

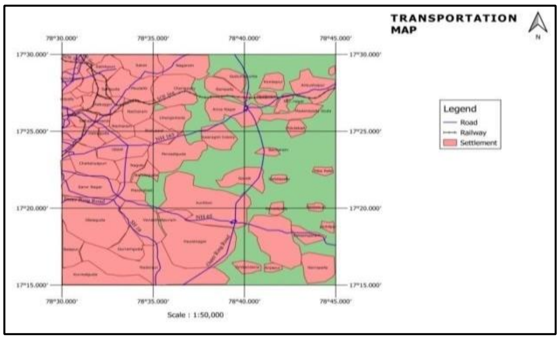

Fig.3 Transportation map

Table 1 Transportation classification area

Transportation mode	Name of the transportation feature
Road	NH 163,NH 65,SH 19
Railway	SCR (South Central Railway) mainline

3.2.Drainage pattern

The drainage patterns observed in the study area are mainly dendritic pattern and deranged pattern. Dense dendritic drainage pattern is observed for the entire study area except the NW part of the study area (it has less dense dendritic pattern). A deranged drainage pattern has been observed at short streams and some tanks shown in (Figure 4). High groundwater potentials can be predicted at the places where drainage density is more, whereas low potentials indicate less drainage density.

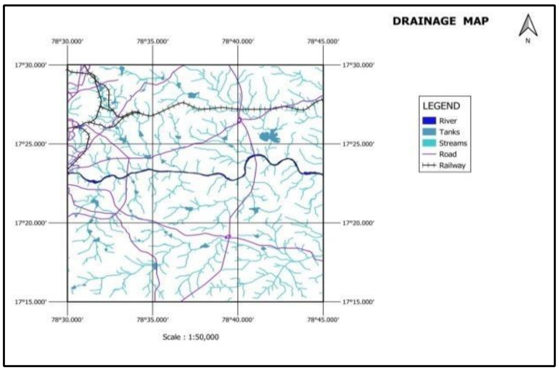

Fig.4 Drainage m ap

Table 2 Water bodies classification

Water bodies	Name of the water bodies
River	Musi river
Tanks	ErraKunta, PeerzadigudaCheruvu, EdulabadCheruvu etc.

3.3.Slope

The slope categories observed in the study area are nearly level, very gently sloping, gently sloping, moderate sloping and moderately steep sloping.

Infiltration rates are high at nearly levels that occupied most of the study area it can be predicted that high groundwater potentials at these levels. The study area consists of 1,2,3,4, and 6 categories shown in (Fig 5).

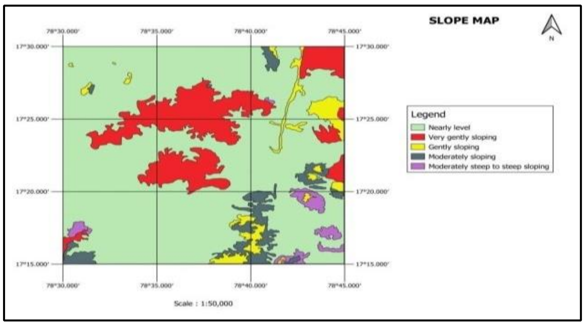

Fig.5 Slope map

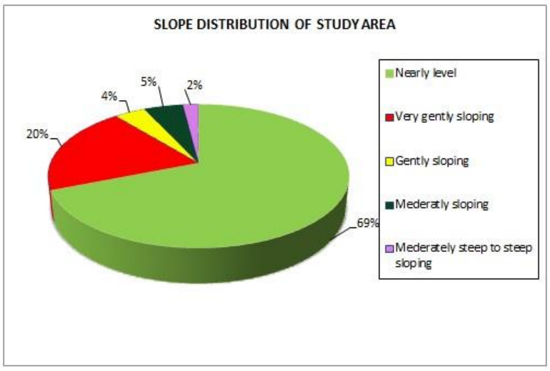

Fig.6 Pie chart showing distribution of slope categories

Table 3 Slope classification

S.No	Category	Slope %
1	Nearly level	0% - 1%
2	Very gently sloping	1% - 3%
3	Gently sloping	3% - 5%
4	Moderately sloping	5% - 10%
5	Strongly sloping	10% - 15%
6	Moderately steep to steep sloping	15% - 30%
7	Very steep sloping	> 35%

