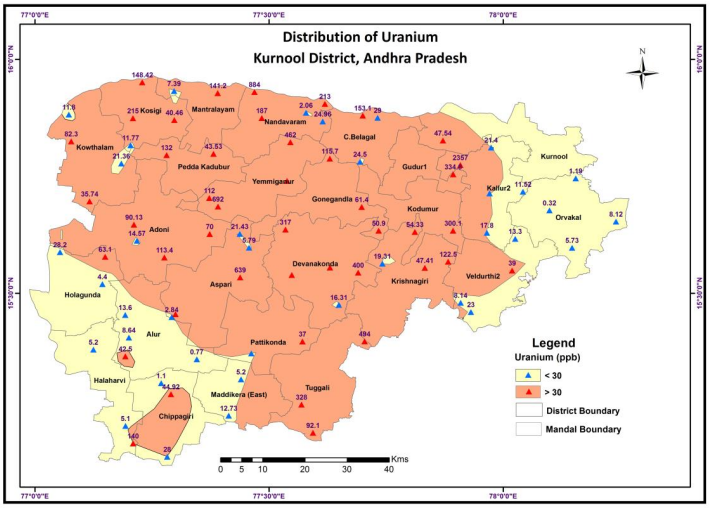
Central Ground Water Board
Department of Water Resources, River Development and GangaRejuvenation
Ministry of Jal Shakti
Government of India

DRAFT REPORT ON
AQUIFER MAPPING AND MANAGEMENT PLAN
OF
KURNOOL DISTRICT, ANDHRA PRADESH



Central Ground Water Board
Southern Region
Hyderabad

March 2023

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1. INTRODUCTION

Ground water is of paramount importance for drinking, domestic, agriculture and industrial purposes. As large parts of India particularly hard rocks terrain have become water stressed due to rapid growth in demand for water due to growth of population, demand for irrigation, rapid urbanization and changing life style. Therefore, in order to have an accurate and comprehensive micro-level picture of ground water in India, aquifer mapping in different hydrogeological settings at the appropriate scale is devised and implemented, to enable robust ground water management plans. This will help in achieving drinking water security, improved irrigation facility and sustainability in water resources development in large parts of rural and urban India. The aquifer mapping program is important for planning suitable adaptation strategies to solve the water shortage.

In hard rock terrain due to lack of primary porosity, the ground water occurrence is limited to secondary porosity which is developed by weathering and fracturing. Weathered zone is the potential recharge zone for shallow and deeper fractures and excessive withdrawal from this zone leads to drying up in places and reducing the sustainability of structures. Besides these, ground water quality also represents a major challenge, which is threatened by both geogenic and anthropogenic pollution. In some places, the aquifers have high level of geogenic contaminants, such as fluoride and arsenic rendering them unsuitable for drinking purpose. High utilization of fertilizers for agricultural production and improper development of sewage system in rural and urban areas leads to point source of pollution viz., nitrate and chloride.

1.1 Objectives

The foremost objective of the Aquifer Mapping can be specified as “Know your Aquifer, Manage your Aquifer”. Systematic mapping of an aquifer incorporates activities such as collection, generation and compilation of available information on aquifer systems, demarcation of their location, extents and their characterization, analysis of data gaps, generation of additional data for filling the identified data gaps and finally preparation of aquifer maps at the desired scale. The two major objectives of the aquifer mapping is the delineation of lateral and vertical disposition of aquifers and their characterization on 1: 50,000 scale in general and further detailing up to 1: 10,000 scale in identified priority areas and the quantification of ground water availability and assessment of its quality to formulate aquifer management plans to facilitate sustainable management of ground water resources at appropriate scales through participatory management approach with active involvement of stakeholders.

1.2 Scope of study

The main scope of study is summarized below.

1. Compilation and interpretation of existing available data (viz.,Exploration, geophysical, water level and water quality with geo-referencing information and identification of principal aquifer units.

2. Long term and dynamic ground water regime monitoring (for water levels and water quality) for creation of time series data base and ground water resource estimation.
3. Quantification of ground water availability and assessing its quality.
4. To delineate aquifer in 3-D along with their characterization on 1:50, 000 scale.
5. Capacity building in all aspects of ground water development and management through information, education and communication (IEC) activities, through information dissemination, education, awareness and training.
6. Enhancement of coordination with concerned central/state govt. organizations and academic/research institutions for sustainable ground water management.

1.3 Study Area

Central Ground Water Board, Southern Region, Hydrabad has taken up NAQUIM study in Kurnool District to prepare aquifer map and its management plan. The name Kurnool is said to have been derived from "Kandanavolu". Kurnool District lies between North latitudes of 15°07´58"-15°57´58"and East longitudes of 76°58´12"-78°16´06". The altitude of the district varies from 100 ft above the mean sea level. This district is bounded on the north by Tungabhadra and Krishna rivers as well as Mahabubnagar district of Telangana State, on the south by Kadapa and Anantapur Districts on the west by the Bellary district of Karnataka State and on the east by Nandiyal District (Figure.1.1). The total geographic area of the district is 7977sqkm and has the population of 22.72lakh. The district comprises of 26 Mandals, 899 Gram Panchayats, 920 revenue villages, 3 Revenue Divisions and 3 Towns.

1.4 Climate and Rainfall

The Climate of the district is normally good and healthy. January, February and March months are usually pleasant with moderate winds from South-East. April and May are hottest months of the year, during these months the wind shifts to Southwest with increased force and brings welcome showers by the end of May. During the succeeding four months the wind blows from Western side in Major parts of the district and brings fair quantum of rainfall. By the end of September the wind is light and pleasant forecasting the onset of Northeast monsoon. In November and December the weather is fine, Rainfall is rare and wind is light with occurrence of heavy dew. District normal rainfall of the year is 670.5 mm. The Normal rainfall in 2019-20 is 513.9 mm. During the Year 2018-20, the rainfall contribution from south west monsoon is 347.3 mm and whereas in north east monsoon the contribution is 102.2mm. It is indicating that the district receives about 67 % of rainfall from south west monsoon only.

Based on the rainfall analysis, 12 Mandals received the above the normal rainfall of the district. The lowest rainfall is recorded in Nandavaram Mandal. Orvakal, Adoni, Alur and Chippagiri Mandals had received rainfall more than the Mandals Normal rainfall. Kallur, Kodumur, Krishnagiri, Kowthalam, Nandavaram and Aspari Mandals are received less than the district normal monsoon (Figure 1.2).

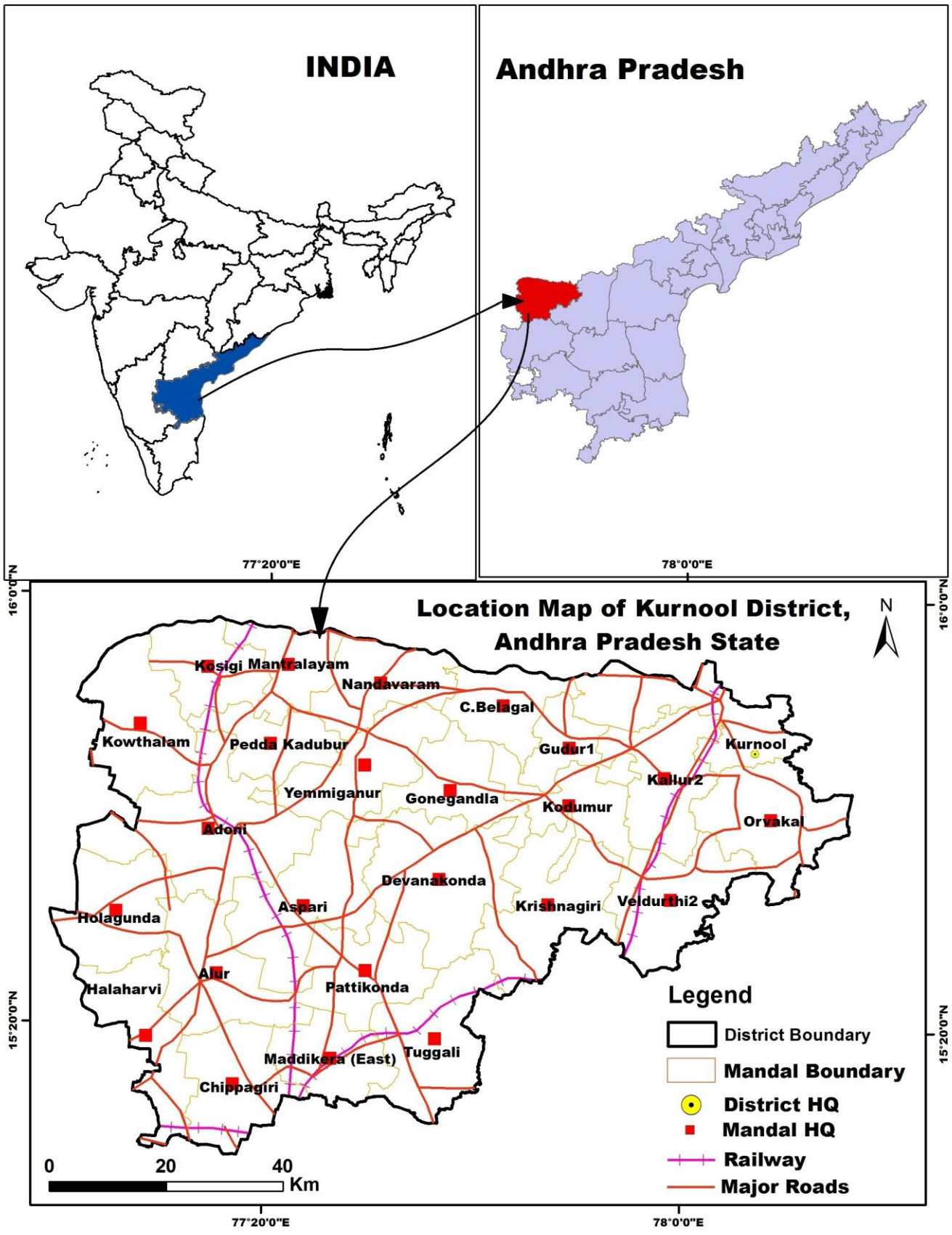
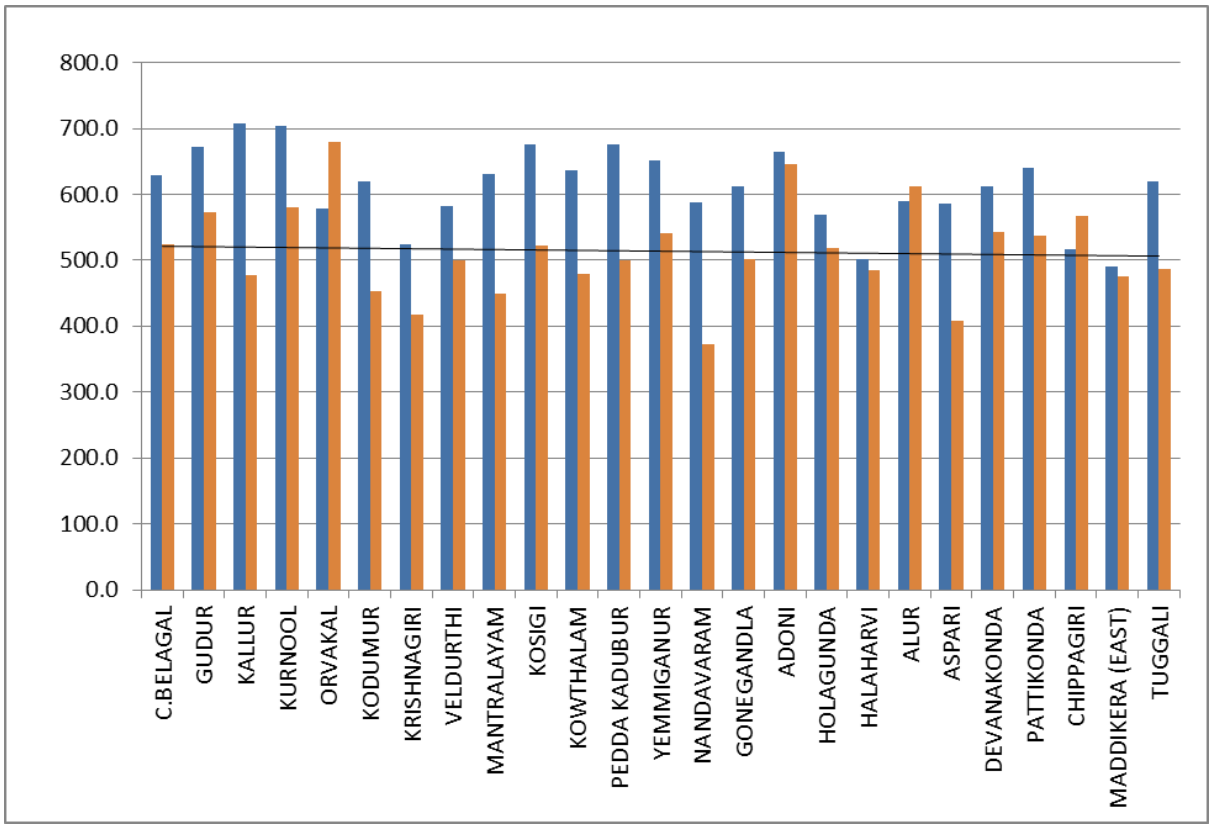


Figure.1.1. **Location map of Kurnool district**

Figure 1.2 Normal Rainfall Vs Actual Rainfall (2019-20) in mm



1.5 Physiography

Nallamalas and Erramalas are the two important mountain ranges in the district running in parallel from North to South. The western tract comprises Pathikonda, Tuggali, Maddikera, Devanakonda, Gonegandla, Dhone, Peapully, Veldurthy, Krishnagiri, Kurnool, Orvakal, Kallur, Kodumur, C.Belagal, Gudur, Yemmiganur, Nandavaram, Mantralayam, Adoni, Peddakadubur, Kosigi, Kowthalam, Alur, Aspari, Holagunda, Halaharvi, Chippagiri Mandals. The terrain here slopes from South to North and it is drained by the river Hundri. The eastern parts is covered by Nandiyal district.The district has the elevation difference of 200mts. The higher elevation is observed in Chakralla village of Patikonda Mandal and The lowest elevation is occurring along the Tungabadra River. The general slope of the district is from south to north direction in western parts of the district where the hard rock formation is occurring. In the eastern part, the slope is from west to east, it is formed by the sedimentary formation of the district.

1.6 Geomorphology

The different landforms discernable on the imagery have been broadly classified into Hills and plateau, Pediment zone, Plain and Valley Fill **(Figure 1.3) (Table1.1).** ***Hills and plateau:*** Hills and plateau are formed in highly elevated hills prone for dissection and denudation. It is characterised by either no soil cover or very thin soil development. The landforms are Structural velley, Structural Hill, Mesa, Hog back, Intermontane valley, Denudational Hill, Residual Hill, Butte and plateau and are generally forming as runoff zone. These landorms are formed by sedimentary formation in the east and granite in the south and western parts of the area. It is covering 12% of the total geographic area.

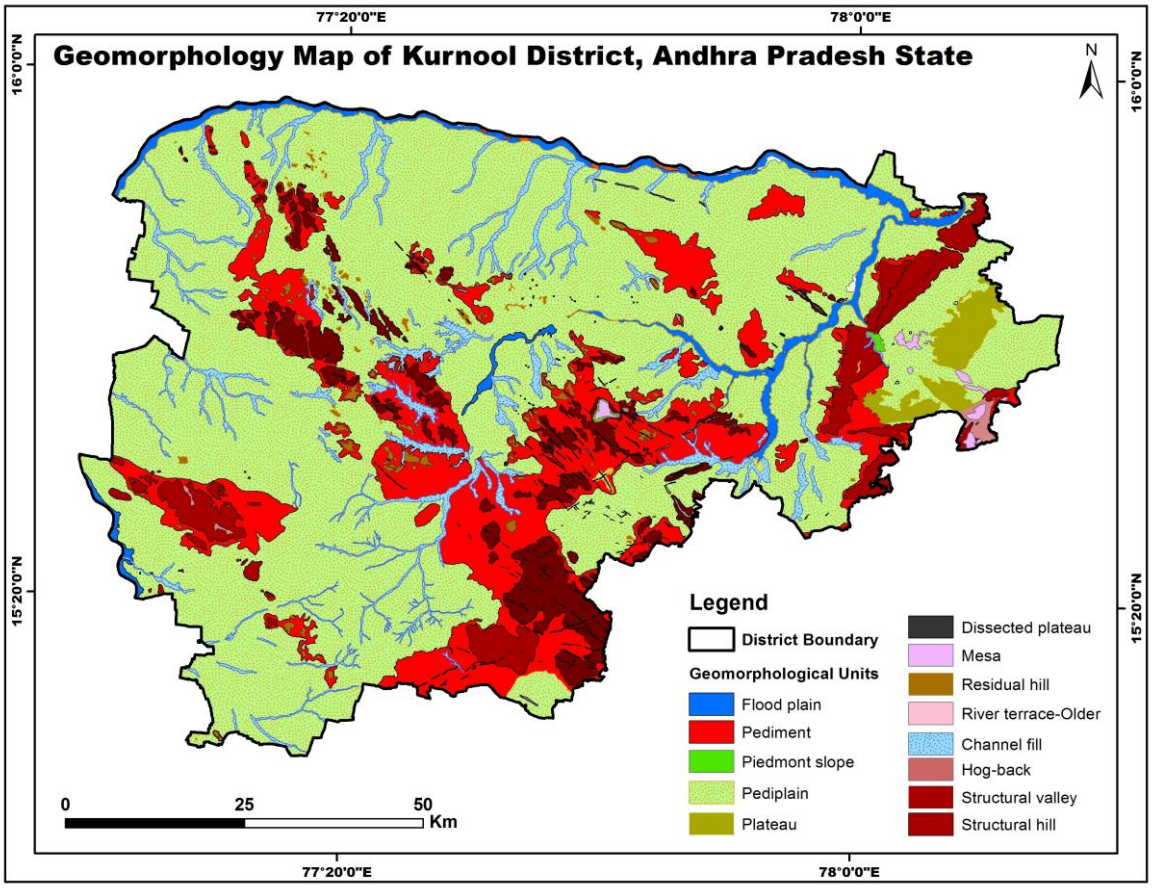


Figure 1.3 Geomorphology map of Kurnool district

Pediment zone: Pediment is gently undulating rock surface and wears a thin mantle of weathered materials. It has been carved over gneissic and granitic formation. Pediment zones permit poor infiltration and act as run-off zones; however, the fractures, which traverse these zones, could act as good recharge zones. This landform is formed around the foot hills of gnessic and granite formation occurring in the central parts of the district trending NW-SE direction NE-SW direction. It is represented by 16% of the total geographic area. In plain area, the pediment is buried by disintegration of county rock and forms buried pediplain shallow, buried pediplain moderate and buried pediplain deep. It is classified on basis of the thickness of the soil development above pediment zone. The shallow buried pediment is having thickness of soil ranging from 1-5mts and the moderate buried pediment thickness is ranging from 5-10mts. The deep buried pediment thickness is more than 10mts. It is covering

most of the area formed by granite rock formation. It is covering 68% of the total geographic area in the district.

Plain has also been developed mainly in the eastern part of the area due to deposition of unconsolidated materials by fluvial agencies. The materials are silt, fine sand and at places pebbly. **The Valley Fill** is formed by the deposition of younger sediments brought by fluvial agents. These landforms are Flood plain, Channel bar, Channel fill, Point Bar and River Terrace and generally found along the river course. It is represented by 5# of the total geographic area. The pediplain and valley fills are playing vital role in Ground Water recharge.

Table 1.1 Geomorphology of Kurnool district

Landform	Category	Area in sq.km	Area In Percentage
Butte	***Hills and plateau***	0.58	12.00
Denudational hill		376.29	
Inselberg		2.31	
Intermontane valley		17.19	
Linear ridge		27.61	
Mesa		20.50	
Plateau		111.37	
Residual hill		57.97	
Structural hill		279.43	
Structural valley		24.71	
Pediment	***Pediment***	1247.73	15.00
Piedmont slope		5.36	
Pediplain	***Pediplain***	5402.52	68.00
Flood plain	***Valley Fill***	27.06	5.00
Channel bar		3.61	
Point bar		4.91	
River terrace		3.66	
Channel fill		364.19	

1.7 Drainage:

The principal rivers flowing in the district are the Tungabhadra (and its tributary is Hundri) The Krishna and the Kunderu. The Tungabhadra rises in the Western Ghats and after forming part of northern boundary for some distance separates Kurnool from the Telangana area flown in an Eastern direction receives Hundri and falls into the Krishna river at Kudali Sangam after winding Northwards. The Hundri, a tributary of Tungabhadra rises in the fields of Maddikera in Maddikera mandal receives a stream from Erramalas at Laddagiri in Kodumur Mandal and joins Thungabhadra at Kurnool (Figure1.1.4). It drains much of Maddikera, Pathikonda, Devanakonda, Gonegandla, Kodumur and Kallur Mandals. This is turbid streams with sudden raise and fall. The Kunderu also called Kumudvathi rises on the western side of Erramalas winds its way into Kunderu valley and flows in a Southern direction collecting drainage all along its course from either side.

