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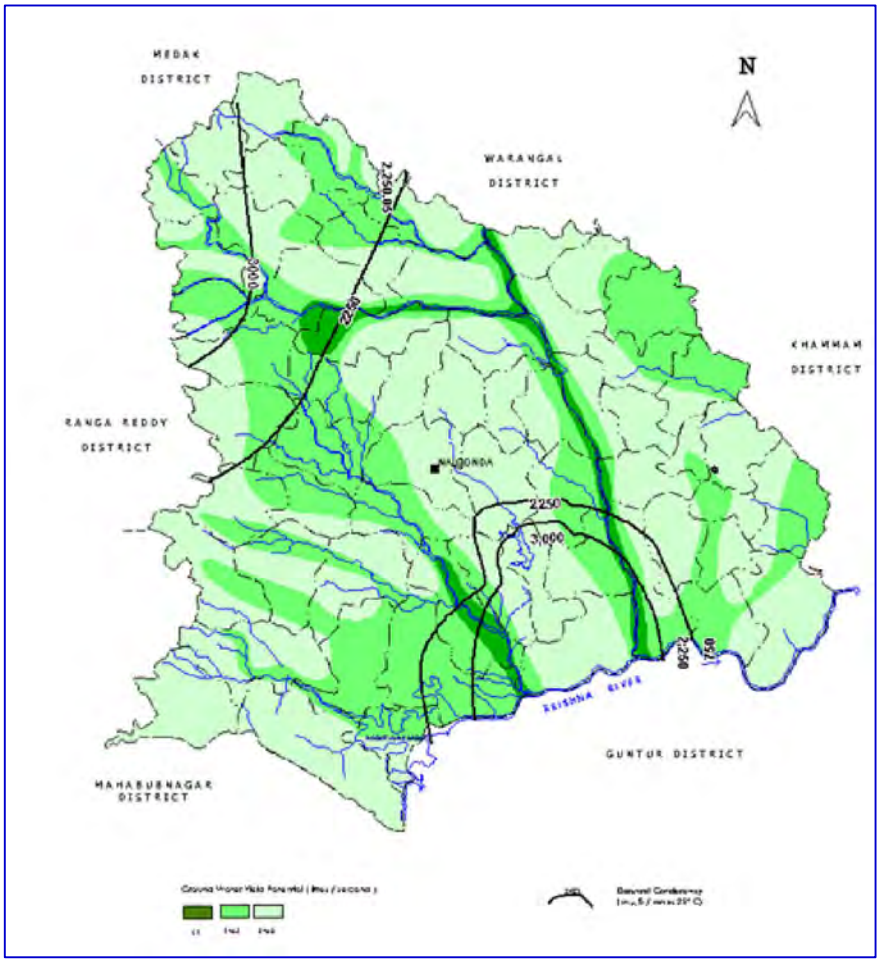
CENTRAL GROUND WATER BOARD
MINISTRY OF WATER RESOURCES
GOVERNMENT OF INDIA

GROUND WATER BROCHURE
NALGONDA DISTRICT, ANDHRA PRADESH



SOUTHERN REGION
HYDERABAD
September 2013

CENTRAL GROUND WATER BOARD
MINISTRY OF WATER RESOURCES
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GROUND WATER BROCHURE
NALGONDA DISTRICT, ANDHRA PRADESH
(AAP-2012-13)

BY

D. MOHANTA
ASST. HYDROGEOLOGIST

SOUTHERN REGION
GSI Post, Bandlaguda
Hyderabad-500068
Andhra Pradesh
Tel: 040-24225201
Gram: Antarjal

BHUJAL BHAWAN,
NH.IV, FARIDABAD-121001
HARYANA, INDIA
Tel: 0129-2418518
Gram: Bhumijal