3.4. Land use and land cover

In the present study Urban, Grass/Grazing land, rural cover Crop land Scrub land, Mining land,

Reservoirs/lakes/ponds area, Scrub Forest, Fallow, River/Stream/Canals area, Forest Plantation area, Plantation, Deciduous are found as shown in (Fig 7).

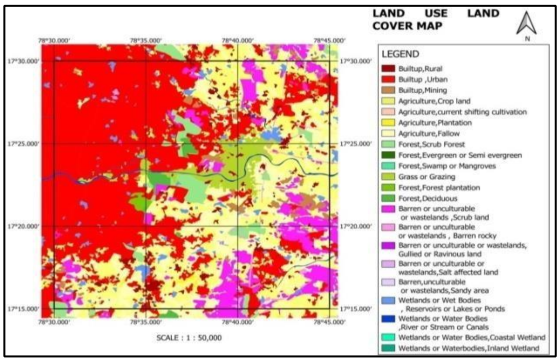

Fig.7 Landuse and land cover map of the study area

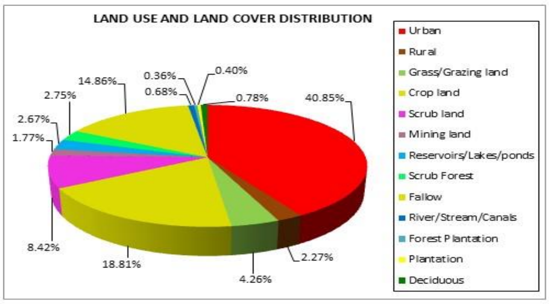

Fig.8 Pie chart showing distribution of Land use and land cover

3.5. Structures

The attitude and relative positions of the rock masses of an area is described. Lineaments are the structural features observed in the study area. Of the lineaments conformed and inferred lineaments are observed. Conformed lineaments are observed at the places where drainage density is more, and inferred lineaments are observed at less drainage places. Thus, the places where conformed lineaments can be predicted has high groundwater potentials as shown in (Fig 9)

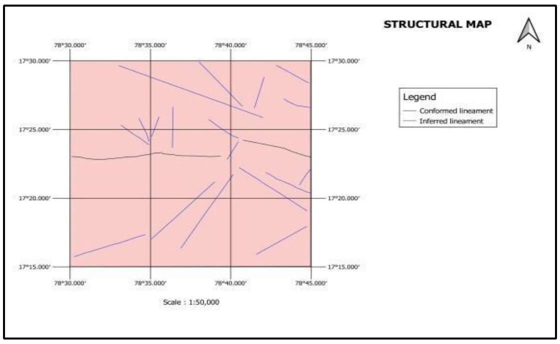

Fig.9 Structural map

3.6. Geology

As almost entire study area (98%) is under predominantly granite and alkali feldspar granite suite; migmatite hence, very good-good-moderate yields of groundwater potentials is found as shown in (Fig 10).