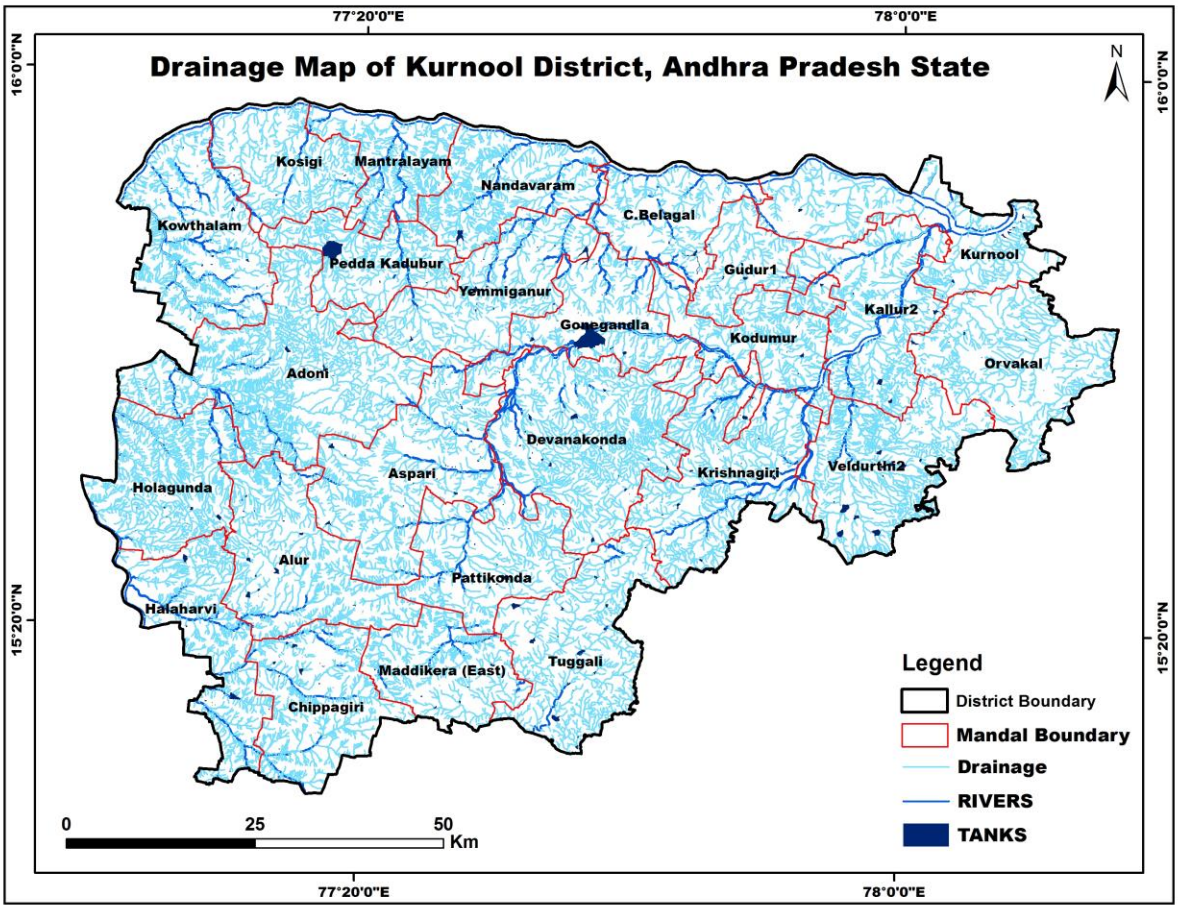


Figure.1.4. Drainage map of Kurnool district

1.8 Land use and cropping pattern

Landuse / Landcover map was generated using satellite data for the study area. Agriculture land, forest land, waste land, settlement and waterbody are the main landuse/landcover in the area **(Figure-1.5)**. The agriculture land which includes kharif crop and rabi crop areas are found in the district. About 90% of the area is covered by Kharif crop and it is mainly depending on rain fall. The double crop area is very scanty and mainly found where the Ground Water condition is good. The forest area is occurring in small pockets and predominantly in the western parts of the district. Waste land and barren rocks found in the western and eastern parts of the areas.

The total Geographical area of the district is 797740 ha. During the year 2020-21 the area covered by forest is 32062 ha which forms 4.02% to the total geographical area. The net area sown is 505573 ha, forming 63.38% to the total geographical area. The total cropped area in the district is 545157ha (Table-1.2) Figure (1.51). The area sowed more than once during the year is 39584ha. The major crops cultivated in the district are cotton, Bengal Gram, Groundnut, Red Gram, Paddy, Jowar, Chilly Maize and Bajra. Based on 2020-21, the total area cultivated in the district is 503797ha (Figure 1.5.2). It is represented by 63% of the total geographic area. About 48% of the total cultivated area is covered by cotton in the district.

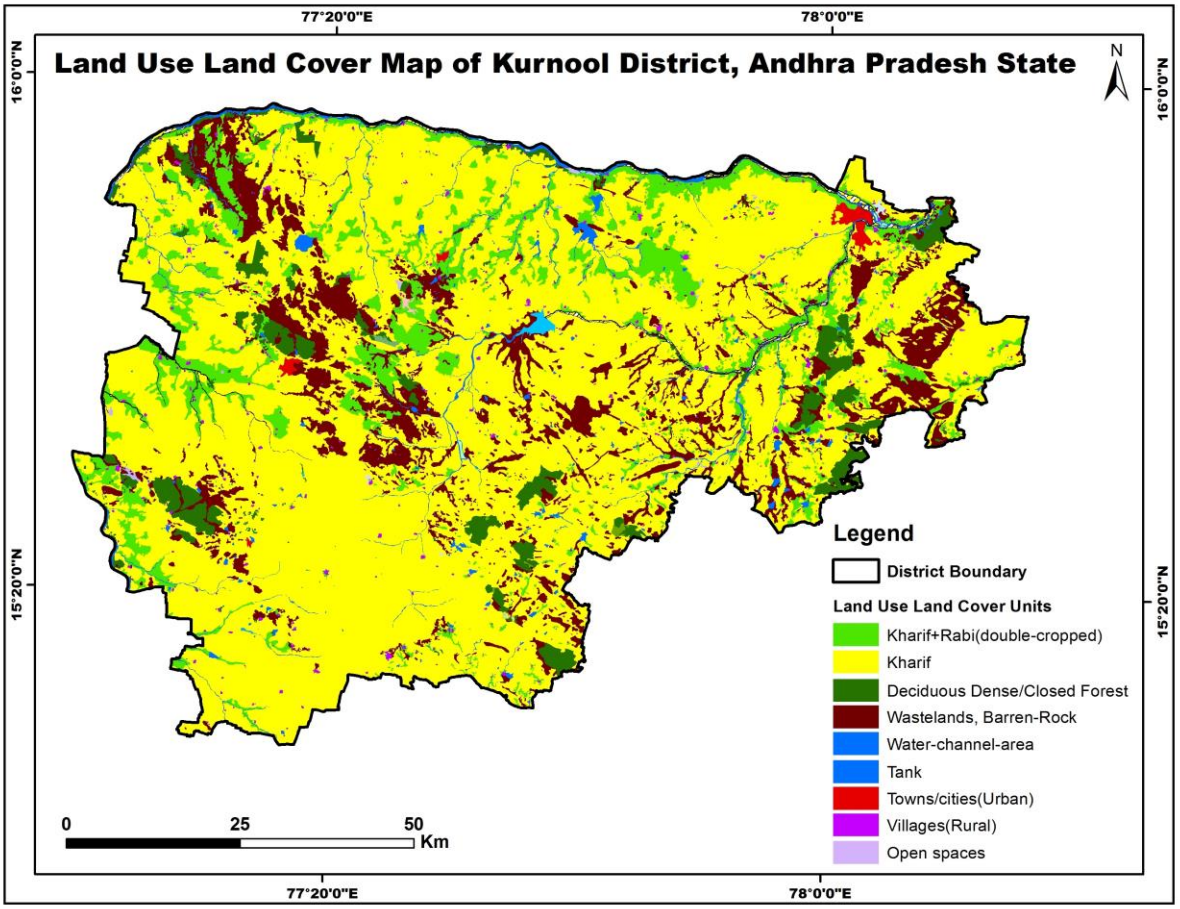


Figure.1.5. Land use and land cover of Kurnool district.

Table.1.2. Land use and land cover of Kurnool district.

Landuse	Area in %
Forests	4.02
Barren & uncultivable land	6.08
Land put to non-agricultural uses	8.86
Cultivable waste	3.26
Permanent pastures and other grazing lands	0.29
Land under miscellaneous tree crops & groves not included in net area sown	0.11
Current fallows	9.36
Other fallow lands	4.65
Net Area Sown	63.38

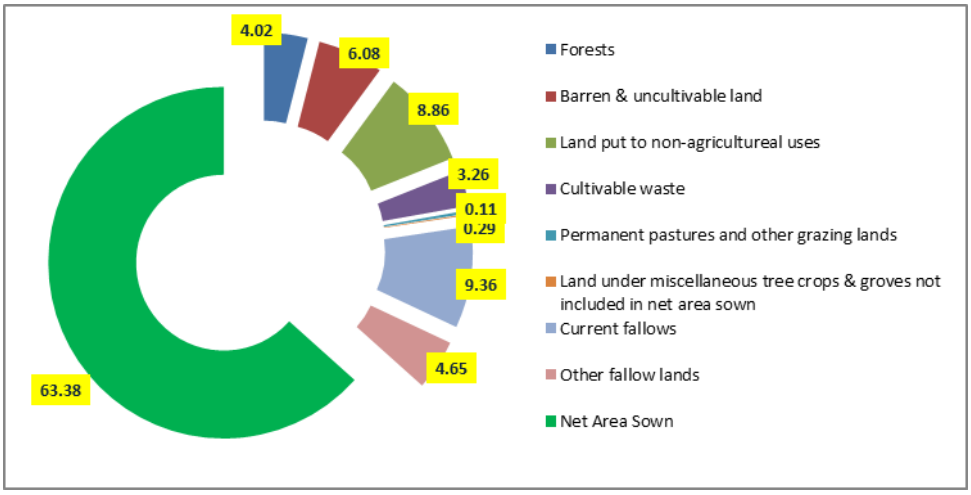


Figure. 1.5.1 Percentage wise Land use and land cover of Kurnool district

Crops	Area in Ha
Coconut	1
Horse gram	3
Green gram	3
Cow gram	6
Seasmum (Gingelly)	11
Turmeric	50
Soyabeen	87
Blackgram	105
Sunflower	270
Sugarcane (Cane)	304
Total Tobacco	1916
Bajra	5043
Maize	7119
Chillies	7752
Castor	12527
Jowar	13413
Paddy	16955
Red gram	25704
Groundnut	78038
Bengal gram	90482
Cotton (Lint)	244008
Total	**503797**

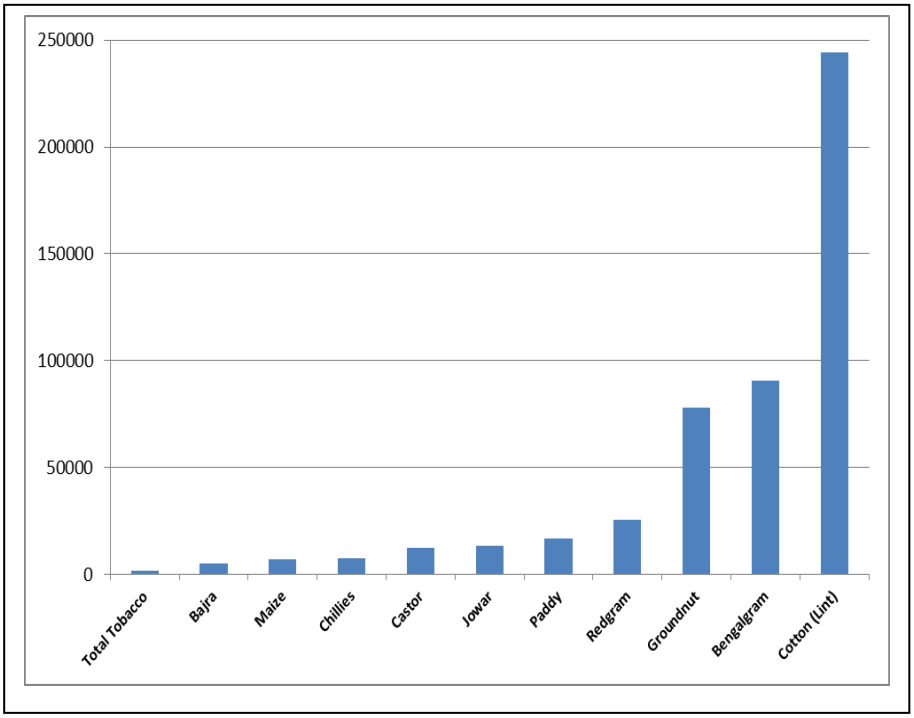


Figure. 1.5.2 Cropping pattern of Kurnool district

1.9 Soils

Kurnool District is rich in regur and red ferruginous soils which constitute about 60 and 40 per cent respectively. They are further classified as clay, loamy and sandy soils. The black cotton soils are predominant in the Mandals of Pattikonda, and Adoni and are formed in the hard crystalline formation.. In the Eastern part of the district, red soil of a poor quality largely predominates and formed by sedimentary formation. . These soils, although generally poor in fertility, yield a very good crop with a minimum rainfall. The crops mainly raised are Jowar, cotton and pulses. Regur soil of superior quality is available in the central section together with Kurnool and Pattikonda Mandals. It responds well for paddy and Bengal gram. The availability of alluvial soil is quite small and is confined to a few villages near the confluence of Rivers. It generally suits for raising mustard, wheat and black gram which are valuable products. Rock lands are not having the soil development and are formed predominantly in the central parts of the district.

Based on the remote sensing data, soil map has been prepared and six soil types have been mapped in the district such as Clayey Skeletal mixed, Coarse, Fine, Loamy mixed, Fine montimorlities and Rocky land. In the district, 80% of the area is covered by Fine montimorlities which is formed by the granite and gneiss rock formation (Figure- 1.6). Loamy soils are occurring in the center of the district. The rocky lands are formed in the eastern and eastern parts of the district formed by the metasedimentary formation of the district.

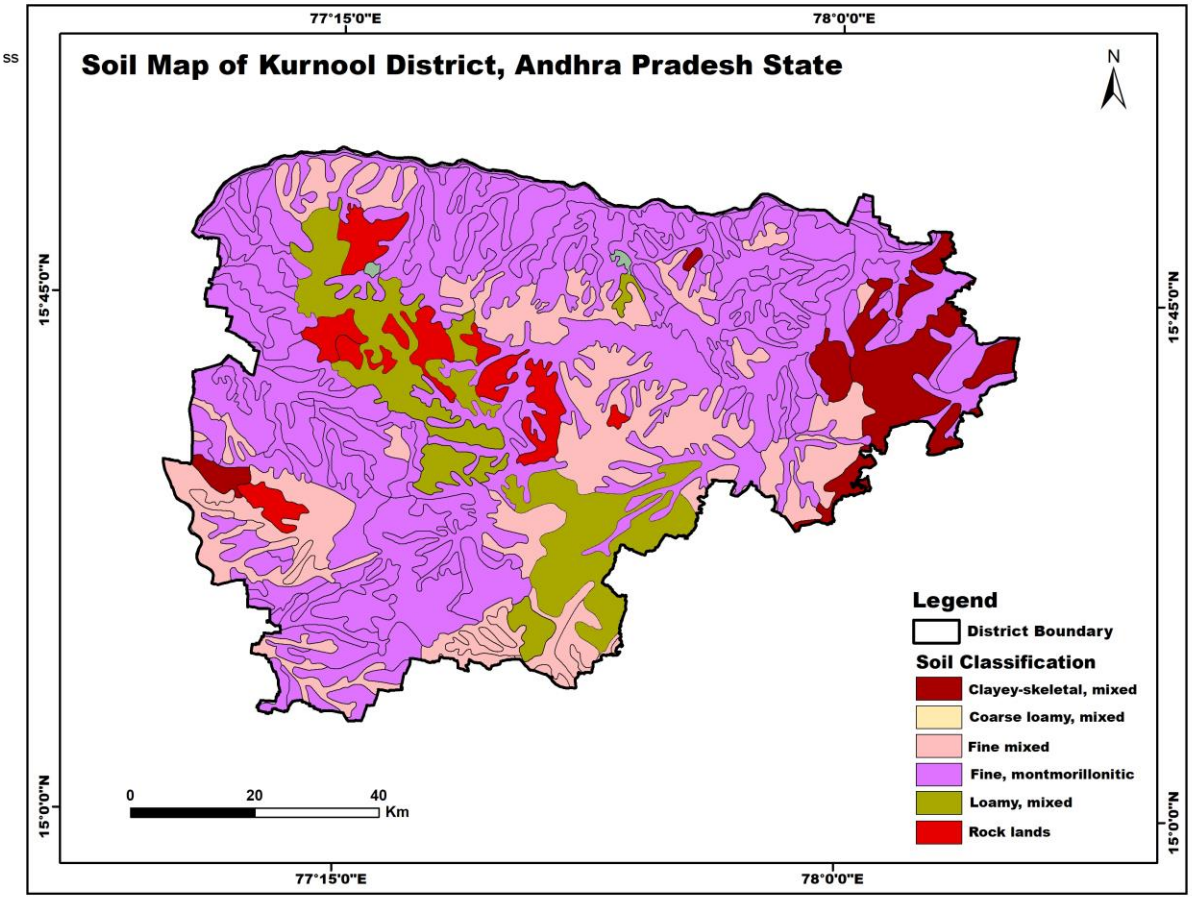


Figure.1.6 Soil map of Kurnool district.

1.10 Irrigation

In the district, Major and medium Irrigations project had been implemented for agricultural practices.

Major irrigation Project:

In the district, the major irrigation project is The Tunga Bhadra Project Low Level Canal (TBP LLC). This system is an integral part of Tunga Bhadra Project with its head works located in Karnataka State. This project is covering an ayacut area of 1.51 lakh acres located in 16 Mandals in Kurnool district. The total number of villages covered through this project is 194 in the district.

Salient Features

Location	:	The TBPLLC takes off from TB Dam on right side.
Mandals Benefitted	:	Halaharvi, Holagunda, Adoni, Kowthalam, Kosigi, Manthralayam, Peddakadubur, Yemmiganur, Nandavaram, Gonegandla, Krishnagiri, C-Belagal, Kodumur, Gudur, Kallur, Kurnool.
Dependable Net Yield	:	24.00 TMC
Length	:	74 Km. (250Km length in Karnataka and 74 Km in A.P)
Ayacut in Acres	:	1,51,134 Acres (43,519 acres in Khariff & 1,07,615 acres in Rabi).
Cropping Pattern	:	Khariff: Paddy, ID. Rabi: ID
Villages Benefited	:	194 Villages

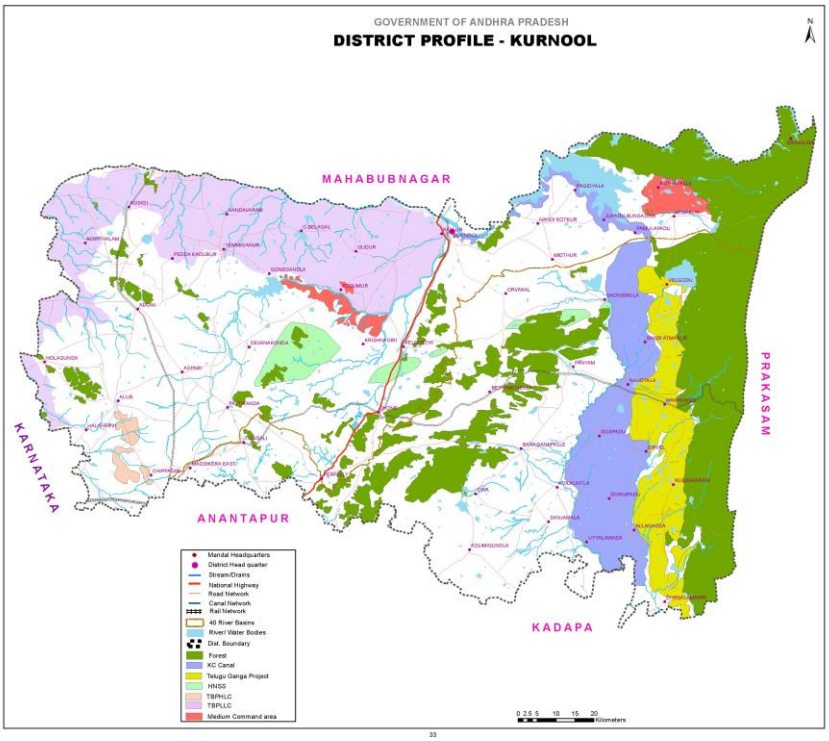


Figure.1.7 Canal command area of erstwhile of Kurnool district.

The Alur Branch Canal is another major irrigation project in the district and it takes off at tail end of Guntakal Branch Canal Km 59.400. The ayacut area of the project is 14.255 acres in the district. It is covered in the Chippagiri, Alur and Halaharvi Mandals of Kurnool District. It is running for the length of 39.680km with19 distributaries . The entitlement for this canal is 2.37 TMC of water at TB Dam for Khariff crops.

Medium Project:

Sanjeevaiah Sagar is a Medium Irrigation project prevailing in the district. It is constructed acroos Hundri River at Gajuladinne Village of Gonegandla Mandal of Karnool District. It is irrigating 24.372 acres in the district for ID crops during Rabi season. The project is covering 21 villages in four Mandals of Karnool district.

Source of Irrigation:

In addition to that major and medium project in the district, the Ground Water is being used for irrigation. The total area irrigated through Ground Water is 49779ha in the district using 24335 nos of Tube well/ Bore well and 5532 nos of dug well in the district (Table 1.3). The surface water is used for irrigation through surface flow like canal network and also by lift irrigation in the district. The total area irrigated through surface flow is 15529ha whereas using lift irrigation, 8751 ha of area is irrigated in the district. The total area irrigated by all means of source is 74053ha of land in the district.

Table-1.3: Salient Features of Irrigation by different source during 2019-20

Source of Irrigation	Irrigation Structures	Total (Numbers)	Area Irrigated in Ha
Ground Water	Tube/Bore wells	24335	49113
	Dug wells	5532	666
Surface Water	Surface Flow	1757	15529
	Lift Irrigation	1503	8751

1.11 Prevailing water conservation/Recharge practices

Based on the APWRIS portal, 43480 farm ponds, 1200 percolation tanks, 3808 Check dams and 18539 other structure are constructed to recharge the ground water by the state water resource department in the district. The total capacity of all the 67027nos of structures are 2546.18mcft (Table 1.4). The present storage of water in all strictures is 1230.60mccft of water in the district. The total amount of water expected to be recharged from all the structures is 738mcft to Ground Water system in the district. The structures constructed in Devanakonda, Krishnagiri, Madikere and Patikonda Mandals are filled with very less quantity of water compare to other Mandals in the district. It is not showing significant recharge to Ground Water system as it was expected. It is may be due to erratic rainfall in the district.