NALGONDA DISTRICT AT A GLANCE

Sl. No	GENERAL INFORMATION	
1	Geographical Area (2011 census)	14200 sq.km
	Headquarters	Nalgonda
	Location	North latitudes 16° 25' and 17° 50' East longitudes 78° 40' and 80° 05'
	Administrative Divisions (As on 31/03/2010)	Mandals-59, Revenue Divisions-4 at Bhongir, Nalgonda, Miryalguda and Suryapet
	No. of Revenue Villages	1161
	Population (2011 census)	3483648
	Population Density	245/ sqkm
2	Land Use (2012)	
	Forest	83073 Ha
	Barren and Uncultivable	121531 Ha
	Cultivable waste	29146 Ha
	Net Area Sown	573291 Ha
3	Irrigation (2012)	
	Major Projects	Nagarjun Sagar
	Medium Projects	1. Musi, 2. AMRP (A. Madhav Reddy Project) 3. Dindi
	Gross Irrigated Area	408093 Ha
	Net Irrigated Area	297796 Ha
4	RAINFALL	
	Normal Annual Rainfall (Mandalwise)	Minimum 540.00 mm (M- Pedda Adiserlapalli) to Maximum 932.00mm (M-Thirumalgiri)
	Annual rainfall (2012)	674 mm
5	Geomorphology	
	Major Drainage	Two; Musi and Dindi
6	Soil Type	1. Red soils, 2. Black soils 3. Alkaline soils and 4. Alluvium (sand and gravel soils)
7	Geological Formation	Granite, Gneisses, Limestone and Alluvium
9	Hydrogeology	
	Water Bearing Formation	Granite- weathered/fractured/ jointed Granite, under phreatic and semi-confined to confined conditions
	Pre monsoon Depth to Water Level (May-2012)	2.30 - 26.10m bgl
	Post monsoon Depth to Water Level (Nov.-2012)	0.54 - 16.17 m bgl
10	Ground Water Exploration (As On 31/03/11)	
	Wells Drilled	EW-98, WT-40
	Depth Range	30.00 to 300.00 m bgl
	Discharge	1.00 – 4.00 lps
	Major Aquifer Zones	35.0 to 80.0 m
	Transmissivity ($m^{2/}$day)-	
	Hard rock	25 to 120
	Soft rock	470
	Storage Coefficient	
	Hard Rock	1.6×10^{-4} to 3.5×10^{-4}

11	Ground Water Quality	
	Ranges of Chemical parameters for Shallow Aquifer (10 DW water samples, May 2011, NHNS) pH = 7.2 to 8.1 EC =740 to 5300 micromhos /cm at 25° C Ca= 30 to 270 milligram/litre Mg = 6.12 to 58.8 milligram/litre. Na= 97 to 1208 milligram/litre K= 2 to 164 milligram/litre CO_3 =0.00 milligram/litre HCO_3 = 262 to 1244 milligram/litre Cl = 64 to 837 milligram/litre SO_4 = 7 to 314 milligram/litre NO_3 = 2 to 285 milligram/litre F= 0.23 to 4.6 milligram/litre SAR = 2.27 to 33.91 Na %= 37 to 92 RSC = -13.33 to 15.59	Ranges of Chemical parameters for Deeper Aquifer (61 EW water samples) pH = 7.0 to 9.3 EC = 135 to 7390 micromhos /cm at 25° C Ca= 3 to 902 milligram/litre Mg = 3 to 158 milligram/litre. Na= 18 to 740 milligram/litre K= Trace to 136 milligram/litre CO_3 =0.00 to 102.00 milligram/litre HCO_3 = 61 to 756 milligram/litre Cl = 14 to 1816 milligram/litre SO_4 = 4 to 480 milligram/litre NO_3 = 0 to 670 milligram/litre F= 0.200 to 4.380 milligram/litre SAR = 0.73 to 19.49 Na %= 16.52 to 86.77 RSC = -9.61 to 50.25
12	Dynamic Ground Water Resources- (As On 31/03/2009)	
	Total annual ground water recharge	2229.24 MCM
	Provision for natural discharge	208.15 MCM
	Net annual ground water availability	2021.09 MCM
	Existing gross ground water draft for all uses	1134.18 MCM
	Resultant Ground water Balance	886.91 MCM
	Stage of ground water development	56%
	Categorisation	Safe
	Nos. Mandals Categorised as	
	Safe (< 70%, development)	44
	Semi-critical (70 to 90%)	10
	Critical (90-100%)	Nil
	Overexploited (> 100%)	5
	Nos. of Villages notified for restricted development (As per APWALTA-2002)	78

Ground Water Brochure - Nalgonda District
Andhra Pradesh

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GROUND WATER BROCHURE
NALGONDA DISTRICT, ANDHRA PRADESH

1.0 INTRODUCTION

1.1 General

Nalgonda district is one of the 23 districts of Andhra Pradesh, with a total geographical area of 14240 Sq.km. It has a total population of 34,83,648 as per 2011 census. The district has 1178 Gram Panchayats, 1161 revenue villages and 59 Mandals. For Administrative convenience the district is divided into 4 revenue divisions located at Bhongir, Nalgonda, Miryalguda and Suryapet.