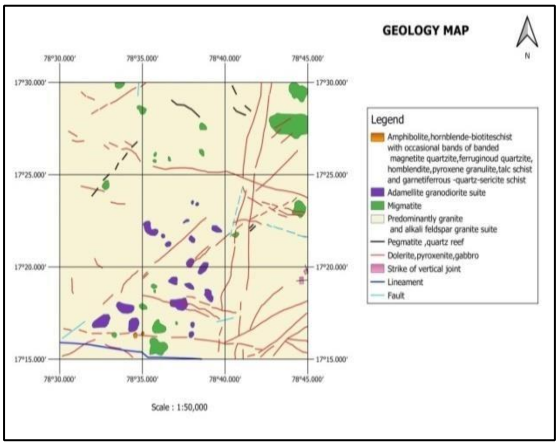

Fig.10 Geology map

3.7.Geomorphology

In the present study area as weathering soil thickness is high for Ppm (10-20m) than to Pps (0-10m); infiltration rates are high for Ppm.Thus, high groundwater potentials can be predicted at Ppm than at Pps. In the present study area Pps occupies a larger part. Here Ppm means pediplain with moderate weathering and Pps means pediplain with shallow weathering Moderate to poor yields of groundwater can be predicted at pediments based on the formation of rock structures. From pediment inselberg complex, inselberg form run-off zones, pediment contributes for limited to moderate recharge. As the dike acts as a barrier for streams, moderate potential of groundwater can get at one side of the dike and dried aquifer at another side as shown in (Fig 11).

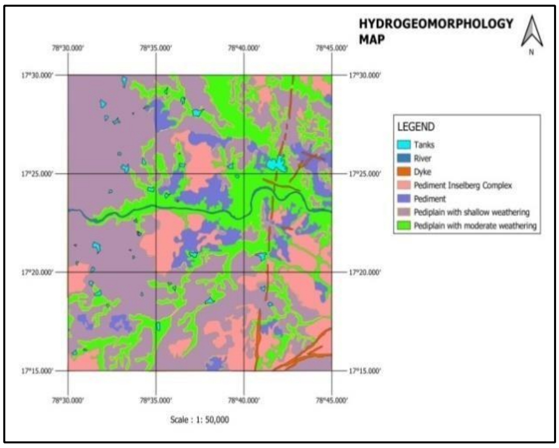

Fig.11 Geomorphology map

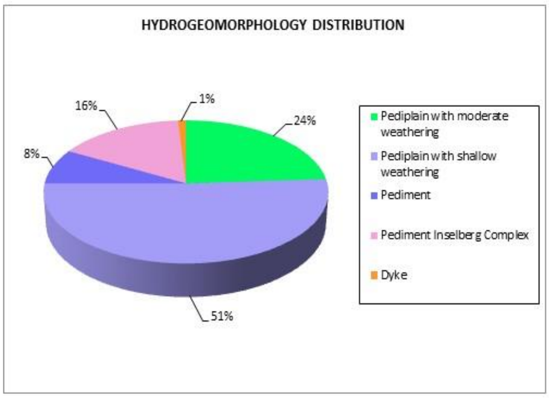

Fig.12 Pie chart showing distribution of geomorphological characteristics

3.8. Groundwater table

Groundwater table map (Fig 13) has been prepared based on the attribute data of groundwater depth of the study area and area with 5-15 m b.g.l (meters below ground level) can be predicted as high groundwater potential.