Table 1.4 The details of ARS constructed in the district by Govt of AP

MANDAL	Farm Pond	Check Dam	Percolation Tank	Other	Total		
					Count (nos)	Capacity (mcft)	Storage (mcft)
ADONI	2837	331	9	1376	4553	164.78	80.3
ALUR	3948	88	48	302	4386	117.61	46.76
ASPARI	3483	155	21	369	4028	114.04	62.4
C BELAGAL	549	240	7	1351	2147	111.65	56.63
CHIPPAGIRI	2141	66	52	440	2699	124.45	44.75
DEVANAKONDA	3126	469	98	474	4167	302.03	73.08
GONEGANDLA	1137	69	6	1064	2276	64.17	32.25
GUDUR (KURNOOL)	625	61	2	339	1027	32.86	26.73
HALAHARVI	2268	24	18	794	3104	53.58	25.77
HOLAGUNDA	1334	91	36	358	1819	69.79	40.76
KALLUR	1024	191	7	333	1555	105.01	67.93
KODUMUR	853	168	4	427	1452	83.65	63.3
KOSIGI	1955	100	5	1423	3483	79.55	28.86
KOWTHALAM	856	36	6	908	1806	41.33	23.75
KRISHNAGIRI	2801	215	32	882	3930	192.87	33.26
KURNOOL MANDAL	429	124	5	600	1158	75.21	40.11
MADDIKERA EAST	2337	85	369	368	3159	215.06	52.48
MANTRALAYAM	805	169	1	1092	2067	91.38	61.03
NANDAVARAM	799	114	11	1417	2341	79.64	48.5
ORVAKAL	1304	191	38	263	1796	117.63	92.79
PATTIKANDA	2099	170	326	380	2975	218.93	49.38
PEDDA KADUBUR	787	79	0	1363	2229	41.78	22.53
TUGGALI	2882	165	90	373	3510	152.97	33.45
VELDURTHI (KURNOOL)	1970	244	6	372	2592	181.03	76.36
YEMMIGANUR	1131	163	3	1471	2768	115.18	47.52
Total	**43480**	**3808**	**1200**	**18539**	**67027**	**2946.18**	**1230.68**

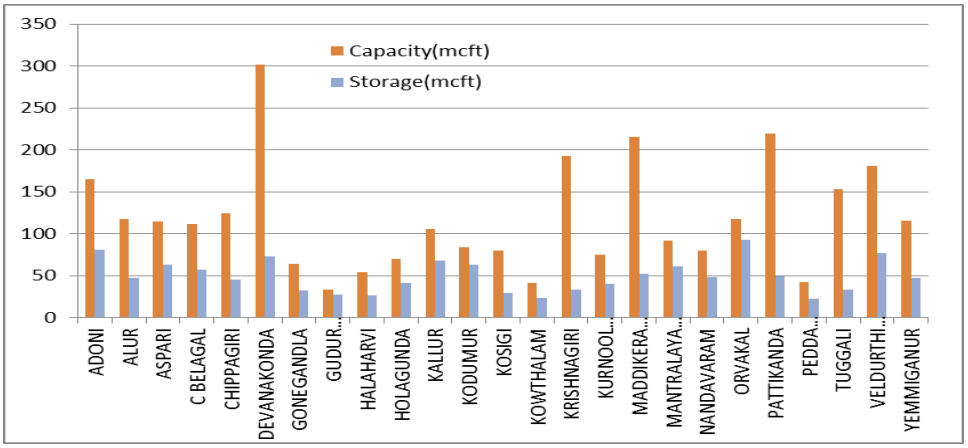


Figure. 1.8 ARS full capacity storage vs current capacity storag

1.12 Geology

Geologically the area is underlain by the hard-crystalline formation of Archaean to Lower Proterozoic age and sedimentary formation of Middle to Upper Proterozoic Age. The stratigraphic succession of the area is given below Table – 1.5.

Table 1.5 Geology of Kurnool district

Sl No	AGE	FORMATION
1	UPPER PROTERZOIC	Shale Limestone /Schist
2	MIDDLE PROTERZOIC	Quartzite Limestone Quartzite Slate Conglomerate
3	ARCHAEAN TO LOWER PROTEROZOIC	Granite
4	ARCHAEAN	Granite Peninsular Gneissic Complex

Peninsular Gneissic Complex and Granite of Archaean age is the major rock type in the district occurring in the western part of the area. The gneissic formation is having the trend of NW-SE direction occurring within the granite of Archaean age. The Yonger grainite of Archaean to Lower Proterozoic is occurring in the north central parts of the district and sandwiched between Gneiss of Archaean age and Sedimentary Formation of Cuddappa Foramtion. This granite formation is having the trend of NW-SE direction and abating with sedimenaty formation in the southern part of the district.

The Sedimentary Formation of Upper Cuddappa Super Group and Kurnool Formation (Middle to Upper Proterozic age) is occurring in the eastern parts district and it is unconformley overlain by Peninsular Gneissic Complex and Granite of Archaean to Lower Proterozic Formation. The unconformity is marked by the conglomerate formation. The sedimenaty formation is consisting of quartzite, slate, limestone and quartzite of upper Cuddappa Formation and followed by shale limestone of Kurnool formation. The sedimentary formation is part of the northen limbs of Antilcline Asymmetric Fold and having the strike of NNW-SSW with 30° to very deep northerly dip direction. The fold is plunging in east direction. The southern tip of northern limbs abruptly is ended with Kalava Fault trending ENE-WSW direction. The younger alluvium of fluvial origin is found all along the river course and consisting of sand, silt and clay.

The Banded gneiss is covered about 56% and granite is occupied 26% of the total geographic area of the district. The remaining area of 18% of the area is covered by sedimentary formation of the district (Table-1.6). The Ground Water is mainly controlled by the hard rock formation of the district.

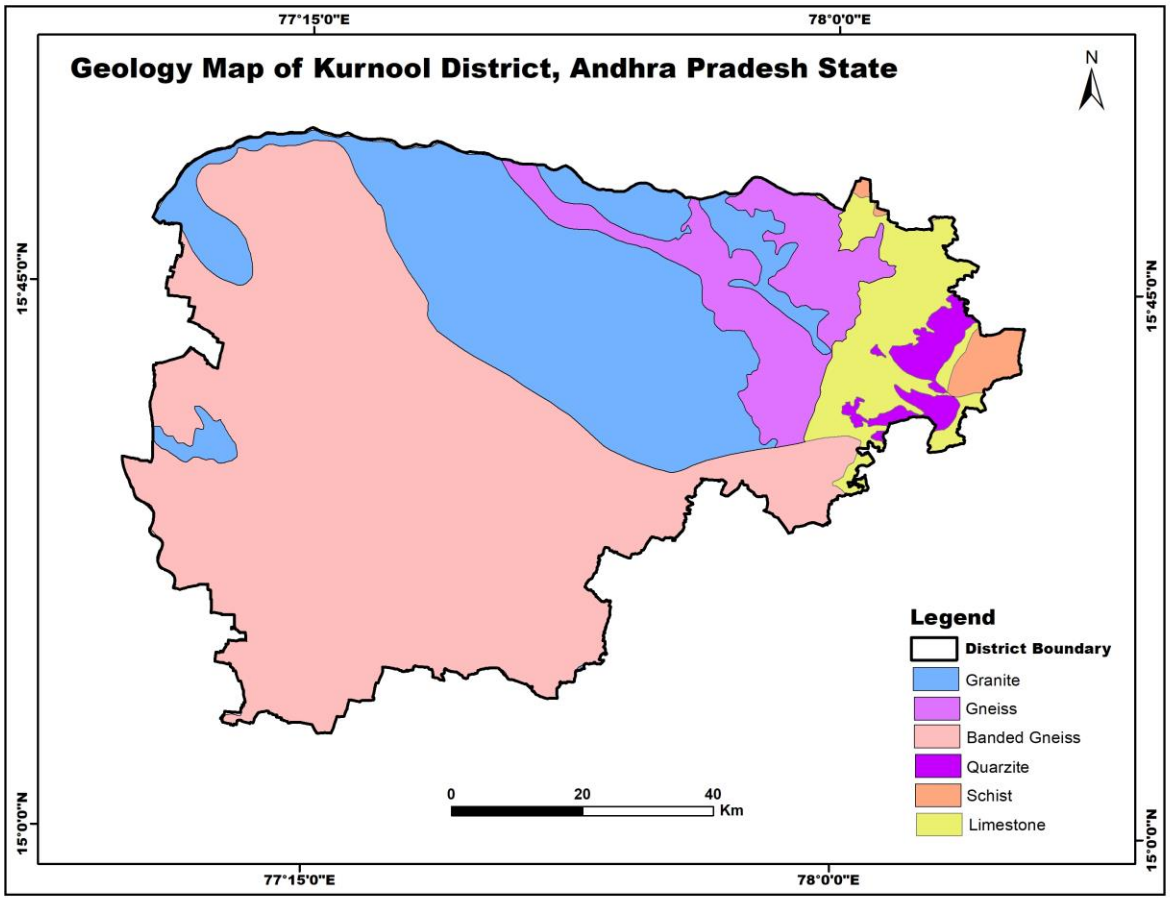


Figure. 1.9 Geology of Kurnool district.

Table 1.6 Lithology wise area coverage in the district

Lithology	Area in sqkm	Percentage of Area
Granite	2097	26.29
Quartzite	138	1.73
Banded Gneiss	4486	56.24
Shale	89	1.12
Limestone	487	6.11
Gneiss	680	8.52

2 DATA COLLECTION AND GENERATION

Collection and compilation of data for aquifer mapping studies is carried out in conformity with Expenditure Finance Committee (EFC) document of XII plan of CGWB encompassing various data generation activities (Table-2.1).

Table-2.1 Data compilation and generations.

S. No.	Activity	Sub-activity	Task
1	Compilation of existing data/ Identification of Principal Aquifer Units and Data Gap	Compilation of Existing data on ground water	Preparation of base map and various thematic layers, compilation of information on Hydrology, Geology, Geophysics, Hydrogeology, Geochemical etc. Creation of data base of Exploration Wells, delineation of Principal aquifers (vertical and lateral) and compilation of Aquifer wise water level and draft data etc.
		Identification of DataGap	Data gap in thematic layers, sub-surface information and aquifer parameters, information on hydrology, geology, geophysics, hydrogeology, geochemical, in aquifer delineation (vertical and lateral) and gap in aquifer wise water level and draft data etc.
2.	Generation of Data	Generation of geological layers (1:50,000)	Preparation of sub-surface geology, geomorphologic analysis, analysis of land use pattern.
		Surface and sub-surface geo-electrical and gravity data generation	Vertical Electrical Sounding (VES), bore-hole logging, 2-D imaging etc.
		Hydrological Parameters on ground water recharge	Soil infiltration studies, rainfall data analysis, canal flow and recharge structures.
		Preparation of Hydrogeological map (1:50, 000 scale)	Water level monitoring, exploratory drilling, pumping tests, preparation of sub-surface hydrogeological sections.
		Generation of additional water quality parameters	Analysis of ground water for general parametersincluding fluoride.
3.	Aquifer Map Preparation (1:50,000 scale)	Analysis of data and preparation of GIS layers and preparation of aquifer maps	Integration of Hydrogeological,Geophysical, Geological and Hydro-chemical data.

4.	Aquifer Management Plan	Preparation of aquifer management plan	Information on aquifer through training to administrators, NGO's, progressive farmers and stakeholders etc. and putting in public domain.

2.1 Hydrogeological Studies

In hard crystalline formation, the Ground Water mainly occurs in weathered and fractured rocks. In the district, gneiss and granite rocks are predominant and forms the aquifer systems in the district. In sedimentary formation, limestone, quartzite and Recent alluvium occurring in the eastern parts of the area are contributing Ground Water to aquifer systems. The Ground Water movement is following the general slope of the area particularly in the hilly region and in plain terrain the Ground Water flow towards the major river draining in the area. It indicates that the rivers draining the area are highly influenced by the Ground Water systems.

2.1.1 Occurrence of Ground Water in Gneiss and Granite

In the study area, gneissic and granite formation is occupying more than around 80% of the area and forms main aquifer system in the area. The gneissic and granite formation is occurring in the central parts and western parts of the area. The Ground Water generally is occurring in the weathered and fracture occurring these formations.. Two types of Ground Water abstraction structures such as dug well and bore well are mainly used in this formation. The depth of the dug well is upto 30m bgl and the depth of dug well varies due to surface water sources. The depth of bore well is generally 200m bgl and the fractures are encountered up to the depth of 200mts.

2.1.2 Occurrence of Ground Water in Sedimentary formation:

In the area, limestone, quartzite and shale of Cuddappa and Kurnool formations are occurring in eastern parts of the area. The Ground Water is occurring in reworked primary and secondary porosity in quartzite and shale under confined and unconfined conditions. The dug well and tube wells are the abstraction structure. The Ground Water in limestone formation is occurring in weathered and karstified medium under unconfined and confined aquifer conditions respectively. The Ground Water abstraction structures are dug well and borewell in this formation. The Ground Water potential of the sedimentary formation is higher than crystalline formation in the district.

2.1.3 Occurrence of Ground Water in Alluvium

In the area, alluvium is formed along the river course. The alluvium is mainly consisting of sand and intercalation of clay. The thickness of the alluvium is generally 5 to 10mts and the Ground Water abstraction structure is mainly of shallow tube well. The Ground Water is occurring under unconfined aquifer system and having good Ground Water potential. The Ground Water quality of this aquifer is considerable good and potable.

2.1.4 Ground water Exploration

Total 22 exploratory wells (19+3) were constructed in the district down to a maximum depth of 200 m with less than 1 to 5 lps yield. The specific capacity ranges from 13 to 81 lpm/m/dd. The Transmissivity ranges from 1-126 m^2/day **(Annexure-I)**. Out of 22 exploratory wells,11 wells yielded <1lps, 5 wells yielded 1 to 3 lps, 5 wells yielded 3 to 5 lps and 2 wells yielded more than 5lps.

2.2 Depth to Water levels

Ground water levels from 106wells (CGWB: 25 and Key wells: 81) are consisting of dug wells and bore wells were monitored for pre-monsoon and post-monsoon seasons. The water level data was processed to understand the water level sectorial of the district. Monitoring Ground Water level of the aquifer systems implies the Ground Water recharge to aquifer system and rate of Ground Water abstraction in an area. In the study area, Ground Water level work is generally carried out four times in a year which covers the pre-monsoon and post-monsoon period. The water level data collected from dug well/ bore well were analysed to prepare water level of pre and post monsoon period. The long term water level data of May (2011-19) and November (2011-20) are considered for pre and post-monsoon water level trend analysis respectively. The water level data of the district is shown in **Annexure-IIA & B.**

2.2.1 Pre-monsoon water level (June 2022)

Ground Water level monitoring well was established in Kurnool district during the June-2022 in Kurnool district to collect the water level of dug well and Borewell/Tube well. The Dug well is representing the Aquifer-I whereas the Bore well/Tube well is representing water level of Aquifer-II. In the district, 106nos of key well were established. Of 106, 34nos are Dug wells and remaining 72 nos are Borewells/ Tubewells.

2.2.2 Pre-Monsoon water level Aquifer-I: (June-2022)

Based on the water level collected from the Dug wells, the water level of the district is ranging from 0.49 (Karivumula) to 10.68mgl (Arikera). The water level data is depicted into four zones such as 0-2, 2-5, 5-10 and 10-20 m bgl. Water level of the district is generally falling in one zone which is 2 to 5m zone and representing 64.7% of the Dugwell. 0 to 2 and 5 to 10mts zones are representing each 11.8% and 20.6% of the Dug wells respectively. The deepest water level is 10-20 mts zone and it is represented by 2.9% of the Total Dug well. The details of water level zone of pre monsoon are given in Table-2.2.

Table: 2.2 Water level zone of pre monsoon (Aquifer-I)

Period	Percentage of water level zone (mbgl)			
	0-2	2-5	5-10	10-20
Pre monsoon (june-2022)	11.8	64.7	20.6	2.9

2.2.3 Pre-Monsoon water level Aquifer-II: (June-2022)

Water level data collected from Bore Well / Tube well was analysed for Aquifer-II. The water level is ranging from 1.42 to 49.60mgl. The shallow water level is reported in Zumaladinne and deepest water level is occurring in Thadakanapalle. The water level data is depicted into five zones such as 0-2, 2-5, 5-10, 10-20 and 20-50m bgl. Water level of the district is generally falling in two zones such as 2 to 5 and 5 to 10mts representing 33.3% and 31.9% respectively. The deep water level of 10-20 mts zone is represented by 16% of the total Bore well. The deepest water level zone of 20-50 is representing 13 % of the total observation well. The details of water level zone of pre monsoon are given in **Table-2.3.**

Table: 2.3 Water level zone of pre monsoon data of Aquifer-II

Period	**Percentage of water level zone (mbgl)**				
	0-2	**2-5**	**5-10**	**10-20**	**20-50**
Pre monsoon (june-2022)	6.9	33.3	31.9	16.	11.1

The Aquifer-I and II water level is merged and prepared map (Figure-2.1). It is indicating that the water level of the district is ranging from 0.49 to 49.60 mbgl and it is mainly indicating the unconfined aquifer and semi-confined aquifer. The pre monsoon water level of the district is shown in five zones such as 0-2, 2-5,5-10, 10-20 and greater than 20m. The district is falling in two zones such as 2-5 and 5-10 m. These zones of water level are occupied in gneiss and granite formation. The next zone of water level 10-20mbgl is mainly occurring in the western and eastern parts of the area. In the western part, the water level of this zone is trending NW-SE direction and falling in the gneissic formations. In the eastern part, it trending the NE-SW direction and is mainly falling in quartzite and part of limestone formations. The deepest water level zone >20 is eastern part of the district and confined within the water level zone of 10-20mbgl. this water level is occurring part of limestone and shale formation. It is mainly indicating the recharge area of the district. The shallow zone of 0-2 is restricted only near to surface waterbodies of the district.

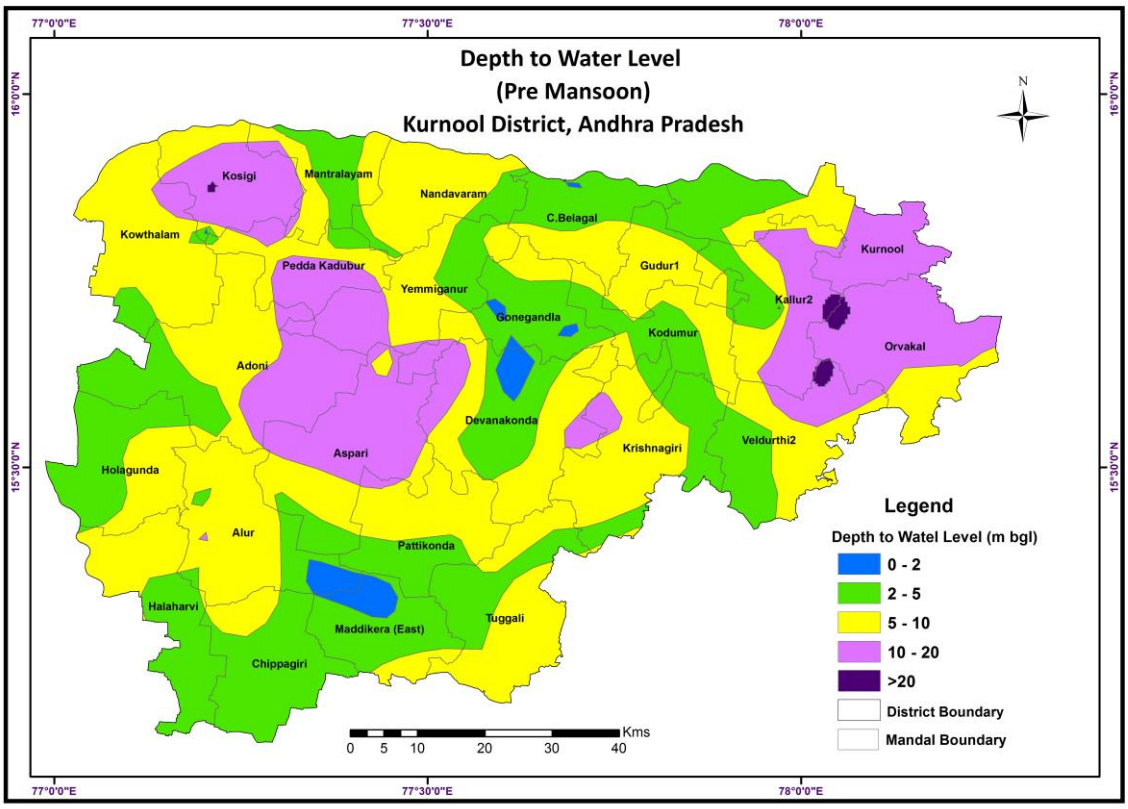


Figure.2.1 Depth to water level, Pre-monsoon (June-2022)

2.2.4 Post-monsoon water level (December 2022)

Ground Water level monitoring well was established in Kurnool district during the December-2022 in Kurnool district to collect the water level of dug well and Borewell/Tube well. The Dug well is representing the Aquifer-I whereas the Bore well/Tube well is representing water level of Aquifer-II. In the district, 106nos of key well were established. Of 106, 34nos are Dug wells and remaining 72 nos are Borewells/ Tubewells.

2.2.5 Post-Monsoon water level Aquifer-I: (December-2022)

Based on the water level collected from the Dug wells, the water level of the district is ranging from 0.22 (Karivumula) to 5.75mgl (Gulyan). The water level data is depicted into four zones such as 0-2, 2-5, 5-10 and 10-20 m bgl. Water level of the district is generally falling in two zones of such as 0-2 and 2 to 5m zones and is representing 50% and 41% of the Dug well respectively. 5 to 10mts zone is representing 9% of the Dug wells. The deepest water level is 10-20 mts zone is not in the district.. The details of water level zone of post monsoon are given in Table-2.4.