The district lies between North latitudes 16° 25' and 17° 50' and between east longitudes 78° 40' and 80° 05' forms a part of major basin of Krishna river and is covered by Survey of India toposheet Nos. 56K, 56L, 56O and 56P. The district with headquarters at Nalgonda town is well connected with road, railway and telecommunications. Two railway lines, Secunderabad-Vijayawada and Secunderabad-Guntur pass through the district. There were 83 Large and Medium scale industries in Nalgonda district. The district is endowed with minerals like limestone, clay, building materials and recently big Uranium deposits have been discovered in Pedda Adiserlapalli mandal area. As for the agriculture is concerned, the main source of irrigation is groundwater being 72.56% of total gross area irrigated, whereas surface water irrigation accounts for 27.33% of gross area.

1.2 Land Use

Out of total geographical area of the district in 2011-2012, forest area was 83073ha current follow land was 253851 ha and net area sown is 573291 ha .

1.3 Irrigation

One major irrigation project i.e. Nagarjun Sagar two Medium Irrigation Projects i.e. AMRP (A. Madhav Reddy Project) and Musi Projects are present in Nalgonda district. Dindi is another medium irrigation project in the district. Ground water plays a predominant role in the net irrigated area 192350 ha, whereas surface water irrigation accounts for 92337 ha, out of the total net irrigated area of 2,97,796 ha. Out of total geographical area of 1424000 ha.

1.4 Cropping Pattern

The cropping pattern is practiced with based on climatic conditions and availability of irrigation sources. Paddy has been a staple crop since ages and cultivated in an area of 273430 ha mostly under canals, tanks and wells. Other principal crops like jowar, bajra, grams, are mostly rainfed crops.

The commercial crops like chilies, cotton and groundnut are grown under irrigation. In food crops, the paddy were grown in gross was 273430 ha, which accounts for 46.77% of total cropped area by principal crops. It is observed that out of total

geographical area of the district, the net area sown is about 31.86%, the area sown more than once is 9.20% and the total cropped area is 41.05%. Out of the 584594 ha of total cropped area in the district, the total net area sown is 453647 ha (77.60%), whereas the area sown more than once is 130947 ha (22.40 %).

2.0 RAINFALL

The average annual rainfall of the district is 751 mm, which ranges from 2.0mm in February to 171 mm in July. July is the wettest months of the year contributing about 23% of annual rainfall. The mean seasonal rainfall is 562 mm in southwest monsoon (June-September), 139 mm in northeast monsoon (Oct-Dec), 7 mm rainfall in Winter (Jan-Feb) and 43 mm in summer (March – May). The percentage distribution of rainfall, season-wise, is 74.8% in southwest monsoon, 18.5 % in northeast monsoon, 0.93 % in winter and 5.73 % in summer. The mean monthly rainfall distribution is given in Fig.1. The annual rainfall during 2012 is 674 mm.