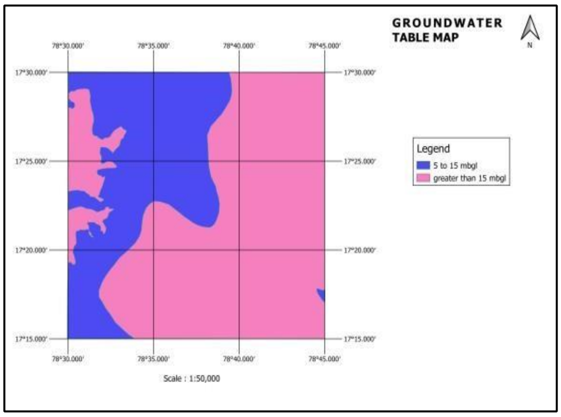

Fig.13 Groundwater table map of study area

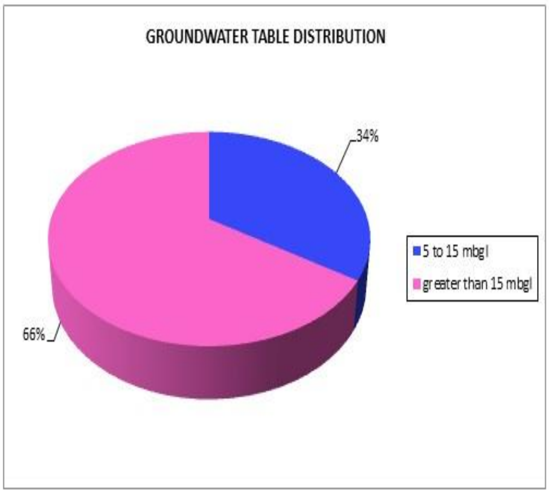

Fig.14 Pie chart showing groundwater table distribution

Table 4 Groundwater table

Groundwater table	Area (sq. km)
Five-fifteen m b.g.l	249.02
Greater than fifteen m b.g.l	486.04

3.9. Groundwater infiltration rates

Infiltration rates along Musi River and areas surrounding major streams and tanks in the study area are high, since weathered soil thickness is high for this area. Medium to low infiltration rates are observed in the remaining major part of the study area where thickness of weathering soil is medium to low. No infiltration rates are observed at barren sheet rock areas as shown in (Fig 15).

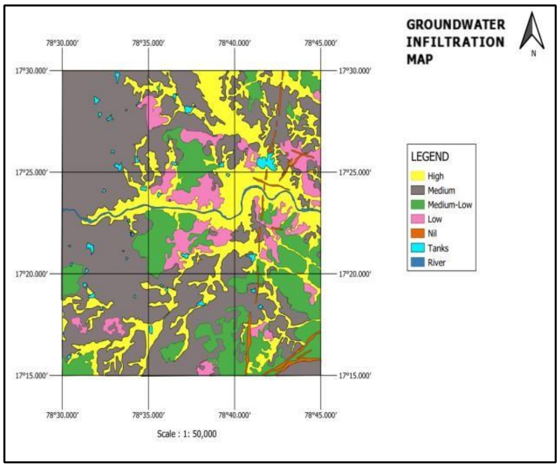

Fig.15 Groundwater infiltration map

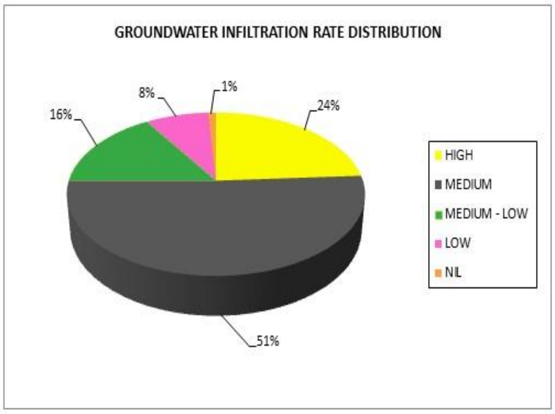

Fig.16 Pie chart showing groundwater infiltration rate distribution

3.10. Groundwater potentials

Very good-good, good-moderate, poor-nil and nil potentials of groundwater are observed in the present study area. Very good-good potentials of groundwater are observed along Musi River and areas surrounding major tanks and streams in the study area .The major part of the study area is having good-moderate groundwater potentials. Poor-nil potentials of groundwater are observed at different parts of the study area. The groundwater potentials in the dyke area are nil as shown in (Fig17).