Table: 2.4 Water level zone of post monsoon (Aquifer-I)

Period	Percentage of water level zone (mbgl)			
	0-2	2-5	5-10	10-20
Post monsoon (Dec-2022)	50	41	9	Nil

2.2.6 Post-Monsoon water level Aquifer-II: (December-2022)

Water level data collected from Bore Well / Tube well was analysed for Aquifer-II. The water level is ranging from 0.88 to 26.86mgl. The shallow water level is reported in Gundrevula and deepest water level is occurring in Pullugummi. The water level data is depicted into five zones such as 0-2, 2-5, 5-10, 10-20 and 20-50m bgl. Water level of the district is generally falling in one zone such as 2 to 5 and is representing 38.9% of the total Bore well. The deep water level of 10-20 mts zone is represented by 12.5% of the total bore well. The deepest water level zone of 20-50 is representing 2.8% of the Bore well. the water level zone of 0-2 and 5-10 are represented by 23.6% and 22.2% of the Borewell respectively. The details of water level zone of post monsoon are given in **Table-2.3.**

Table: 2.3 Water level zone of post monsoon data of Aquifer-II

Period	Percentage of water level zone (mbgl)				
	0-2	2-5	5-10	10-20	20-50
Post monsoon (Dec-2022)	23.6	38.9	22.2	12.5	2.8

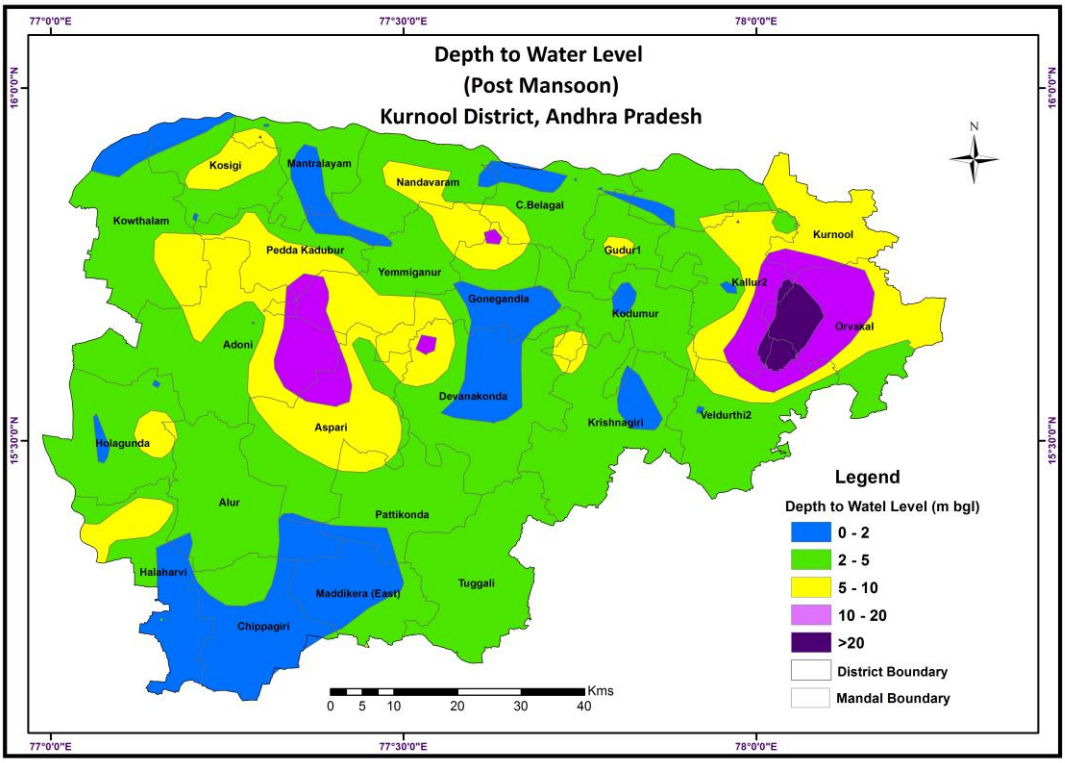


Figure.2.2 Depth to water level, Post-monsoon (December-2022)

The Aquifer-I and II water level is merged and prepared map (Figure-2.2). It is indicating that the water level of the district is ranging from 0.22 to 26.86mbgl and it is mainly indicating the unconfined aquifer and semi-confined aquifer. The post monsoon water level of the district is shown in five zones such as 0-2, 2-5,5-10, 10-20 and >20m. The district is falling in one zone such as 2-5m. This zone of water level is occupied in gneiss and granite formation. The 0 – 2 water level zone is occurring in and around the surface water bodies. The water level 5-10 and 10-20mbgl are mainly occurring in the western and eastern parts of the area. In the western part, the water level of this zone is trending NW-SE direction and falling in the gneissic formations. In the eastern part, it trending the NE-SW direction and is mainly falling in quartzite and part of limestone formations. The deepest water level zone >20 is eastern part of

the district and confined within the water level zone of 10-20mbgl. This water level is occurring part of limestone and shale formation. It is mainly indicating the recharge area of the district.

2.2.7 Water Level Fluctuations (June 2022 vs. December 2022)

The water level of pre and post monsoon of the district was compared to understand the groundwater recharge in the aquifer system due to rainfall. It is observed that groundwater level is raised in the entire district except in the northern part of the district. The raised water level is generally ranging from 0.04 to 38 mts. The water level fluctuation map of the district is depicting in three zones in water level rise such as 0-2, 2-4 and >4 (Figure 2..3). Based on the water level fluctuation, the district is falling in 0-2 mt rise of water level and it is represented by 52.83% of the total well. the next water level rise zone is represented by 27.47%. The >4m water level rise zone is represented by 18.87% of the total well. It is generally occurring in the eastern and western parts of the district. In the eastern parts of the district, the wells are occurring in the sedimentary formation and in the western parts it is formed by the hard rock formation. The rise water level rise in the western part is trending NW-SE direction. The significant rise of water level is observed in the Bore well than the Dug well. The fall water level zone is found in only 3% of the total well in the district. The > 4 m water level rise may be indicating the recharge area of the district.

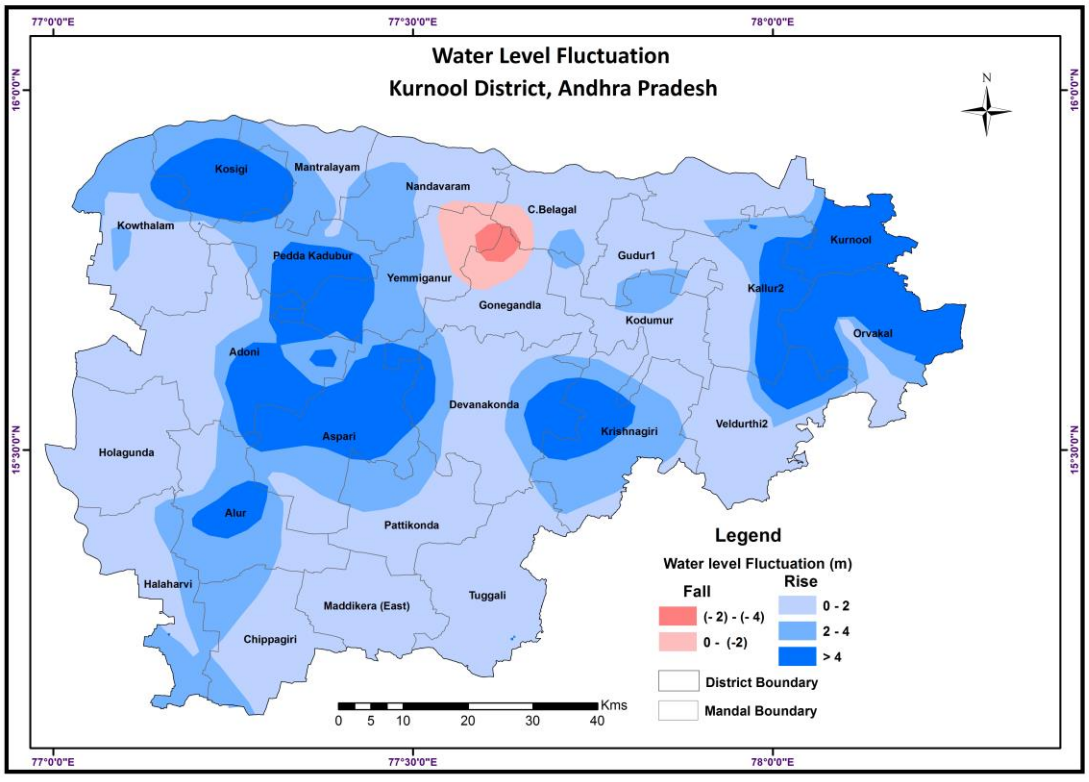


Figure .2.3 Water Level Fluctuation map (December-2022 Vs June-2022)

2.2.8 Long term water level trends

Pre-monsoon water level Aquifer-I (Decadal Mean)

Average water level data collected from May-2011 to 19 was analysed for pre-monsoon. The water level data is classified into four zones such as 0-2, 2-5, 5-10 and 10-20 m bgl. Water level of the district is generally falling in one zone such as 5 to 10mts representing 59% of the

total well.. The deepest water level of 10-20 m zone is represented by 16% of the total observation well. The details of water level zone of pre monsoon are given in **Table-2.4.** The water level zone of 2-5 m is represented by 25% of the total well and water level zone of 0-2 is nil in the district.

Table: 2.4 Water level zone of Pre monsoon of Aquifer-I

Period	Percentage of Average depth to Water Level (mbgl)			
	0-2	2-5	5-10	10-20
Pre monsoon (2011-19)	Nil	25	59	16

Pre-monsoon water level Trend

Based on the long time water level trend, the district is showing the falling trend. The rising trend is observed only in the small pockets. It is mainly found in and around surface water body of the district (Figure-2.4). The rising water level trend is observed in only in Devnakonda Mandal of the distrct.

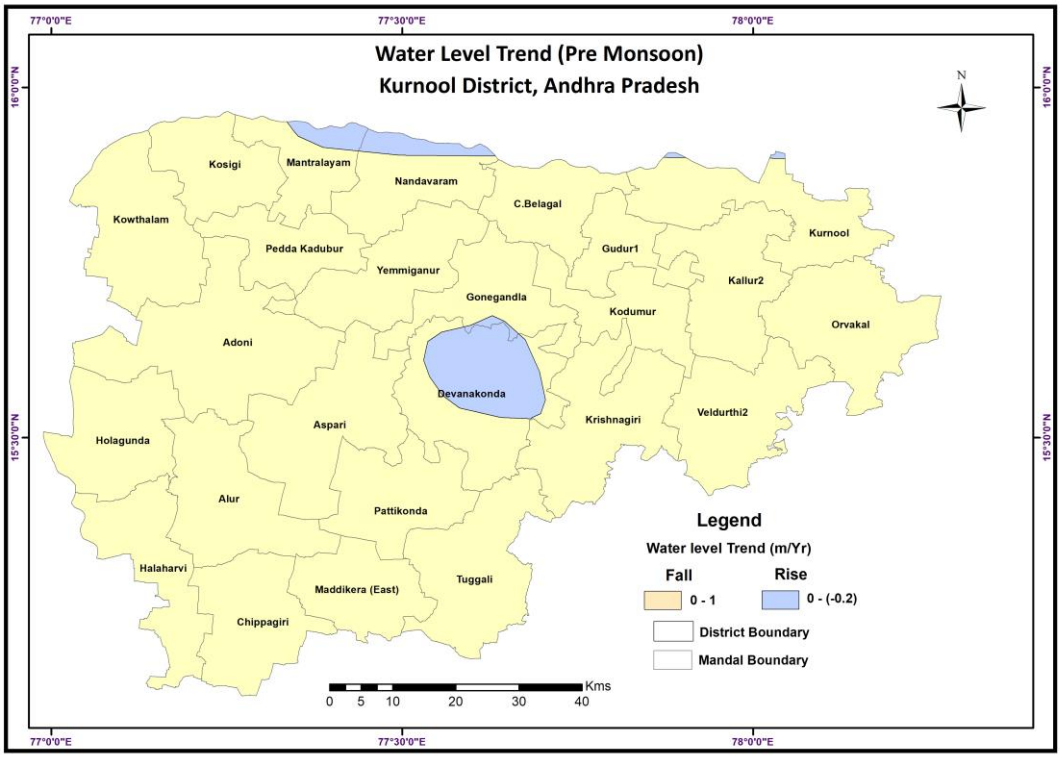


Figure.2.4 Long-term water level trends, Pre-monsoon (2011-2019)

Post-Monsoon water level Aquifer-I (Decadal Mean)

Average water level data collected from November-2011 to 20 was analysed for post-monsoon. The water level data is classified into four zones such as 0-2, 2-5, 5-10 and 10-20 m bgl. Water level of the district is generally falling in two zones such as 2 to 5 and 5 to 10mts representing 42% and 58% respectively. The water level zone of 0-2 and 10-20m zone are not falling in the district The details of water level zone of post monsoon are given in **Table-2.5.**

Table: 2.5 Water level zone of post monsoon data of Aquifer-I

Period	Percentage of Average depth to Water Level (mbgl)			
	0-2	2-5	5-10	10-20
Post monsoon (2011-20)	Nil	42	58	Nil

Post-monsoon water level Trend

Based on the long time water level trend, the district is showing the falling trend. The rising trend is observed only in the small pockets. It is mainly found in and around the surface water body of the district (Figure-2.5). It is observed in Devnakonda, Krishnagiri, Kodumur and Veldurthi Mandals in south and Kosagi and Kowthalam Mandals in north of the district.

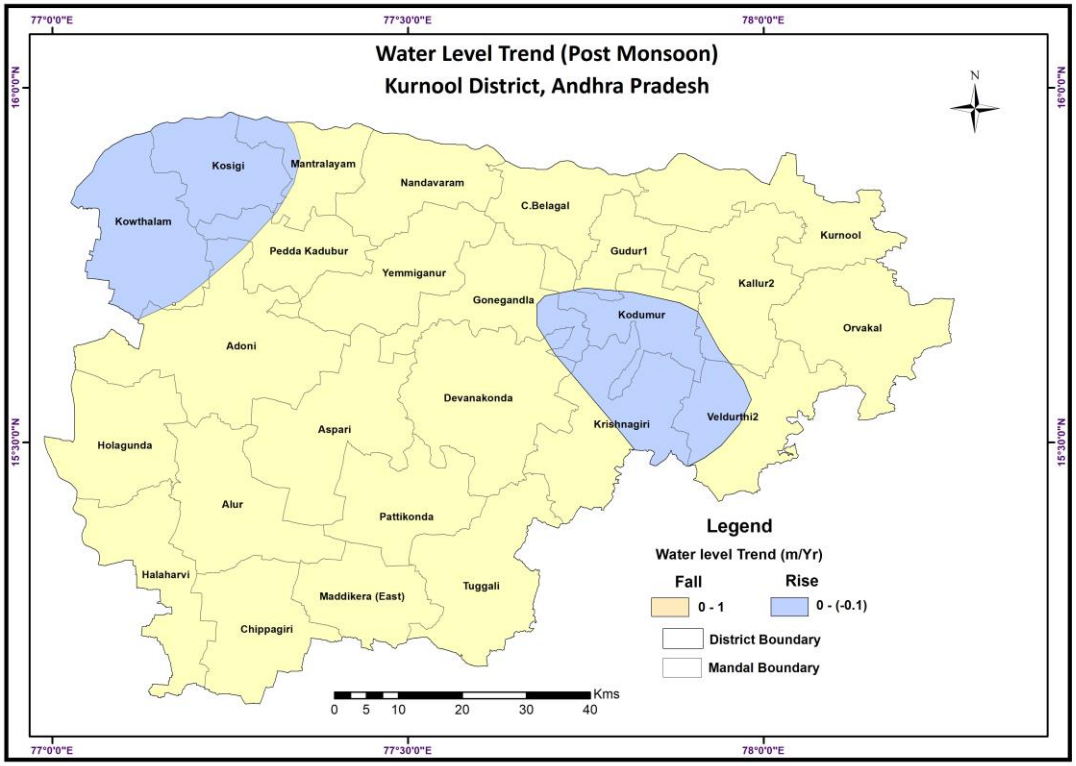


Figure.2.5 Long-term water level trends (post-monsoon-2006-2015).

2.2.9 Water Table Elevation

The pre monsoon water level data was used to prepare water table contour map of the district. The water table elevation was estimated with reference to Mean Sea Level. Based on the elevation, Water Table elevation or Iospach map was prepared for the district (Figure:2.6). The water table elevation of the district is ranging from 279.54 m (Kurnool) and 499.04m (Chakrall. In the district three water mounds ate purposed. All three mounds are having the elevation ranges from 410 m to 490m. The ground water is flowing from south to North East of the district. The water table elevation contour is very closely spaced and it is formed in the southern parts of the area. The ground water flow in the southern parts of the district is south westerly. In the sedimentary formation, the ground water flow is easterly direction

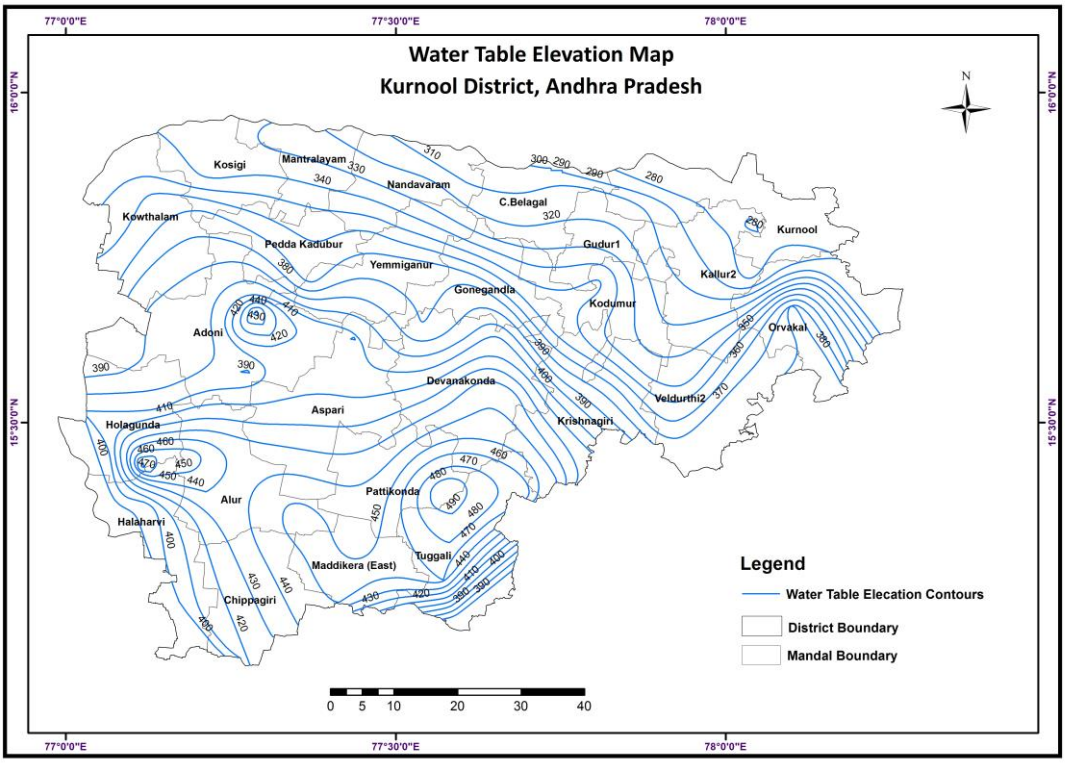


Fig. 2.6 Water Table Elevation Map

2.4 Hydro-chemical Studies

Ground Water samples were collected from 19 dug wells and 62 borewell / tubewell and analysed for pH, EC, anion, cation, flouride and nitrate concentrations during June-2022. In addition to that heavy metals were also analysed. The chemical quality of the district is shown in **Annexure-III.** The samples have been analyzed at Regional chemical laboratory, Southern Region, Hyderabad as per NABL standards.

2.4.1 Electrical conductivity

The EC of Ground Water is discussed in the report. The Ec is ranging from 380 µS/cm at Meedivemula to 29900 µS/cm at Parla. 42% of the sample is showing EC between 750-2250 µS/cm at 25 °C which is considered as moderately fresh water.15% of the sample is falling between EC of 2250 -3000 µS/cm at 25 °C which is classified Ground Water as slightly mineralised. EC of >3000 µS/cm at 25 °C is representing 36% of sample and it is classified as

highly mineralised water. It is highly harmful for living things and this water cannot be used any purposes.

Table-2.5 EC of Ground Water

EC (µS/cm at 25º C)	**Water Class**	**Percentage of Samples**
0-750	Fresh	**07%**
750 – 2250	Moderately Fresh	**42%**
2250 – 3000	Slightly mineralized	**15%**
>3000	Highly mineralized	**36%**

7% of sample is showing the EC less than 750 µS/cm at 25 °C and this Ground Water is considered as fresh water and highly suitable for drinking water purposes. (**Table-3.5**).

Aquifer-I

Water samples collected from dug well is analysed to understand the Ground Water quality of the aquifer-I in the district.The EC is ranging from 380 µS/cm at Molagavalli to 9410 µS/cm at Chinnahothur. 42% of the sample is showing EC between 750-2250 µS/cm at 25 °C which is considered as moderately fresh water.21% of the sample is falling between EC of 2250 - 3000 µS/cm at 25 °C which is classified Ground Water as slightly mineralised. EC of >3000 µS/cm at 25 °C is representing 32% of sample and it is classified as highly mineralised water. It is highly harmful for living things and this water cannot be used any purposes. 5% of sample is showing the EC less than 750 µS/cm at 25 °C and this Ground Water is considered as fresh water and highly suitable for drinking water purposes. (**Table-3.6**).

Table-3.6 EC of Ground Water in dug well and bore well

EC (µS/cm at 25º C)	**Water Class**	**Percentage of Samples (Dug well)**	**Percentage of Samples Borewell**
0-750	Fresh	**05%**	**08%**
750 – 2250	Moderately Fresh	**42%**	**45%**
2250 – 3000	Slightly mineralized	**21%**	**10%**
>3000	Highly mineralized	**32%**	**37%**

Aquifer-II

Water samples collected from Borewell well is analysed to understand the Ground Water quality of the aquifer-II in the district. The Ec is ranging from 380 µS/cm at Meedivemula to 29900 µS/cm at Parla. 45% of the sample is showing EC between 750-2250 µS/cm at 25 °C which is considered as moderately fresh water. 10% of the sample is falling between EC of 2250 -3000 µS/cm at 25 °C which is classified Ground Water as slightly mineralised. EC of >3000 µS/cm at 25 °C is representing 37% of sample and it is classified as highly mineralised water. It is highly harmful for living things and this water cannot be used any purposes. 8% of sample is showing the EC less than 750 µS/cm at 25 °C and this Ground Water is considered

as fresh water and highly suitable for drinking water purposes. (**Table-3.6**). The Ground Water of aquifer-I and II are not showing the mush difference in ground water quality. As per the result, the Ground Water from aquifer-II is considerably good and potable.

The EC data is represented spatially in **Figure-3.2** and it is showing EC into three zones such as <750, 750-2250, and >2250 µS/cm at 25 °C. The maximum area is falling under EC above 2250 µS/cm at 25 °C. < 750 µS/cm at 25 °C is occurring small area in eastern parts of the area and pockets in the southern parts of the area. The EC of between 750-2250 µS/cm at 25 °C is falling in northern and southern parts of the area. The high mineralisation is found in the northern parts of the area. It is mainly occupied in the hard crystalline formation and the low mineralisation is mainly occupied in the sedimentary formation.

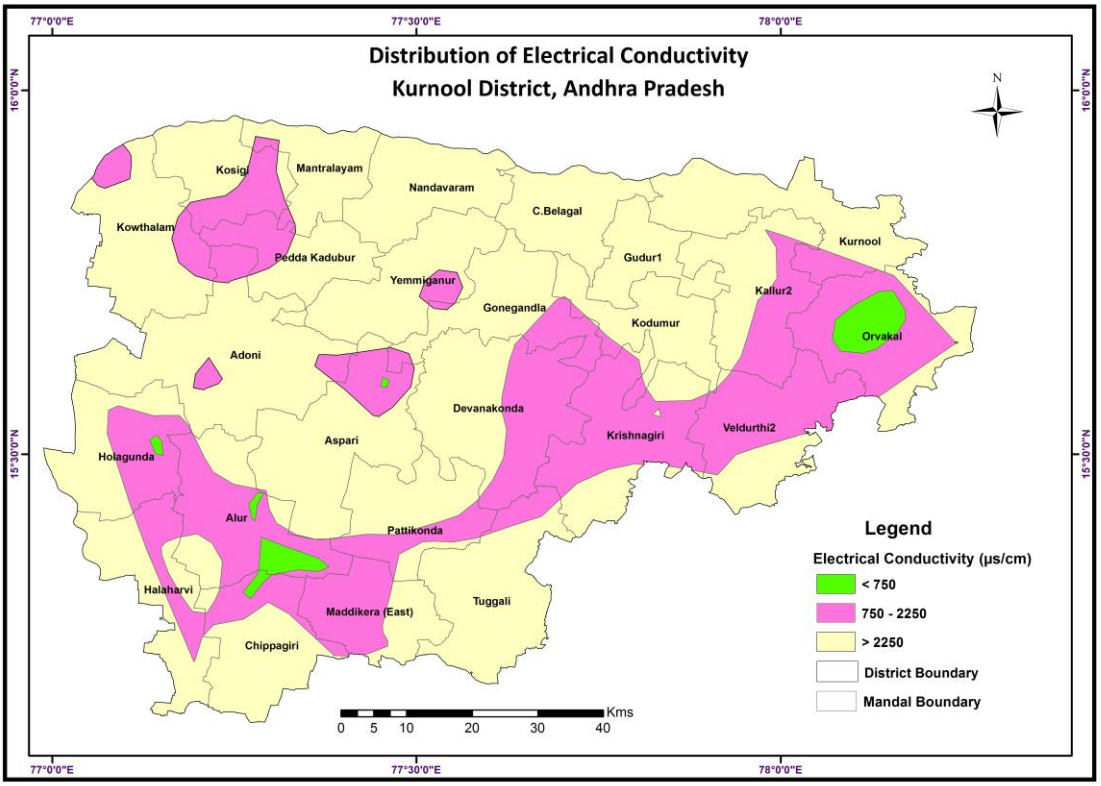


Fig.2.7 Distribution of Electrical Conductivity (Pre-monsoon-2022).

2.4.2 Nitrate

Nitrate in ground water samples of Kurnool district falls in the ranges of 0 to 888 mg/l. the maximum concentration is occurring at Chetnihalli of Manthralayam Mandal and minimum is found at Sambahallu of Adoni Mandal. 30% of ground water samples is falling below permissible limit and is generally falling in the eastern part of the district where the meta-sedimentary formation is occurring. The remaining 70% of the water samples are falling above the permissible limits. The high concentration of Nitrate is occurring in northern and central parts of the district (Figure-2.9).

2.4.3 Total Hardness (TH):

Water described as “hard” contains high amounts of calcium and magnesium. Total hardness is the sum of the calcium and magnesium concentrations, both expressed as calcium carbonate, in milligrams per liter (mg/L). Based on the IS 10500:2012 drinking water standards, the desirable limit of TH is less than 200mg/l and permissible limit is less than 600mg/l. In the district, TH is ranging from 90mg/l (Kurnur) to 6000mg/l (Parla). 15% of the sample is falling below the desirable limit and it is soft water. 60% of the samples are falling between 200-600mg/l which is moderately soft. 26% of the water samples are falling above 600mg/l which is hard water and prone for the health hazard.

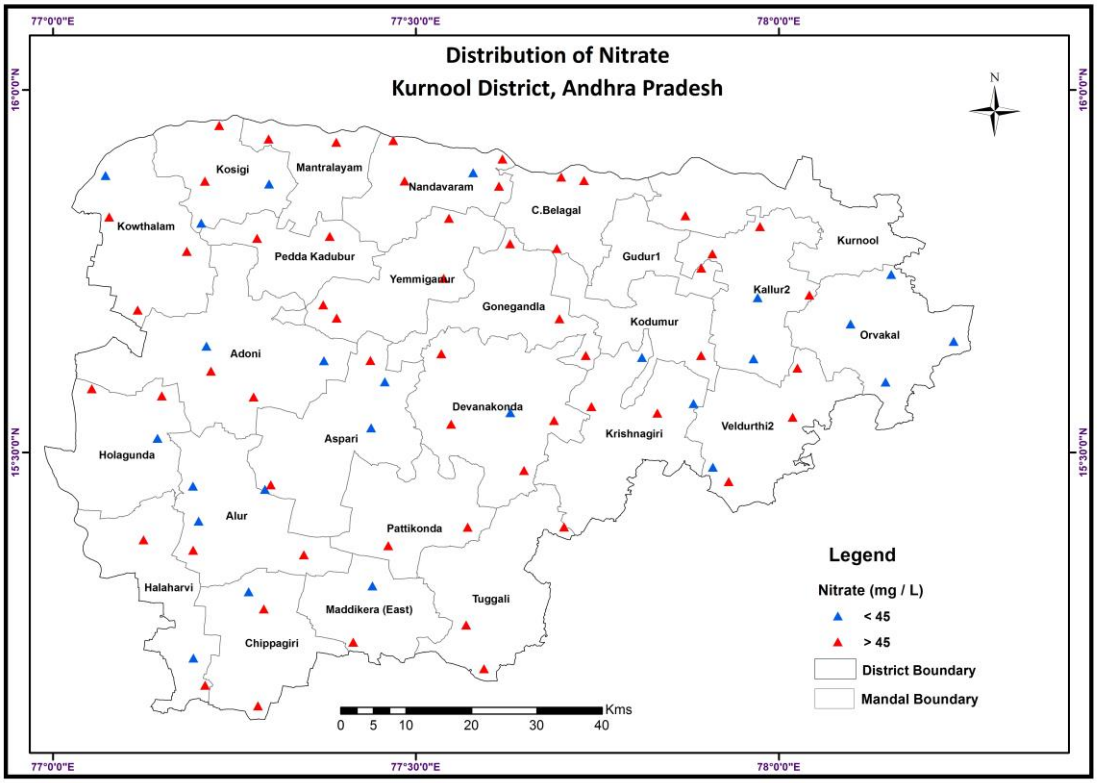
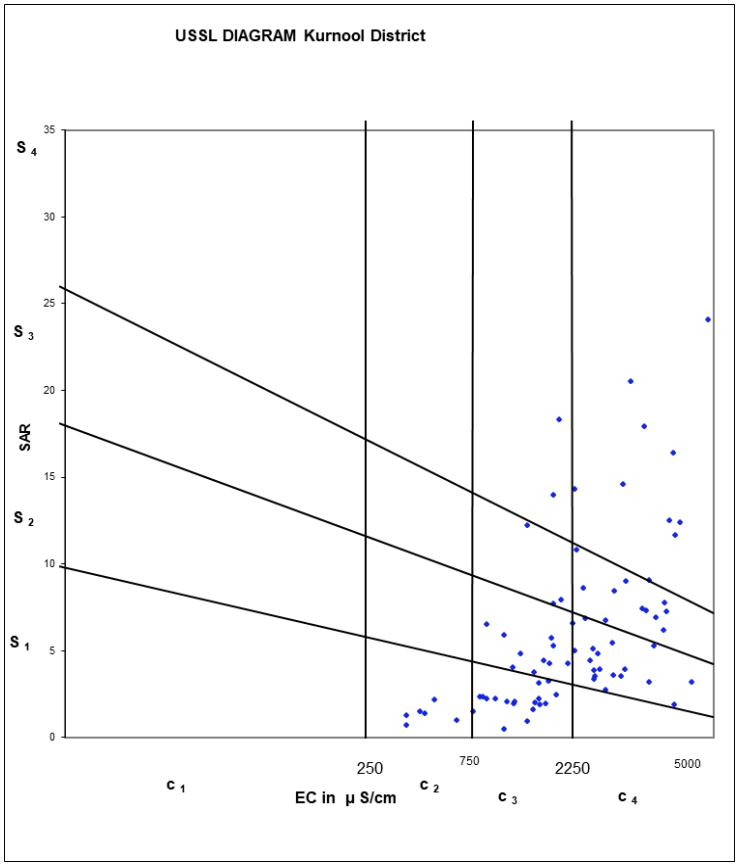


Figure.2.9 Distribution of Nitrate (Pre-monsoon-2022).

2.4.3 USSL Diagram for Irrigation Water Quality

It is diagram for identification of ground water for irrigation purposes. The EC and SAR are plotted to know the Salinity hazard of the groundwater. Based on the diagram, 17 % of the water samples are falling in the Very High salinity and very high SAR classes. It is indicating that Very High salinity and SAR class of water cannot be used for agricultural purposes.



3.0 DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

The aquifer disposition of the area is demarcated based on sub-surface geology inferred from Borewell and Sounding data which depicts the lateral and vertical configuration of the aquifers using Rockworks software. In the study area, two aquifer systems have been demarcated based on the groundwater water occurrence and movement in hard crystalline formation and in meta sedimentary formation.. The first aquifer (Aquifer-I) is weathered layer of gneiss, granite, limestone and quartzite formation and also formed by alluvium. The second aquifer (Aquifer-II) is fractured layers of gneiss, granite, limestone and quartzite. The bottom of the aquifer-II is demarcated using the deepest fractured depth encountered in the bore well.

3.1 3D Aquifer Disposition

Three Dimension of the aquifer system of the district was prepared and shown in **Figure-3.1**. The lateral extension of the Aquifer-I in gneissic formation is pinching in western part of the district against Aquifer-II. Similarly, the aquifer-I of granite is extending towards easterly. In sedimentary formation, the aquifer-I is having the uniform thickness and formed by top layers of limestone, quartzite and alluvium. The Aquifer-II of the gneissic formation is directly exposed to surface on the western parts of the district it is action as the first aquifer-I in the area. The aquifer-II in the granite formation is encountered at shallow depth running easterly. In sedimentary formation, the aquifer- II is encountered in the tube well and it is indicating the formational thickness rather than fractures.

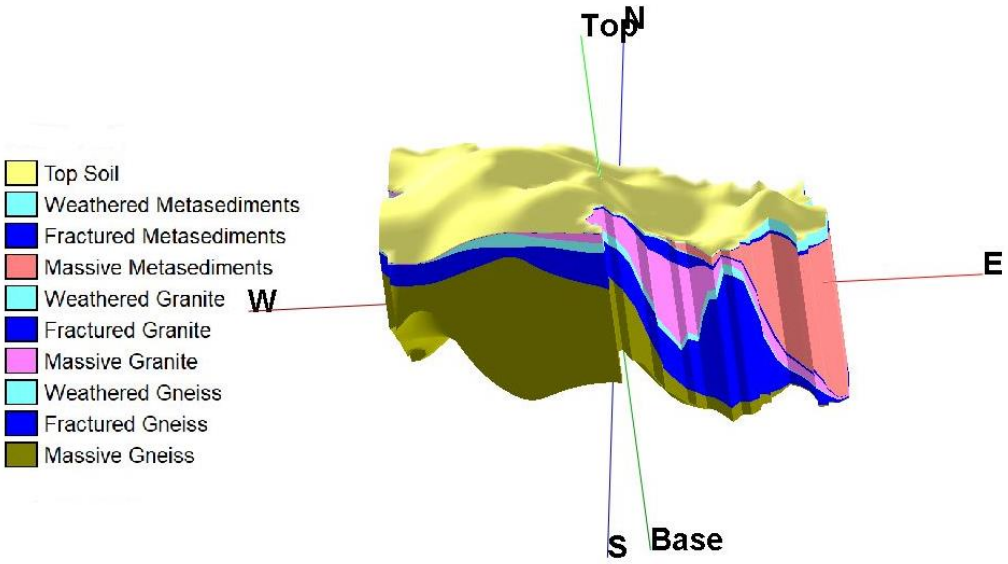


Fig.-3.1: Aquifer disposition in 3-D Model, Kurnool district.

3.2 2D Aquifer disposition (Hydrogeological cross section)

In the study area, hydrogeological cross sections were prepared principle aquifer wise to know the vertical and lateral extension of the district aquifer system.

3.2.1 Hydrogeological cross section across Aquifer-I in Gneissic Formation.

The hydrogeological cross section across gneissic formation covering from Jaggrahalli- Hosur Road is shown in **Figure- 3.2**. The Aquifer section is indicating that aquifer-I is having maximum thickness in the center of the section and pinching at eastern and western parts of the district. In the eastern parts of the section, the Aquifer-II is exposed at the Hosur road and not encountered from Jagarahalli to Natakaladoddi.

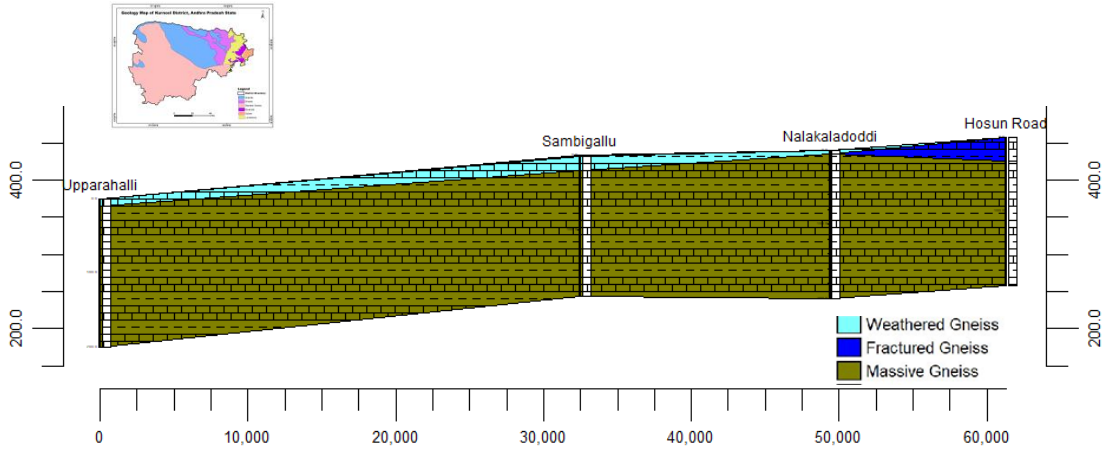


Figure 3.2- Hydrogeological cross section in Gneissic Formation

3.2.2 Hydrogeological cross section across Granite Formation

The hydrogeological cross section across the granite formation running from Chitnahalli to Gorantla is shown in **Figure- 3.**3 It indicates that the thickness of fractured aquifer is high at the Kodumuru and almost reduced from Gundrevulla to Chitnihalli. In the east of the Kodumuru, the aquifer-II is directly exposed on the surface.

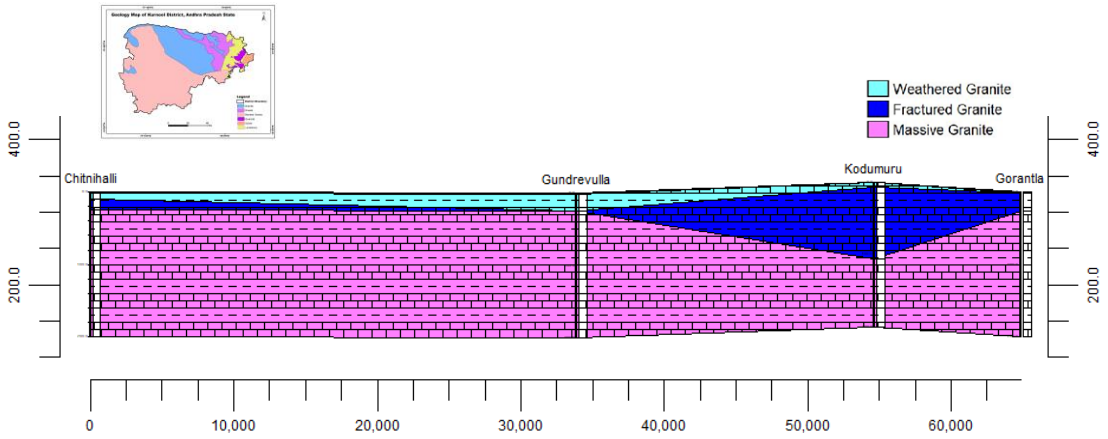


Figure 3.3- Hydrogeological section across the Granite Formation

3.2.3 Hydrogeological cross section across aquifer meta sedimentary formation

The hydrogeological cross section across the aquifers running from Uyalawada to Kalva is shown in **Figure- 3.4**. It indicates that the thickness of aquifer- I is uniform all long the area and sloping towards easterly. The Aquifer-II of the meta sedimentary formation is clearly depicting the formation thickness particularly shale exposed in the western parts of the area.

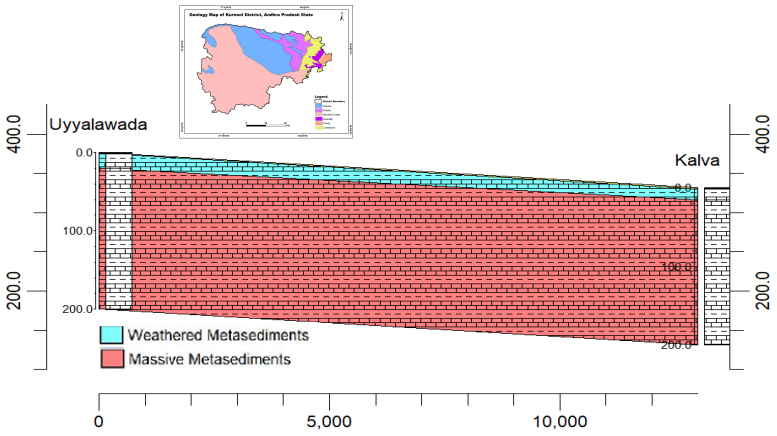


Figure 3.4 - Hydrogeological cross section across the meta sedimentary formation

3.2.4 Hydrogeological cross section across the district

The hydrogeological cross section across the aquifer district is shown in **Figure- 3.5**. The section is taken from Upprahalli to Kalva cutting across gneiss, granite and meta sediments starting from west to east direction.. The topography of the district is having undulating terrain and also expressing the contact between the gneiss and granite and also granite to meta sedimentary formation. The contact between gneiss and granite is occurring at Sambigallu and sloping westerly in gneissic formation and easterly on granite formation. The fracture in gneissic formation is not encountered from Upprahalli to Sambigalu. The Granite Formation is occurring between sambigalu to Gorantla and sloping towards Gorantla. The aquifer-I is not much prominent and as the aquifer-II. The contact between the granite and meta sediment is occurring at Gorantla and raising towards easterly. The meta sedimentary formation such as limestone is having the general slope towards easterly and scarp slope westerly. The scarp slope generally cutting across all lithological formation and helps in recharging the all lithological formation.

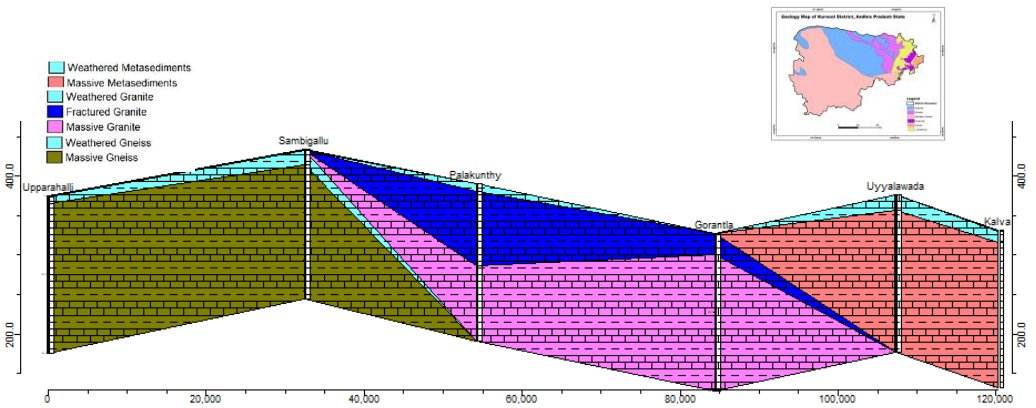


Figure 3.5- Hydrogeological section across the district

3.2.5Thickness of Aquifer-I

Thickness of the Aquifer-I was prepared based on the weathered thickness, shallow fracture depth which has connectivity with the weathered mantle and alluvium, limestone and quartzite inferred from Borewell and VES data. . The bottom depth of the weathered/shallow layer is considered as thickness of the Aquifer-I shown in **Figure 3.6**. The thickness of Aquifer-I is depicted spatially with 10m contour intervals having three zones such as less than 10mts, 10-20mts and >20mts. The maximum area of the district is occupied by 10-20 m thickness followed by less than 10 m and >20 m aquifer thickness. The thickness of 10-20 m is mainly occurring in the granite formation. . The thickness >20m of Aquifer-I is found in eastern parts of the study area formed due to Meta sedimentary formation and in granite formation, it is occurring in the central parts of the area. The thickness of Aquifer-I is directly indicating the groundwater storage in the aquifer. The average thickness of Aquifer-I is 10mts in hard rock formation and 30m in meta sedimentary formation.

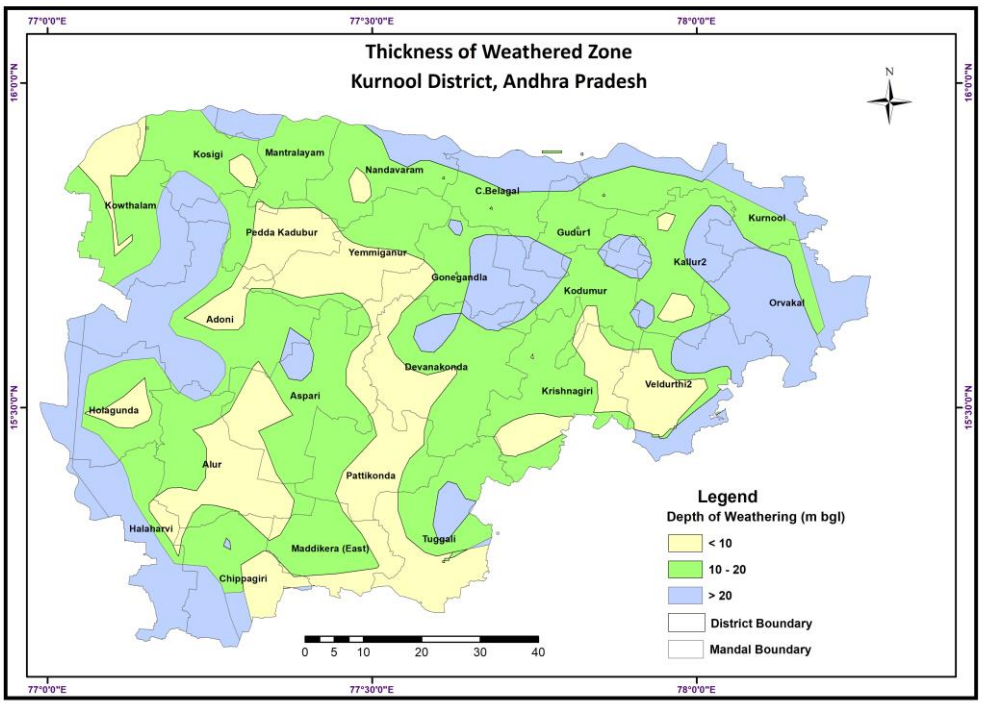


Figure.3.6: Thickness of weathered zone, Kurnool district.