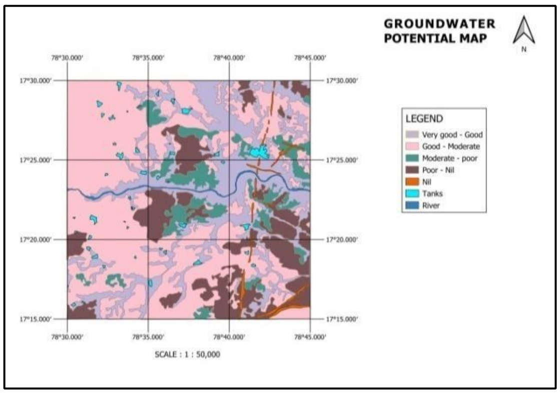

Fig.17 Groundwater potential map

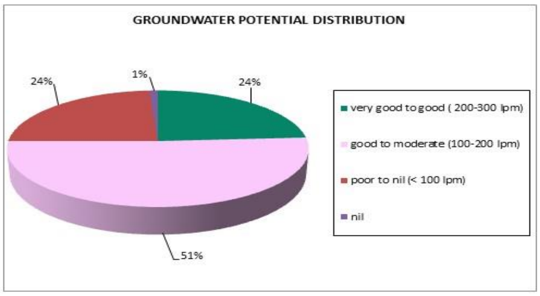

Fig.18 Pie chart showing groundwater potential distribution

3.11. Ground water prospects map

By integrating all the thematic maps we get groundwater prospects map (Fig 19).

High yield ranges of groundwater are observed along Musi river and surrounding major streams and tanks, good-moderate yield ranges are observed in the remaining major part of the study area and poor-nil yield ranges are observed in In the central, North east, East and southern part of study area, nil yield ranges are observed in the southern part of study area (mostly South east part of study area).

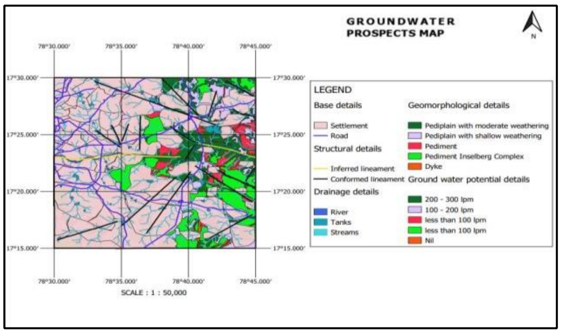

Fig.19 Groundwater prospects map

Conclusions

The study area comprises a part of Hyderabad, Ranga Reddy, Yadadri-Bhuvanagiri and Medchal-Malkajgiri districts of Telangana, India. The area is drained by the Musi River. The landforms observed in the study area are pediplain with moderate and shallow weathering, pediments, pediment inselberg complex and dykes. The area is underlain mainly by the oldest rocks of the Archaean Group of pink and grey granites and lineaments, adamellite-granodiorite suites and migmatite. Structures observed in the study area are lineaments. Of the lineaments, conformed lineaments (along Musi river), inferred lineaments are observed in the study area. Though drainage network is distributed in the entire study area, most of it is distributed in the southern part of the study area. The major part of the settlement (part of Hyderabad) area occupied the NW part of the study area. The map showing four different potential zones for artificial recharge has been prepared for the study area. The final (groundwater prospects) map was prepared by integrating various thematic maps, viz., and geomorphological, structural, geological and hydrological maps. The present study shows the areas of less groundwater potential zones so that we can improve groundwater levels in the perspective of groundwater use for future generations.

References

Y.SrinivasaRao,T.V.KrishnaReddy,P.T.Naidu,(1997), Hydrogeomorphological studies by Remote Sensing application in Niva river basin, Chittor District, A.P, *Journal of the Indian Society of Remote Sensing,* vol.25,no. 3,pp 187-194.

V. Jothiprakash , G . Marimuthu , R. Muralidharan , N . Senthilkumar,(2003),Delineation of porential zones for artificial recharge using GIS, *Journal of the Indian Society of Remote Sensing,* 31,pp 37-47.

S.Chakraborty,Surajit,(2004),Identification of potential groundwater zones in the Baghmundi block of Purulia district of West Bengal using remote sensing and GIS, *Journal of the Geological Society of India* ,nol.64,pp 6975.

M.A.Khan and P.C.Moharana,(2002) Use of Remote Sensing and Geographical Information System in the Delineation and Characterization of Ground Water Prospect Zones, *Journal of the Indian society of remote sensing*, vol.30, No.3,pp 131-141.

I.M. Bahuguna , ShaileshNayak , V. Tamilarsan andJ.Moses , (2003) , *Journal of the Indian Society of Remote Sensing*,31,pp 101-105.