3.2.6 Depth of occurrence of Aquifer-II

Based on the last fracture depth encountered in bore well, the depth of occurrence of Aquifer-II was prepared for aquifer system inferred from borewell and VES data, presented in **Figure-3.7**. Based on this, occurrence of Aquifer-II is demarcated into four zones such as no fracture, <50, 50-100 and >100mts. The <50mts depth of occurrence of aquifer-II is found in eastern parts of the area and it is mainly formed by meta sedimentary formation in east and granite formation in the north.. The third and fourth zone 50 -100 mts and >100mts are occurring in the northern parts of the district running parallel to Tungabhadra River. No fracture zone is occupying western parts of the district. All the zones of the second aquifers are indicating that the thickness of the second aquifer is increasing from south to north and east direction.

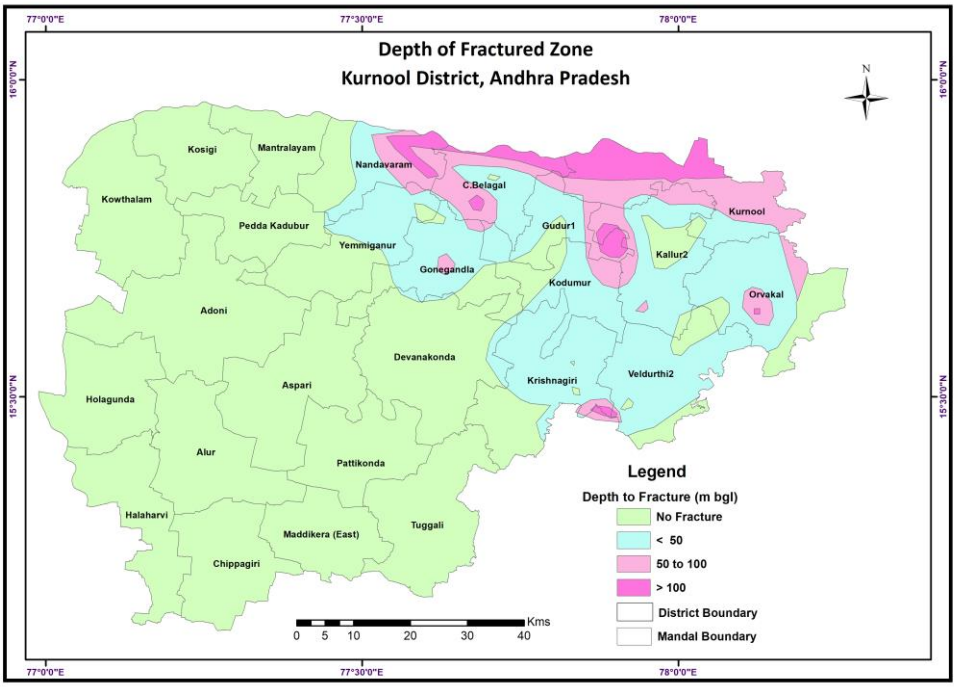


Fig.-3.7: Upto the Depth of bottom fracture in Kurnool district.

3.2.7 Aquifer Characterization

Based on the aquifer configuration and characteristics, two aquifer systems such as Aquifer –I & II have been demarcated. The hydraulic characteristics are the main parameter to demarcate the aquifer system in the area. The properties of aquifers such as specific yield, transmissivity and storativity are compiled and demarcated the aquifers system. The long duration pumping test data have been used to estimate the properties of the aquifers of the basin. The list of high yielding well is given below with aquifer property **(Table-3.4).**

Table 3.4: Details on Long duration pumping test results

No.	Location	Discharge (lpm)	Drawdown (m)	T (m^2/ day)	S
1	Haradgiri	180	5.62		
2	Kodumuru-I			2.6	
3	Gorantla	300	8.66	49.72	
4	Gorantla	300	0.68	125.56	
5	Palakunthy	261	21.01	10.95	
6	Kapatrala			2.27	
7	Pandikona	332.4	4.59	6.26	
8	Burjula			9.22	
9	Govardhanagiri			2.08	0.1
10	Kurnool			87.2	0.001

3.2.8Aquifer-I

The weathered layer of all four lithological units such as gneiss, granite, limestone, quartzite and alluvium are considered for the Aquifer-I **(Table-3.5**). In general, the thickness of the aquifer-I in gneiss is ranging from 5 to 10 mts with an average thickness of 7mts. The discharge of the Aquifer- I is ranges from 20 to 30 m^3/day which sustains pumping for 1 -2 hrs during monsoon period whereas in summer period < 1 hrs of pumping for groundwater utilisation. Based on the long duration pumping test, the transmissivity of the aquifer is determined and it is ranging from 5 to 10m^2/day. The groundwater is found suitable for all purposes

The thickness of the aquifer-I in gneiss is ranging from 10 to 20 mts with an average thickness of 15mts. The discharge of the Aquifer- I is ranging from 100 to 150m^3/day which sustains pumping for 2 -3 hrs during monsoon period whereas in summer period < 1 to 2 hrs of pumping for groundwater utilisation. Based on the long duration pumping test, the transmissivity of the aquifer is determined and it is ranging from 10 to 30m^2/day. The groundwater is found suitable for all purposes and at places the groundwater is having high mineralisation.. The large diameter square dug wells are constructed in this region.

Large diameter Dug well in Satnoor village

The thickness of the aquifer-I in alluvium is ranging from 5 to 10 mts with an average thickness of 5mts. The shallow tube wells are the abstraction structures in Alluvium, The discharge of the Aquifer- I is ranging from 50 to 70 m^3/day which sustains pumping for 0.5- 1 hrs during monsoon period whereas in summer period of less than 0.5hrs of pumping for groundwater utilisation. Based on the long duration pumping test, the transmissivity of the aquifer is determined and it is ranging from 10 to 15m^2/day. The groundwater is found suitable for all purposes. The Aquifer –I in limestone and quartzite is almost similar to Alluvium Aquifer-I.

Table 3.5 Details on aquifer-I properties and its sustainability

Type of Aquifer	Formation	Thickness/ occurrence of fractures (m)	Range of Yield (m^3/day)	Sustainability (hrs)	Aquifer parameter (Transmissivity – m^2/day)
Aquifer I	**Alluvium/ Limestone/ Quartzite**	**10 – 30**	**50 - 75**	**Monsoon: 2 to 3 hrs. & Non monsoon: < 1 to 1hrs**	**10 - 15**
Aquifer I	**Weathered Granite**	**10 – 20**	100 - 150	**Monsoon: 2-3 hrs. & Non monsoon: < 1 to 2**	**10 - 30**
Aquifer I	**Weathered Gneiss**	**0 - 10**	**20- 30**	**Monsoon: 1-2 hrs. & Non monsoon: < 1 hrs.**	**5 - 10**

3.2.9 Aquifer-II

In general, the thickness of the aquifer-II in gneiss is ranging from 10 to 30 mts with an average thickness of 15 m **(Table 3.6).** based on the VES data, the occurrence of fracture is very feeble and almost nil in many places in Gneissic terrain. The discharge of the Aquifer- II is ranging from 10 to 30 m^3/day which sustains pumping for 1-2 hrs during monsoon period whereas in summer period <1hr of pumping for groundwater utilisation. Based on the long duration pumping test, the transmissivity of the aquifer is determined and it is ranging from 10 to 3 m^2/day.

The thickness of the aquifer-II in granite is ranging from 40 to 50 mts with an average thickness of 45mts. The discharge of the Aquifer- II is ranging from 100 to 500 m^3/day which sustains pumping for 1 - 3 hrs during monsoon period whereas in summer period < 1 to 2 hrs of pumping for groundwater utilisation. Based on the long duration pumping test, the transmissivity of the aquifer is determined and it is ranging from 50 to 125m^2/day.

The thickness of the aquifer-II meta sedimentary of Cuddappa and Kurnool formation is ranging from 50 to 100 mts with an average thickness of 50 mts. The discharge of the Aquifer- II is raning from 10 to 18 m^3/hrs which sustains pumping for 3 -4 hrs during monsoon period whereas in summer period 2 to 3 hrs of pumping for groundwater utilisation. Based on the long duration pumping test, the transmissivity of the aquifer is determined and it is ranging from 400 to 600m^2/day.

Table 3.6 Details on Aquifer-II properties and its Sustainability

Type of Aquifer	Formation	Thickness/ occurrence of fractures (m)	Range of Yield (m^3/day)	Sustainability (hrs)	Aquifer parameter (Transmissivity– m^2/day)
Aquifer II	Limestone/ Quartzite	50 to 150	500 - 800	Monsoon: 3-4 hrs. & Non monsoon 2 to 3hrs	400 - 600
Aquifer II	Jointed & Fractured Granite	40 -50 (3 to 4 fractures exist)	100 - 500	Monsoon: 1 - 3 hrs. & Non monsoon 1 to 2 hrs.	50 - 125
Aquifer II	Jointed & Fractured Gneiss	No fracture At places 10 – 100 m	10-30	Monsoon: 1-2 hrs. & Non monsoon <1hr	10 - 30

4.0 GROUND WATER RESOURCES (2022)

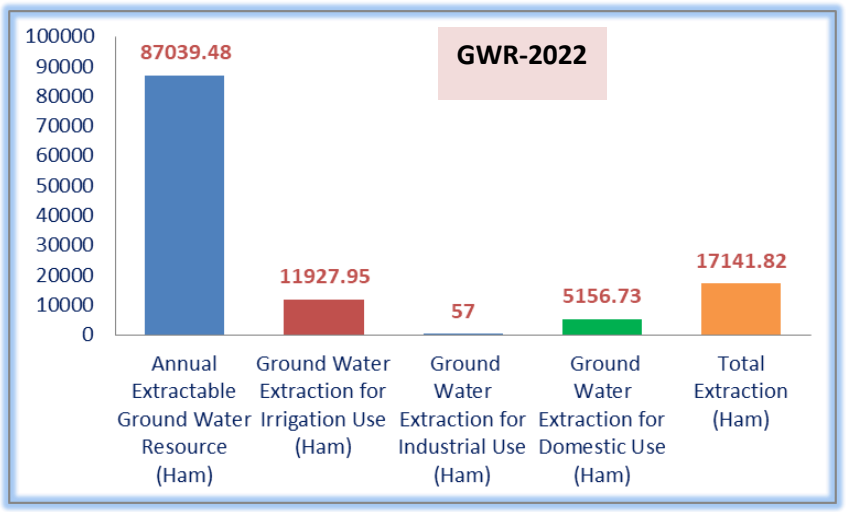
The Ground Water resource of Aquifer-I was estimated for Mandal as the assessment unit as on March-2022.The Mandal is smallest administrative unit of revenue division of Andhra Pradesh. The total number of assessment unit is 25 in the Kurnool District. The Ground Water resource of Kurnool district was estimated based on GEC-1997 methodology and are presented in **Annexure-IV.**

4.1 Ground Water Resources

Based on the Ground Water resources estimation, the net Ground Water availability of the district is 87039.48 HAM **(Table 4.1 and Plot-4.1).** The existing Ground Water draft for all purposes is 17141.82 HAM whereas the irrigation draft alone is 11927.95 HAM. It is representing 70% of the total draft of the district. The remining 30% of the draft is goes to domestic and industrial applications in the district. The overall stage of Ground Water development of the district is 19.69%. Based on the stage of Ground Water development, Mandal has been categorised into safe (>70%), semi-critical (70-90%), Critical (90-100%) and over-exploited (>=100%) in the district. Based on the estimation, All the mandal are categorised as safe (Table 4.2).

Table 4.1 The details of Ground Water Resources

District	Annual Extractable Ground Water Resource (Ham)	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Stage of Ground Water Extraction (%)
Kurnool	**87039.48**	**11927.95**	**57**	**5156.73**	**17141.82**	**19.69**



Plot 4.1 The details of Ground Water Resource

Table 4.2 Ground Water Resource categorisation of district

Total Mandal	25
Over exploited	Nil
Critical	Nil
Semi-critical	Nil
Safe	25

4.2 Stage of Ground Water development

As per Ground Water resources assessment, All 25 Mandal are safe category. Out of 25 Mandal, Two Mandals namely Gonigonda and Orvakal are having the stage of grounswater extraction is more than 40%. It is indicating that the Ground Water extraction of those tow mandals may increase in the next few years. A total of 11 nos Mandal are having the moderate developments and other 12 Mandals are having very poor Ground Water developments. Mandal like Alur and Veldurthi mandals are having poor Ground Water deleopemts which may leads to water logging scenario in the district.

Class in safe categorey	Stage of Ground Water Extraction (%)	No of Mandal
1	Less 20	12
2	21-40	11
3	41-70	22

Table 4.2 Categorisation of Mandal based on GW development

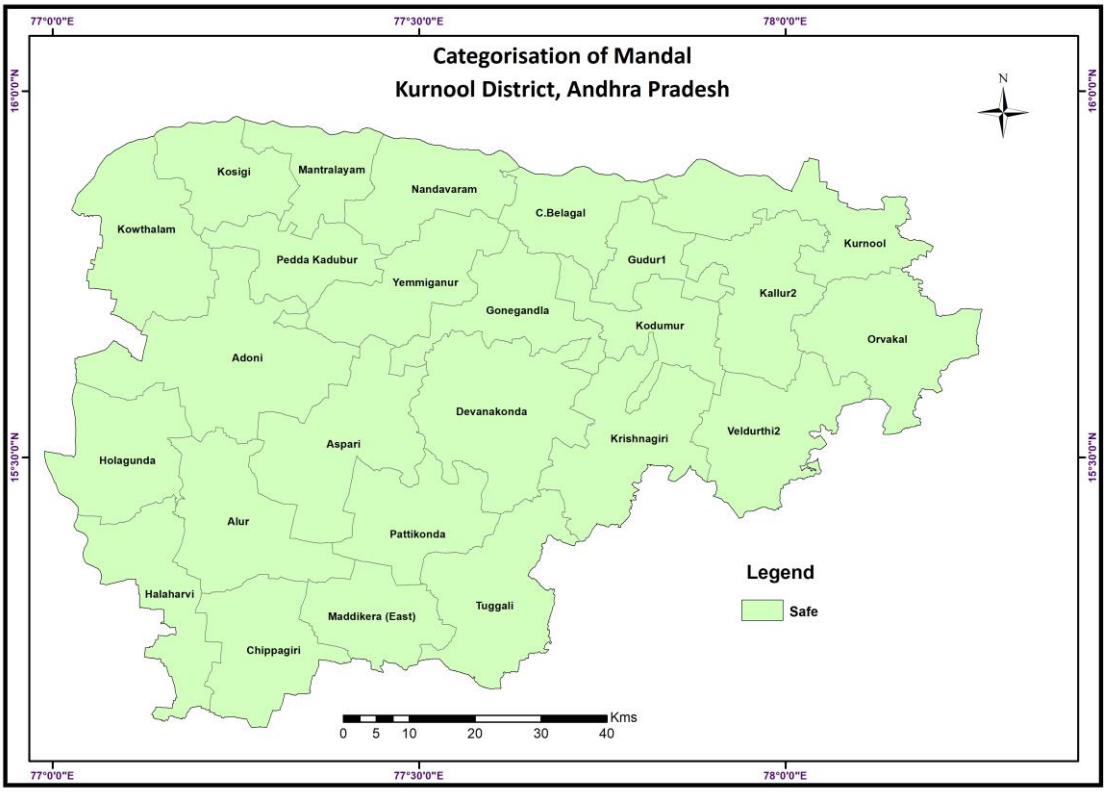


Figure: Ground Water Resource categorisation of district

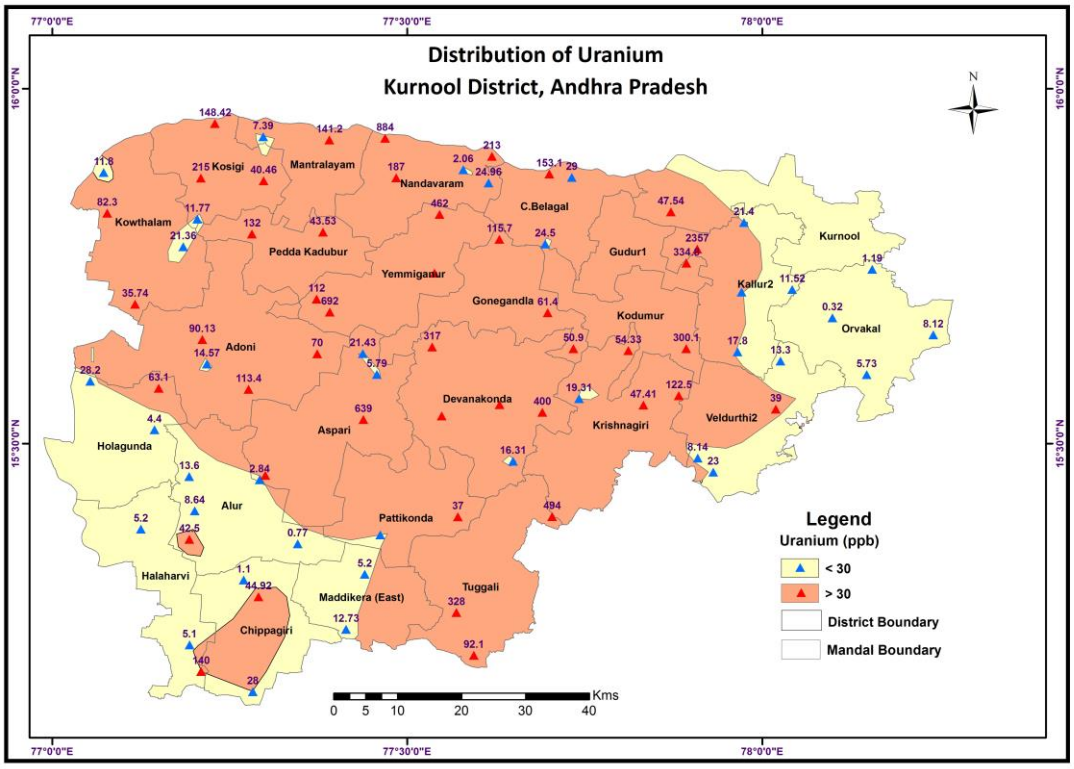
5. GROUND WATER RELATED ISSUES

5.1 Geo-genic pollution (Uranium)

Uranium is a naturally occurring chemical element of radioactive nature that occurs in low concentrations in nature. It is present in certain types of soils and rocks, especially granites. Mostly ingested uranium is food intake with lesser amounts also from water or air. Mostly, Uranium is rapidly eliminated from the body, however a small amount is absorbed and carried through the blood stream & accumulate in bones. Studies show that elevated levels of uranium in drinking water can affect the kidneys. Bathing and showering with water that contains Uranium is not considered a health concern. WHO have set drinking water standards for Uranium concentration in drinking water at 30ppb. Atomic Energy Regulatory Board, India has prescribed the maximum limit of U in drinking water at 60 µg/L (ppb) Natural Uranium is a mixture of three isotopes of Uranium, as 234U, 235U, and 238U. They are different radioactive with different radioactive properties. But all three isotopes behave the same chemically, so any combination of the three would have the same chemical effect on a person's health. In the district, the uranium in Ground Water is ranging from 0.3ppb to 2357ppb. The unanium concentration in Ground Water is classified into five classes to understand elevated calues. The five classes are less than 30, 30-60, 60-100, 100-1000, Greater than 1000ppb. 46% of the sample is falling below permissible limit and it is falling in eastern and south western parts of the area. 19% of the sample is falling between 30-60ppb and it is also falling in the western and eastern parts of the area. The remaing water samples are falling in the above permissible limit of 60ppb.. It is occupied in the younger granite completely (Figure-5.2)

Table 5.2 Ground Water Class based on Uranium concentration

Uranium ppb	Percentage of Samples
Less than 30	46
30-60	19
60-100	06
100-1000	28
Greater Than 1000	01

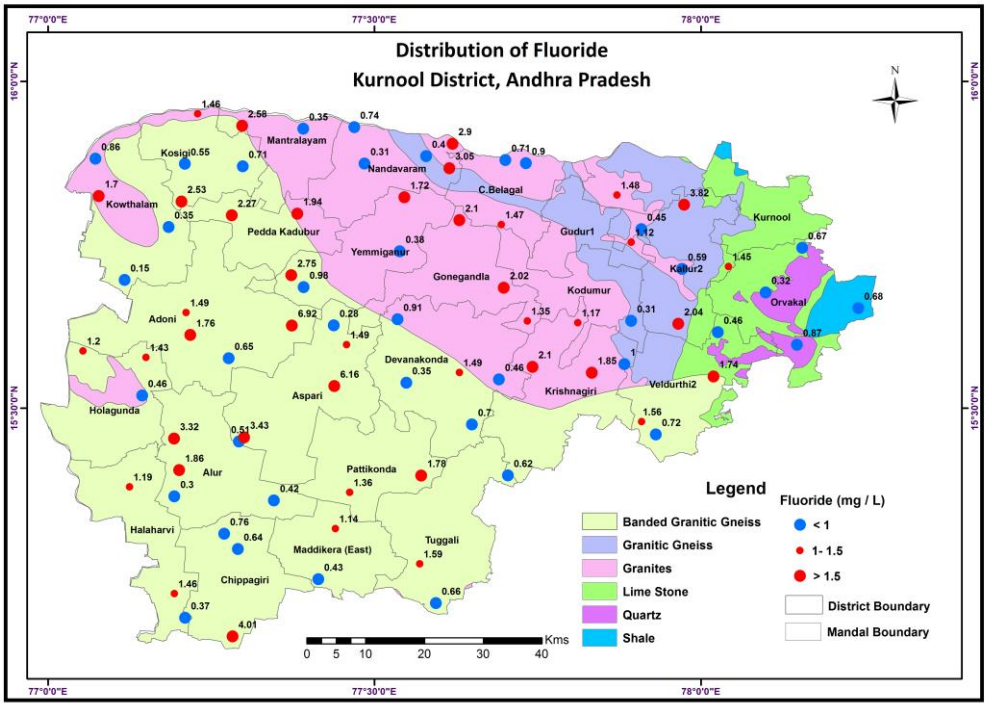


5.2 Geo-genic pollution (Fluoride)

Fluoride concentration in Aquifers is ranging from 0.15mg/l at Kuntanahal to 6.92mg/l at Sambagallu. Based on BIS standard on Ground Water quality for Fluoride concentration, Ground Water is classified into three classes for drinking water purposes. Fluoride concentration between <1 mg/l in Ground Water is comes under desirable limits which is highly suitable drinking water purposes. 47% of the water samples are having Fluoride concentration between <1 mg/l (Table-5.1). Fluoride of 1-1.5mg/l concentration in Ground Water is falling under permissible a limit which is found in 21% of the water samples. Above permissible limits >1.5 mg/l which is not suitable drinking water purposes and it is found only in 32% of the water samples. These are mostly found in western parts of the area where younger granite is occurring. (Figure 5.1).

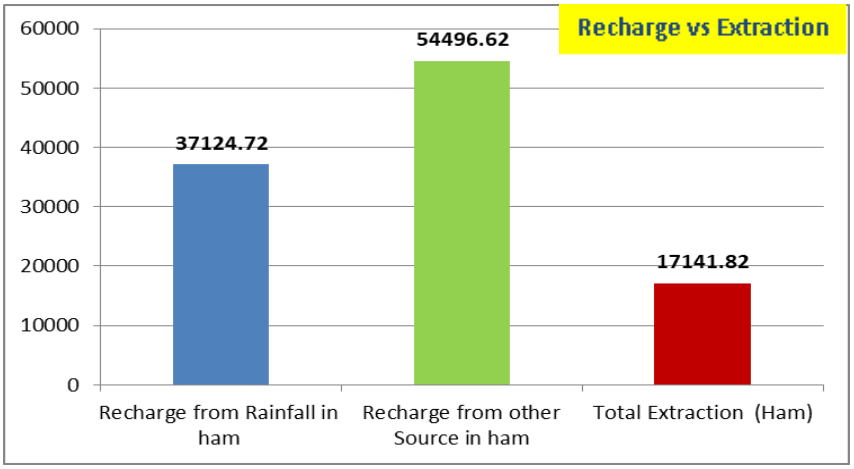
Table 5.1 Ground Water Class based on Fluoride concentration

Fluoride mg/L	Water Class	Percentage of Samples
0-1	Desirable limit	47
1-1.5	Permissible limit	21
> 1.5	Above permissible limit	32



5.3 Recharge of Groundwater

The total recharge of groundwater in district is 91621.34ham. The total available extractable groundwater is 87040ham after deducting 5% for natural discharge. The recharge is estimated from two sources such rainfall and other than rainfall. In the district, the recharge from rainfall is 37124.72ham whereas from the other source is 54496.62ham. The recharge from other source is contributing 60 % of the ground water resource of the district. 17372ham of water is more than the rainfall recharge. This amount of water for getting the other source recharge may be contributed from surface water return flow irrigation and also ARS constructed in the non-command area. These sources are also indirectly from the rainfall only. If there is an erratic rainfall occurs in the district, the recharge from the other source may not be available for the utilisation. In this scenario, the district is mainly depending on the resource from the previous rainfall recharge only. The groundwater extraction for all purposes is 17141.82ham which is the 46% of the rainfall source. Hence, the groundwater extraction in the district should be maintained to curb the district pushing into next groundwater extraction category.



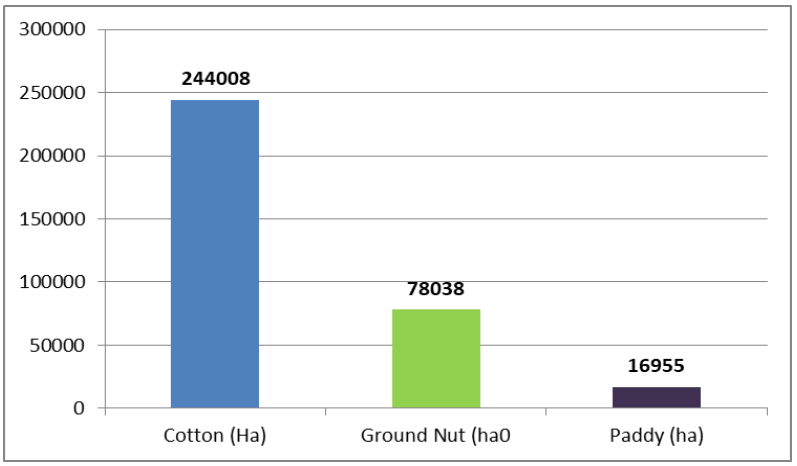
5.4 Poor Yielding aquifer

The aquifer formed by granite of Archaean age is poor yielding aquifer and the groundwater is mainly occurring in the fractured aquifers. The groundwater potential of this aquifer is confined only within the 50mts depth and having the yield is less than 1lps. The occurring and movement of groundwater is mainly due to high frequrncy of fractures and high density of fractures. In the district, the occurrence of fracture in gneissic terrain is almost zero.The groundwater of the aquifer is also depending on the recharge potenials of the aquifer systems. In the district, the area is having the black cotton soil spreading all over the area and it permits less amount water to percolate into aquifer system. The general slope of the hard rock formation is towards north and due to this, there is quick dissipation of rainwater into drainage system and the interaction between the surface to subsurface is very occasional in the district.

6. MANAGEMENT STRATEGIES

Supply side management: Based on the APWRIS portal, 43480 farm ponds, 1200 percolation tanks, 3808 Check dams and 18539 other structure are constructed to recharge the ground water by the state water resource department in the district. The total capacity of all the 67027nos of structures are 7209.98ham. The present storage of water in all strictures is 3484.67ham of water in the district. The total amount of water expected to be recharged from all the structures is 2089.98 to Ground Water system in the district and it is contributing 4 % of the recharge from other source. It is indicating that the majority fo the recharge is from return flow irrigation. Hence, the ground water development plan is advisable for the district and it is recommended that the present draft for the irrigation should be continued to keep the ground water resource of the district in intact.

Demand side Management: The total area cultivated in the district is 503797ha. It is represented by 63% of the total geographic area. About 48% of the total cultivated area is covered by cotton in the district. The ground nut and paddy are also cultivated in the district other than gram crops. These crops are mainly need water for irrigation. The total cultivated by these crops is 339001 ha.



The total area irrigated by all source is 74059 ha which is 28% of these three crops cultivated area. It is indicating that 72% of the area are comes under rain fed area which does not have the any source of water. The ground water extracted for irrigation is 17141ham as per the GEC-2022. The crop water requirement for the cotton is 1.3ham The water efficiency techniques such as drip irrigation can be used to cultivate cotton crop which will reduce upto 15 to 20% of the water utilisation. It means that 2385ham of groundwater can be conserved through drip irrigation methods which will have the irrigation potential of cotton crops is 2294ha of land.

Drinking water Management: Based on the groundwater quality of water, 54 % of the water sample is having high concentration of Uranium and 32% of water samples are having high concentration of Fluoride contamination in groundwater. It is mainly occurring in granite and gneissic terrain of the Kurnool district. The drinking water for the district mainly in hard rock formation should have the treated potable water for the public.

Recommendation:

- **Detailed study on uranium concentration in ground water may be carried out.**
- **Groundwater resource of the district assessed based on the groundwater potential of the aquifer.**

Acknowledgment
The author's express sincere thanks to Sh. S. Sunil Kumar, Chairman, Sri Sathish, Member (South) of the Central Ground Water Board, Govt. of India and Shri J. Siddhardha Kumar, Regional Directors, SR, Hyderabad for their support and encouragement. The author also express thanks to Smt. Rani V.R., Scientist D & Nodal Officers NAQUIM. The author acknowledges Chief Planning Officer and his entire office , Kurnool District for making available collateral data for preparing this report.

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1. Chief Planning Officer (CPO) (2020-21) Handbook of Statistics, Kurnool district, Government of Andhra Pradesh.
2. Groundwater brochure of old Kurnool district.
3. APWRIS portal for ARS details.
4. Water Resources department – irrigation Project.

Annexure –I The details on ground water exploration of the district

Sl No	Location	Latitude	Longitude	Total Depth (m)	Lithology	Casing depth in m	Zone From depth	Zone To depth	Discharge (Lps)	T m2/day
1	Haradgiri	15°18'20"	77°11'23"	51	Granite gneiss	0	13	25	3	
2	Kodumuru-I	15°40'17"	77°46'44"	200	Granite	7.3	104.3	105.3	0.22	2.6
3	Kirshnapuram	15°38'49"	77°45'58"	200	Granite	6.1	11.6	13	0.592	
4	Gorantla	15°37'52"	77°51'51"	200	Granite	8.1	9.7	9.85	3.34	49.72
5	Gorantla	15°37'52"	77°51'51"	32	Granite gneiss	0	22.9	23.9	0	125.56
6					Granite gneiss		26	27	2.11	
7	Gorantla	15°37'52"	77°51'51"	26	Granite gneiss	0	9.5	9.7	2.11	
8	Ternekallu	15°38'03"	77°31'36"	62.5	Granite	7.8	5.8	6.05	0.59	
9	Devarakonda	15°32'00"	77°32'54"	200	Granite gneiss	21.3	29.3	29.55	0.316	
10	Devarakonda	15°32'00"	77°32'54"	148	Granite gneiss		43.2	43.55	0.316	
11	Khairuppala	15°33'45"	77°29'36"	200	Granite gneiss	8.2			1.2	
12	Palakunthy			170	Granite	11	9.7		0.97	10.95

13	Kapatrala	15°36'24"	77°37'50"	200	Granite	17.75	14.8		0	2.27
14	Pandikona	15°26'30"	77°33'30"	78.3	Granite gneiss	16.3	19.3	20.4	0.59	6.26
15	Burjula	15°18'52"	77°26'20"	198	Granite gneiss	19.6			0.44	9.22
16	Sambigallu	15°37'00"	77°22'52"	190	Granite gneiss	20.5			0.21	
17	Nalakaladoddi	15°28'18"	77°25'50"	100	Granite gneiss	0	14.3	15.3	0.59	
18	Hosun Road	15°23'00"	77°29'40"	200	Granite gneiss	0	11.1	32.3	5	
19	Tangavadona			142.5	Granite gneiss	0	60.1	61.1	0	
20	Pattikonda	15°24'10"	77°30'00"	173.3	Granite gneiss	0	47.2	48.2	5	
21	Govardhanagiri			191	Granite gneiss	14	15	174	0.20	2.08
22	Kurnool			50.05	Shale	10	37.85	40.9	0.78	87.2

Annexure-II The details on Ground water level of pre and post monsoon

Sl No	Mandal	Location	Type	Longitude (DD)	Latitude (DD)	Elevation in m	Water Level (Pre Monsoon) in m	Water Table Elevetion in m	Water Level (Post Monsoon) in m	Water Level Fluctuation in m
1	Kurnool	KURNOOL	DW	78.0373	15.8281	284.9	5.36	279.54	4.56	0.8
2	KALLUR	THADAKANAPALLE	BW	78.0422	15.717	329.3	49.6	279.7	23.25	26.35
3	KALLUR	A. NAGALAPURAM	BW	77.9743	15.8114	303.7	15.44	288.26	10.44	5
4	Kallur2	IMD Kurnool -EW	EW	78.0397	15.8056	295.8	4.23	291.57	2.53	1.7
5	ORVAKAL	KETHAVARAM	BW	78.155	15.7456	328.7	32.65	296.05	9.46	23.19
6	ORVAKAL	BRAHMANAPALLE	BW	78.2409	15.6533	309.8	13.06	296.74	6.21	6.85
7	C.BELAGAL	GUNDREVULA	BW	77.7004	15.8799	301.5	1.62	299.88	0.88	0.74
8	KALLUR	BASTIPADU	BW	77.971	15.7133	305.6	1.9	303.7	1.39	0.51
9	NANDAVARAM	RAYACHOTY	BW	77.6193	15.9047	309.2	3.63	305.57	2.55	1.08
10	NANDAVARAM	CHAMALAGUDURU	BW	77.6145	15.8673	310.4	3.2	307.2	0.97	2.23
11	KALLUR	PARLA	BW	77.9086	15.7741	310.7	3.2	307.5	2.11	1.09
12	C.BELAGAL	KONDAPURAM	DW	77.7318	15.8751	311.5	3.59	307.91	2.04	1.55
13	GUDUR	PENCHIKALAPADU	BW	77.8933	15.7543	316.5	5.7	310.8	3.35	2.35
14	NANDAVARAM	NADIKHAIRAVADI	BW	77.4688	15.9301	317.1	4.87	312.23	4.12	0.75
15	KURNOOL	REMATA	DW	77.8713	15.8264	317.1	2.8	314.3	1.35	1.45
16	NANDAVARAM	MITTASOMPURAM	BW	77.5788	15.8858	321.7	6.3	315.4	5.05	1.25
17	KODUMUR	LADDAGIRI	BW	77.8931	15.6336	325.8	5.69	320.11	4.36	1.33
18	C.BELAGAL	BURANDODDI	DW	77.6942	15.7811	328.1	6.4	321.7	3.35	3.05
19	NANDAVARAM	MACHAPURAM	BW	77.4846	15.8745	331.7	9.28	322.42	5.78	3.5
20	MANTRALAYAM	CHETNIHALLI	BW	77.3905	15.9278	327.9	4.72	323.18	2.92	1.8
21	MANTRALAYAM	DIBBANA DODDI	BW	77.2971	15.9322	337.3	13.28	324.02	10.8	2.48
22	GONEGANDLA	ALWALA	BW	77.6297	15.7877	332.9	7.07	325.83	11.82	-4.75
23	KALLUR	ULINDAKONDA	BW	77.9651	15.6291	340	12.84	327.16	11.5	1.34
24	Gudur1	Gudur-EW -WT	EW	77.8089	15.7725	335.6	7.65	327.95	6.1	1.55

25	Yerragondapalem	Tungabhadra	DW	77.3014	15.9478	334	4.2	329.8	1.74	2.46
26	Mantralayam	Madhavaram	DW	77.3565	15.8993	332.8	2.59	330.21	0.92	1.67
27	YEMMIGANUR	TSALLAKUDLUR	BW	77.5457	15.8228	336.4	4.45	331.95	5.45	-1
28	KOSIGI	DUDDI	BW	77.2093	15.8742	376.8	44.7	332.1	6.7	38
29	Veldurthi2	Veldurti1	EW	77.9347	15.5522	339.4	4.08	335.32	3.85	0.23
30	KRISHNAGIRI	MANNEGUNTA	BW	77.8115	15.631	338	2.2	335.8	2.03	0.17
31	KOSIGI	SATHANUR	DW	77.2291	15.9507	337.9	2.04	335.86	1.4	0.64
32	KRISHNAGIRI	THOGARCHEDU	BW	77.8826	15.5675	342.1	4.63	337.47	3.26	1.37
33	Veldurthi2	Veldurti	DW	77.9249	15.5463	344.4	2.55	341.85	1.65	0.9
34	KOSIGI	BELAGALLU	BW	77.2979	15.8701	360.9	18.06	342.84	3.95	14.11
35	DORNIPADU	KUMBALANUR	BW	77.0724	15.8819	349.8	4.72	345.08	1.9	2.82
36	Kodumur	Kodumuru	DW	77.7667	15.6833	355	4.98	350.02	3.12	1.86
37	KOWTHALAM	LINGALADINNE	BW	77.0775	15.8247	359.3	6.68	352.62	4.97	1.71
38	Yemmiganur	Yemignur	EW	77.4925	15.7803	361.1	6.65	354.45	2.18	4.47
39	Kowthalam	Bapuram	EW	77.0835	15.7886	360.5	5.68	354.82	2.78	2.9
40	VELDURTHI	PULLAGUMMI	BW	78.0257	15.6162	401.5	46.4	355.1	26.86	19.54
41	PEDDA KADUBUR	JALVADI	BW	77.3815	15.7978	359.1	3.59	355.51	1.48	2.11
42	Kodumur	Pylakurthi	EW	77.8097	15.7153	363	4.75	358.25	1.4	3.35
43	GONEGANDLA	THIPPANUR	BW	77.698	15.6844	360.4	1.63	358.77	1.02	0.61
44	GONEGANDLA	KURNUR	BW	77.734	15.6336	368.7	9.38	359.32	7.4	1.98
45	YEMMIGANUR	MALAKAPURAM	BW	77.3725	15.7035	394.4	34.14	360.26	15.32	18.82
46	Kowthalam	Podalakunta	DW	77.1208	15.8542	365	4.58	360.42	2.25	2.33
47	VELDURTHI	GUNDHUPELEE	DW	77.9091	15.4798	367.1	4.37	362.73	2.75	1.62
48	PEDDA KADUBUR	HULIKANVI	BW	77.2813	15.7952	376.9	9.97	366.93	6.16	3.81
49	Nandavaram	Yemmiganur	DW	77.4583	15.7833	372.1	4.65	367.45	1.42	3.23
50	VELDURTHI	BHOGOLA	BW	77.9309	15.4598	376.1	4.2	371.9	3.28	0.92
51	YEMMIGANUR	KADIMETLA	BW	77.5385	15.74	375.4	3.18	372.22	2.46	0.72
52	KRISHNAGIRI	KRISHNAGIRI	BW	77.8327	15.5543	378.2	5.21	372.99	1.31	3.9
53	VELDURTHI	SARPARAJAPURAM	BW	78.0192	15.5487	381.7	6.8	374.9	3.91	2.89
54	KOSIGI	ZUMALADINNE	BW	77.2043	15.8163	377.4	1.41	375.99	1.55	-0.14

55	DEVANAKONDA	TERNEKAL	BW	77.5351	15.6361	393	15.05	377.95	12.05	3
56	KOWTHALAM	KAMAVARAM	BW	77.1845	15.7772	389	8.35	380.65	7.33	1.02
57	TUGGALI	GOOTY ERRAGUDI	BW	77.5938	15.2019	394.9	12.75	382.15	12.9	-0.15
58	Gonegandla	Gonegondla	DW	77.5959	15.7115	383.4	0.92	382.48	0.6	0.32
59	Gonegandla	Gonegandla	EW	77.6141	15.7079	386.3	3.32	382.98	1.24	2.08
60	HOLAGUNDA	GAJJEHALLI	DW	77.0535	15.5879	387	3.7	383.3	3.13	0.57
61	ORVAKAL	PALAKOLANU	DW	78.147	15.5971	386.2	2.2	384	0.76	1.44
62	ORVAKAL	MEEDIVEMULA	BW	78.099	15.6772	407	20.28	386.72	19.9	0.38
63	Halaharvi	Gulyan	DW	77.0649	15.3608	393.9	6.63	387.27	5.75	0.88
64	KOWTHALAM	KUNTANAHAL	DW	77.1169	15.6964	392.3	4.01	388.29	2.55	1.46
65	KRISHNAGIRI	AGAVELI	BW	77.7419	15.5633	401.3	11.6	389.7	3.62	7.98
66	YEMMIGANUR	KOTEKAL	BW	77.3911	15.6853	405.7	15.2	390.5	9.49	5.71
67	HOLAGUNDA	PEDDA GONEHAL	BW	77.1499	15.5779	394.4	1.97	392.43	1.9	0.07
68	Devanakonda	Karivemula	DW	77.6000	15.6297	393.6	0.49	393.11	0.22	0.27
69	ADONI	V.KONDAPURAM	BW	77.2177	15.612	399.5	5.15	394.35	3.45	1.7
70	ALUR	MUSANAHALLI	BW	77.2765	15.5764	415.4	17.26	398.14	5.03	12.23
71	ADONI	MADIRE	BW	77.2115	15.6466	406.1	7.7	398.4	5.55	2.15
72	HALAHARVI	NITRAVATTI	BW	77.1248	15.3797	412.9	9.85	403.05	8.55	1.3
73	ASPARI	KARUMANCHI	BW	77.4572	15.5975	424	20.01	403.99	3.33	16.68
74	Adoni	Naganathanahalli	DW	77.2333	15.5667	409	4.4	404.6	2.99	1.41
75	HOLAGUNDA	LINGADAHALLI	BW	77.144	15.5194	416	9.25	406.75	7.28	1.97
76	Devanakonda	Kapatrala	EW	77.6519	15.6439	412.4	2.3	410.1	0.94	1.36
77	Adoni	DODDANAKERE	DW	77.2849	15.6994	417.2	6.37	410.83	5.25	1.12
78	Halaharvi	Bapuram1	EW	77.1489	15.3486	415.3	3.89	411.41	1.97	1.92
79	HALAHARVI	SEEDARAHAL	BW	77.2096	15.1792	418.4	3.27	415.13	0	3.27
80	HOLAGUNDA	Holagondi	DW	77.0667	15.4967	419	2.95	416.05	0.98	1.97
81	HALAHARVI	SIRUGAPURAM	BW	77.1934	15.2164	420.4	2.27	418.13	0	2.27
82	ADONI	SAMBAGALLU	BW	77.3734	15.6266	438.9	20.63	418.27	19.88	0.75
83	ASPARI	YATAKALLU	BW	77.4382	15.5339	434.4	16.1	418.3	9.22	6.88
84	Vidapanakal	Aluru1	EW	77.2422	15.1400	427.4	7.56	419.84	2.6	4.96

85	ASPARI	MULUGUNDAM	BW	77.4374	15.6269	428	7.91	420.09	3.26	4.65
86	DEVANAKONDA	DEVANAKONDA	BW	77.5486	15.5389	429.1	4.09	425.01	2.06	2.03
87	ALUR	KURUVALLI	DW	77.1932	15.3651	433.8	4.85	428.95	1.56	3.29
88	CHIPPAGIRI	KHAJIPURAM	DW	77.2824	15.1507	435.1	3	432.1	1.5	1.5
89	DEVANAKONDA	CHELLELICHELIMALA	BW	77.6905	15.5441	450.3	11.37	438.93	2.87	8.5
90	ALUR	THUMBALABEEDU	BW	77.292	15.4492	447.4	6.59	440.81	-0.35	6.94
91	ASPARI	CHINNAHOTHUR	DW	77.3001	15.4555	446.8	3.7	443.1	2.68	1.02
92	MADDIKERA EAST	NAGARADONE	BW	77.2696	15.3078	452.9	8.78	444.12	4.3	4.48
93	CHIPPAGIRI	NEMAKAL	DW	77.2905	15.2844	448.2	3.3	444.9	2.15	1.15
94	DEVANAKONDA	JILLEDUBUDAKALA	DW	77.63	15.5548	451.2	2.94	448.26	0.62	2.32
95	PATTIKANDA	HOSUR	DW	77.4619	15.3715	454	2.75	451.25	1.65	1.1
96	Adoni	Adoni Kota	DW	77.2875	15.6667	457.7	5.65	452.05	1.9	3.75
97	MADDIKERA EAST	BURGULA	DW	77.44	15.316	454.2	1.35	452.85	1.31	0.04
98	ALUR	ARIKERA	DW	77.2007	15.4053	466.2	10.68	455.52	5.25	5.43
99	DEVANAKONDA	GUNDLAKONDA	BW	77.6491	15.4752	463.4	6.12	457.28	4.26	1.86
100	ALUR	KARADIGUDDAM	DW	77.1929	15.4535	468.1	4.5	463.6	3.55	0.95
101	CHIPPAGIRI	NANCHARLA	BW	77.4138	15.2384	469.9	4.15	465.75	1.81	2.34
102	ALUR	MOLAGAVALLI	DW	77.3458	15.3589	468	1.4	466.6	1.3	0.1
103	TUGGALI	JONNAGIRI	BW	77.5693	15.2621	474.8	4.26	470.54	2.56	1.7
104	TUGGALI	LINGNENIDODDI	BW	77.7041	15.3972	479.6	4.43	475.17	2.3	2.13
105	HOLAGUNDA	Sullavai	DW	77.1156	15.4339	487.8	6	481.8	3.75	2.25
106	PATTIKANDA	CHAKKARALLA	DW	77.5715	15.397	504.6	5.56	499.04	4.41	1.15

Annexure-III the details on long term pre and post monsoon water level trend

MANDAL	SITE	LONGITUDE	LATITUDE	PRE-MONSOON TREND	POST MONSOON TREND
DEVANAKONDA	Karivemula	77.6042	15.6167	-0.20	-0.35
MANTRALAYAM	Madhavaram	77.3631	15.9369	-0.16	-0.06
PAMULAPADU	Rudravaram-DW13	78.4708	15.8503	-0.13	-0.39
HOLAGONDA	Holagondi	77.0500	15.4833	0.16	-0.17
ADONI	Naganathanahalli	77.2333	15.5667	0.24	-0.01
DADIVEMULA	Santajutur	78.4417	15.6333	-0.18	-0.31
VELUGODU	Velugodu	78.5667	15.7292	0.85	-0.57
NANDYALA	Nandyal-DW13	78.4947	15.4897	-0.01	-0.43
NANDAVARAM	Yemignur	77.4792	15.8278	0.59	-0.02
ORVAKAL	Orvakallu	78.1750	15.6875	0.39	-0.18
MAHANANDI	Mahanandi-DW13	78.6200	15.4692	0.11	-0.38
GONEGANDLA	Gonegondla	77.6000	15.7167	-0.05	-0.36
JUPADUBUNGLOW	Nandikotkur	78.2750	15.8667	0.28	-0.10
ATMAKUR	Venkatapuram2	78.6500	15.8833	-0.14	-0.28
GONEGANDLA	Gonegandla	77.5972	15.7122	0.30	-0.38
ALUR	Aluru1	77.2244	15.4008	1.07	-0.30
ALLAGADDA	Ahobilam	78.6667	15.1531	0.67	-0.22
PEAPALLE	Yenugumarri	77.7917	15.2972	0.24	-0.39
VELDURTHI	Veldurti	77.9333	15.5500	0.19	-0.55
MANTRALAYAM	Tungabhadra 2013DW	77.3083	15.9372	0.28	-0.85
KODUMUR	Kodumuru 2013DW	77.7667	15.6833	0.30	-0.60
DADIVEMULA	Gadivemula-DW13	78.4408	15.6672	0.03	-1.04

Annexure-IV The ground water quality of Kurnool district

LOCATION	MANDAL	LONGITUDE	LATITUDE	Source	Ph	EC	TH	Ca	Mg	Na	K	Cl	SO4	NO3	F	Alkalinity	CO3	HCO3	TDS	Uranium	SAR
MEEDIVEMULA	ORVAKAL	78.099	15.6772	BW	7.7	380	135	30	15	18	2.0	18	40	1	0.32	115	0	140	210	0.3	0.68
MOLAGAVALLI	ALUR	77.3458	15.3589	DW	7.7	380	115	34	7	31	5.1	14	50	73	0.42	60	0	73	260	0.8	1.26
NAGARADONE	MADDIKERA EAST	77.2696	15.3078	BW	7.51	440	115	36	6	37	1.9	18	29	7	0.76	140	0	171	240	1.1	1.51
KETHAVARAM	ORVAKAL	78.155	15.7456	BW	7.58	860	235	72	13	83	4.6	110	84	13	0.67	195	0	238	526	1.2	2.36
MITTASOMPURAM	NANDAVARAM	77.5788	15.8858	BW	7.64	4150	250	40	36	746	45.9	1064	64	16	0.40	350	0	427	2272	2.1	20.51
THUMBALABEEDU	ALUR	77.292	15.4492	BW	7.61	650	210	36	29	33	2.5	43	19	40	0.51	195	0	238	348	2.8	1.00
LINGADAHALLI	HOLAGUNDA	77.144	15.5194	BW	7.94	510	125	32	11	55	2.1	50	25	1	0.46	165	0	201	299	4.4	2.14
SIRUGAPURAM	HALAHARVI	77.1934	15.2164	BW	7.83	1970	280	40	44	305	4.9	234	235	8	1.46	430	0	525	1192	5.1	7.92
BURGULA	MADDIKERA EAST	77.44	15.316	DW	7.48	1070	140	32	15	161	0.7	149	135	2	1.14	170	0	207	621	5.2	5.90
NITRAVATTI	HALAHARVI	77.1248	15.3797	BW	7.79	1180	250	64	22	147	4.3	121	140	61	1.19	210	0	256	716	5.2	4.04
PALAKOLANU	ORVAKAL	78.147	15.5971	DW	7.26	1190	360	88	34	84	34.7	121	156	18	0.87	220	0	268	700	5.7	1.92
KARUMANCHI	ASPARI	77.4572	15.5975	BW	7.9	460	125	30	12	36	0.5	14	13	13	1.49	170	0	207	246	5.8	1.40
DIBBANA DODDI	MANTRALAYAM	77.2971	15.9322	BW	7.78	1280	230	36	34	167	1.1	92	65	54	2.58	390	0	476	742	7.4	4.79
BRAHMANAPALLE	ORVAKAL	78.2409	15.6533	BW	7.55	770	255	74	17	54	2.5	53	37	30	0.68	265	0	323	466	8.1	1.48
GUNDHUPELEE	VELDURTHI	77.9091	15.4798	DW	7.55	1730	480	64	78	164	11.4	206	25	6	1.56	540	0	659	958	8.1	3.26
ARIKERA	ALUR	77.2007	15.4053	DW	7.41	980	285	46	41	87	7.3	46	40	27	1.86	350	0	427	558	8.6	2.25
THADAKANAPALLE	KALLUR	78.0422	15.717	BW	7.74	1550	420	80	53	146	4.6	248	55	102	1.45	270	0	330	892	11.5	3.10
ZUMALADINNE	KOSIGI	77.2043	15.8163	BW	7.68	890	245	34	39	80	4.5	53	33	5	2.53	345	0	421	507	11.8	2.21
KUMBALANUR	DORNIPADU	77.0724	15.8819	BW	7.46	1470	550	120	61	85	1.4	220	183	44	0.86	220	0	268	878	11.8	1.58
NANCHARLA	CHIPPAGIRI	77.4138	15.2384	BW	7.14	1210	320	84	27	84	35.5	128	78	61	0.43	290	0	354	712	12.7	2.04
PULLAGUMMI	VELDURTHI	78.0257	15.6162	BW	7.34	1080	420	96	44	21	2.5	106	15	101	0.46	220	0	268	550	13.3	0.46
KARADIGUDDAM	ALUR	77.1929	15.4535	DW	7.45	1750	420	64	63	201	4.3	191	108	11	3.32	430	0	525	966	13.6	4.26
V.KONDAPURAM	ADONI	77.2177	15.612	BW	7.89	890	105	14	17	153	0.4	50	95	124	1.76	205	0	250	608	14.6	6.50
GUNDLAKONDA	DEVANAKONDA	77.6491	15.4752	BW	7.46	1110	320	96	19	84	31.0	85	68	48	0.70	320	0	391	670	16.3	2.04
ULINDAKONDA	KALLUR	77.9651	15.6291	BW	7.86	830	265	22	51	87	1.0	53	21	23	2.04	370	0	452	536	17.8	2.33
AGAVELI	KRISHNAGIRI	77.7419	15.5633	BW	7.55	1870	560	100	75	133	1.1	156	145	244	2.10	230	0	281	1028	19.3	2.44
KAMAVARAM	KOWTHALAM	77.1845	15.7772	BW	7.41	1580	530	80	80	99	8.7	298	115	63	0.35	210	0	256	900	21.4	1.86

A. NAGALAPURAM	KALLUR	77.9743	15.8114	BW	7.93	2290	180	32	24	442	0.8	128	320	143	3.82	500	0	610	1465	21.4	14.31
MULUGUNDAM	ASPARI	77.4374	15.6269	BW	7.54	1490	440	56	73	97	67.0	121	38	172	0.28	450	0	549	959	21.4	2.02
BHOGOLA	VELDURTHI	77.9309	15.4598	BW	7.65	3490	420	72	58	397	363.8	355	285	307	0.72	720	0	879	2374	23.0	8.42
BURANDODDI	C.BELAGAL	77.6942	15.7811	DW	7.52	2500	380	72	49	386	1.9	355	300	266	1.47	260	0	317	1624	24.5	8.62
HOSUR	PATTIKANDA	77.4619	15.3715	DW	7.55	2230	360	72	44	287	70.1	369	220	58	1.36	340	0	415	1374	24.7	6.58
CHAMALAGUDURU	NANDAVARAM	77.6145	15.8673	BW	7.65	2560	500	88	68	352	1.9	312	410	185	3.05	260	0	317	1614	25.0	6.84
KHAJIPURAM	CHIPPAGIRI	77.2824	15.1507	DW	7.53	6500	800	240	49	1066	11.8	886	1563	73	4.01	300	0	366	4116	28.0	16.39
GAJJEHALLI	HOLAGUNDA	77.0535	15.5879	DW	7.85	2700	380	56	58	198	393.6	255	210	177	1.20	620	0	757	1811	28.2	4.41
KONDAPURAM	C.BELAGAL	77.7318	15.8751	DW	7.35	3430	1100	224	131	275	9.8	553	600	46	0.90	260	0	317	2034	29.0	3.60
BASTIPADU	KALLUR	77.971	15.7133	BW	7.56	2120	500	112	53	219	4.6	383	330	14	0.59	160	0	195	1236	30.0	4.26
KUNTANAHAL	KOWTHALAM	77.1169	15.6964	DW	7.44	6060	700	160	73	440	960.5	815	525	735	0.15	500	0	610	4081	35.7	7.22
CHAKKARALLA	PATTIKANDA	77.5715	15.397	DW	7.3	1680	600	100	85	108	2.3	163	105	129	1.78	430	0	525	1014	37.0	1.92
SARPARAJAPURAM	VELDURTHI	78.0192	15.5487	BW	7.51	1480	360	44	61	163	1.6	78	53	90	1.74	520	0	635	878	39.0	3.73
BELAGALLU	KOSIGI	77.2979	15.8701	BW	7.26	1640	340	112	15	188	42.7	291	120	3	0.71	280	0	342	980	40.5	4.43
KURUVALLI	ALUR	77.1932	15.3651	DW	7.18	4710	800	160	97	483	383.2	851	325	539	0.30	350	0	427	3099	42.5	7.42
JALVADI	PEDDA KADUBUR	77.3815	15.7978	BW	7.36	2760	720	112	107	313	2.7	397	480	131	1.94	340	0	415	1798	43.5	5.07
NEMAKAL	CHIPPAGIRI	77.2905	15.2844	DW	7.12	2800	840	257	49	223	42.2	510	190	253	0.64	300	0	366	1747	44.9	3.34
JILLEDUBUDAKALA	DEVANAKONDA	77.63	15.5548	DW	7.57	1780	330	56	46	238	1.6	191	120	8	1.49	470	0	574	1013	46.4	5.71
KRISHNAGIRI	KRISHNAGIRI	77.8327	15.5543	BW	7.5	2290	500	112	53	256	4.7	355	200	53	1.85	380	0	464	1318	47.4	4.97
REMATA	KURNOOL	77.8713	15.8264	DW	7.45	2970	840	160	107	262	2.0	440	540	59	1.48	280	0	342	1780	47.5	3.93
KURNUR	GONEGANDLA	77.734	15.6336	BW	8.01	1380	90	12	15	266	1.6	121	68	73	1.35	420	0	513	869	50.9	12.19
MANNEGUNTA	KRISHNAGIRI	77.8115	15.631	BW	7.69	2330	280	40	44	416	1.9	284	285	5	1.17	540	0	659	1479	54.3	10.82
THIPPANUR	GONEGANDLA	77.698	15.6844	BW	8.1	1940	90	8	17	400	7.1	135	225	89	2.02	470	0	574	1232	61.4	18.32
PEDDA GONEHAL	HOLAGUNDA	77.1499	15.5779	BW	7.53	3940	680	128	87	540	75.9	454	850	122	1.43	400	0	488	2557	63.1	9.00
CHINNAHOTHUR	ASPARI	77.3001	15.4555	DW	7.82	9410	700	60	134	1463	644.9	1028	2375	65	3.43	650	0	793	6257	65.5	24.04
SAMBAGALLU	ADONI	77.3734	15.6266	BW	8.05	1810	120	12	22	351	8.6	99	135	0	6.92	600	0	732	1082	70.0	13.95
LINGALADINNE	KOWTHALAM	77.0775	15.8247	BW	7.35	5041	1000	140	158	659	0.5	957	650	191	1.70	250	0	305	2943	82.3	9.06
KADIMETLA	YEMMIGANUR	77.5385	15.74	BW	7.66	1560	370	92	34	97	111.9	177	130	72	0.38	310	0	378	946	86.0	2.19
MADIRE	ADONI	77.2115	15.6466	BW	7.18	3170	680	88	112	406	0.7	355	200	10	1.49	800	0	976	1768	90.1	6.76
GOOTY ERRAGUDI	TUGGALI	77.5938	15.2019	BW	6.9	3720	1240	329	102	287	10.0	610	285	410	0.66	340	0	415	2286	92.1	3.54

MALAKAPURAM	YEMMIGANUR	77.3725	15.7035	BW	7.39	2930	740	120	107	302	6.4	440	265	328	2.75	300	0	366	1794	112	4.83
MUSANAHALLI	ALUR	77.2765	15.5764	BW	7.23	5400	1400	361	122	594	1.9	815	1163	80	0.65	250	0	305	3323	113	6.90
ALWALA	GONEGANDLA	77.6297	15.7877	BW	7.62	4780	400	80	49	824	3.4	674	675	176	2.10	550	0	671	2892	116	17.91
THOGARCHEDU	KRISHNAGIRI	77.8826	15.5675	BW	7.62	1810	250	72	17	281	20.9	241	235	2	1.00	310	0	378	1101	123	7.72
HULIKANVI	PEDDA KADUBUR	77.2813	15.7952	BW	7.47	1820	350	92	29	227	7.2	269	100	46	2.27	370	0	452	1049	132	5.27
SEEDARAHAL	HALAHARVI	77.2096	15.1792	BW	7.25	16300	4100	601	632	1914	5.7	2411	4000	95	0.37	300	0	366	9882	140	13.00
CHETNIHALLI	MANTRALAYAM	77.3905	15.9278	BW	6.79	7900	3000	561	389	402	14.3	1560	763	888	0.35	250	0	305	4763	141	3.19
SATHANUR	KOSIGI	77.2291	15.9507	DW	7.32	4880	1150	220	146	569	14.4	780	938	171	1.46	250	0	305	3025	148	7.30
GUNDREVULA	C.BELAGAL	77.7004	15.8799	BW	7.31	5280	1500	321	170	468	8.2	815	1075	120	0.71	250	0	305	3164	153	5.25
MACHAPURAM	NANDAVARAM	77.4846	15.8745	BW	7.04	6600	2900	681	292	231	9.8	1347	800	411	0.31	250	0	305	3958	187	1.87
DEVANAKONDA	DEVANAKONDA	77.5486	15.5389	BW	7.11	5850	1100	200	146	469	607.1	1064	375	830	0.35	400	0	488	3989	193	6.15
RAYACHOTY	NANDAVARAM	77.6193	15.9047	BW	7.66	3820	400	104	34	671	2.2	440	825	46	2.90	380	0	464	2408	213	14.59
DUDDI	KOSIGI	77.2093	15.8742	BW	7.04	3170	1060	240	112	204	1.0	539	405	188	0.55	240	0	293	1868	215	2.72
LADDAGIRI	KODUMUR	77.8931	15.6336	BW	7.08	5920	1400	341	134	667	31.2	780	1375	275	0.31	300	0	366	3826	300	7.75
TERNEKAL	DEVANAKONDA	77.5351	15.6361	BW	7.35	3420	880	136	131	370	12.4	596	275	291	0.91	400	0	488	2110	317	5.42
JONNAGIRI	TUGGALI	77.5693	15.2621	BW	7.06	7010	1250	160	207	1008	37.3	1595	738	209	1.59	350	0	427	4216	328	12.40
PENCHIKALAPADU	GUDUR	77.8933	15.7543	BW	7.4	6240	1150	180	170	976	210.8	1099	1425	154	1.12	700	0	854	4737	335	12.51
CHELLELICHELIMALA	DEVANAKONDA	77.6905	15.5441	BW	7.36	1370	540	148	41	48	2.6	234	105	162	0.46	140	0	171	846	400	0.90
TSALLAKUDLUR	YEMMIGANUR	77.5457	15.8228	BW	7.25	6620	1250	220	170	949	15.9	1241	1050	233	1.72	400	0	488	4179	462	11.67
LINGNENIDODDI	TUGGALI	77.7041	15.3972	BW	7.28	2830	500	184	10	180	298.9	284	340	357	0.62	320	0	391	1892	494	3.49
YATAKALLU	ASPARI	77.4382	15.5339	BW	7.08	2810	700	200	49	233	1.9	482	145	2	6.16	440	0	537	1447	639	3.83
KOTEKAL	YEMMIGANUR	77.3911	15.6853	BW	6.86	5020	1800	421	182	310	13.3	993	275	719	0.98	250	0	305	3100	692	3.18
NADIKHAIRAVADI	NANDAVARAM	77.4688	15.9301	BW	7.26	3900	1240	200	180	317	5.4	539	650	52	0.74	460	0	561	2286	884	3.92
PARLA	KALLUR	77.9086	15.7741	BW	7.19	29900	6000	601	1094	3780	634.1	5530	5950	258	0.45	600	0	732	18294	2357	21.22

Annexure- V The ground water resources of Kurnool district as on march 2022

Assessment Unit Name	Annual Extractable Ground Water Resource (Ham)	Irrigation Use (Ham)	Industrial Use (Ham)	Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semi-critical/Safe)
YEMMIGANUR	4063.47	834.61	5.00	247.27	1086.85	257.23	2966.64	26.75	safe
VELDURTHI (KURNOOL)	7608.31	320.20	2.00	192.72	514.95	200.49	7085.60	6.77	safe
ORVAKAL	2048.26	771.72	5.00	201.25	977.96	209.34	1062.21	47.75	safe
PEDDA KADUBUR	4773.83	693.41	0.00	195.09	888.51	202.95	3877.47	18.61	safe
MANTRALAYAM	2516.37	188.00	0.00	168.84	356.88	175.63	2152.69	14.18	safe
ADONI	6632.65	508.61	5.00	572.23	1085.81	595.29	5523.80	16.37	safe
DEVANAKONDA	2926.15	752.66	0.00	245.32	997.98	255.19	1918.30	34.11	safe
ALUR	7434.97	259.15	1.00	191.02	451.21	198.70	6976.09	6.07	safe
HALAHARVI	2379.9	59.43	0.00	141.63	201.09	147.32	2180.65	8.45	safe
KURNOOL MANDAL	1509.52	357.25	10.00	198.44	565.71	206.45	935.78	37.48	safe
HOLAGUNDA	4305.65	299.86	0.00	148.79	448.66	154.81	3850.97	10.42	safe
C BELAGAL	3906	768.56	2.00	157.95	928.53	164.31	2971.10	23.77	safe
KOSIGI	3021.84	753.33	0.00	232.45	985.72	241.82	2050.86	32.62	safe
MADDIKERA EAST	1528.45	160.91	0.00	126.85	287.79	131.97	1235.54	18.83	safe
GUDUR (KURNOOL)	1228.11	230.91	2.00	128.65	361.57	133.82	861.36	29.44	safe
TUGGALI	2101.17	230.95	1.00	204.77	436.73	213.03	1656.20	20.79	safe
ASPARI	2450.47	504.97	0.00	224.15	729.09	233.20	1712.30	29.75	safe

PATTIKANDA	1828.66	293.31	2.00	184.57	479.86	191.99	1341.38	26.24	safe
KRISHNAGIRI	5594.2	680.13	0.00	160.31	840.42	166.79	4747.32	15.02	safe
CHIPPAGIRI	2097.49	138.87	0.00	112.88	251.75	117.42	1841.20	12.00	safe
KOWTHALAM	5634.7	505.10	0.00	254.82	759.90	265.08	4864.54	13.49	safe
KALLUR	2385.02	527.43	19.00	162.75	709.20	169.33	1669.26	29.74	safe
KODUMUR	2166.12	525.03	2.00	256.89	783.93	267.24	1371.84	36.19	safe
NANDAVARAM	4041.32	387.32	1.00	209.22	597.60	217.64	3435.30	14.79	safe
GONEGANDLA	2856.85	1176.22	0.00	237.86	1414.12	247.46	1433.14	49.50	safe
Total	**87039.48**	**11927.95**	**57.00**	**5156.73**	**17141.82**	**5364.50**	**69721.54**	**19.69**	**safe**