Table 1 Monthly Rainfall Distribution

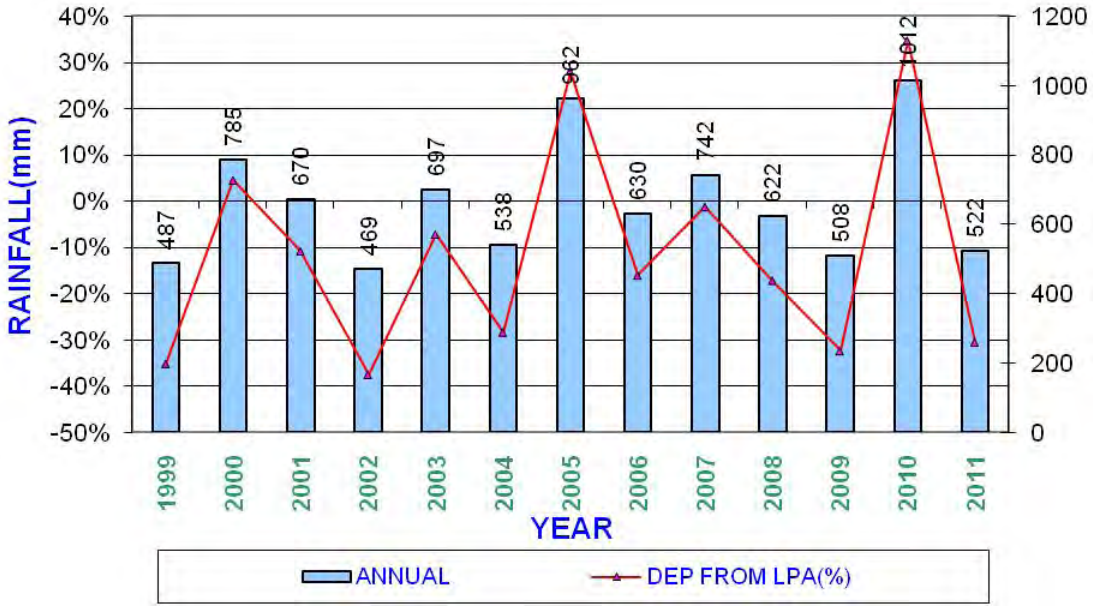
Sl No	YEAR	ANNUAL	SWM	NEM	WINTER	SUMMER	SWM (%)	NEM (%)	WINTER (%)	SUMMER (%)	DEP FROM LPA (%)
1	1999	487.0	418.0	34.0	11.0	24.0	85.83%	6.98%	2.26%	4.93%	-35%
2	2000	785.0	718.0	15.0	7.0	45.0	91.46%	1.91%	0.89%	5.73%	5%
3	2001	670.0	516.0	141.0	0.0	13.0	77.01%	21.04%	0.00%	1.94%	-11%
4	2002	469.0	317.0	116.0	9.0	27.0	67.59%	24.73%	1.92%	5.76%	-38%
5	2003	697.0	548.0	135.0	0.0	14.0	78.62%	19.37%	0.00%	2.01%	-7%
6	2004	538.0	342.0	123.0	28.0	45.0	63.57%	22.86%	5.20%	8.36%	-28%
7	2005	962.1	576.8	298.0	25.1	62.2	59.95%	30.97%	2.61%	6.47%	28%
8	2006	630.4	423.9	70.7	0.0	135.8	67.24%	11.22%	0.00%	21.54%	-16%
9	2007	741.7	611.6	78.3	4.4	47.4	82.46%	10.56%	0.59%	6.39%	-1%
10	2008	622.1	423.9	70.7	19.3	108.2	68.14%	11.36%	3.10%	17.39%	-17%
11	2009	507.5	330.9	124.8	4.4	47.4	65.20%	24.59%	0.87%	9.34%	-32%
12	2010	1012.0	724.0	209.0	18.0	61.0	71.54%	20.65%	1.78%	6.03%	35%
13	2011	522.0	419.8	32.4	22.0	47.8	80.42%	6.21%	4.21%	9.16%	-30%
Long Period Average		751.0	562.0	139.0	7.0	43.0	74.83%	18.51%	0.93%	5.73%	

Source: Indian Meteorological Department And Directorate Of Economics And Statistics

Fig. -1 Monthly Rainfall distribution of Long Period Average in Nalgonda district

The annual and seasonal rainfall distribution with its departure from mean along with percentage distribution year-wise is given in Table-1. The data is presented in Figure-2. The annual rainfall ranges from 469 mm in 2002 to 1012 mm in 2010. The annual rainfall departure ranges from -38 % in 2002 to 35 % in 2010. The southwest monsoon rainfall contributes about 75 % of annual rainfall. It ranges from 317 mm in 2002 to 724 mm in 2010. The year 1999, 2002, 2004, 2009 and 2011 experienced drought conditions as the annual rainfall recorded in five years was < 75 % of the long period average (LPA). The cumulative departure of annual rainfall from LPA is presented in Fig.2. It indicates that, the rainfall departure as on 2011 is negative -149%, showing rainfall deficit. The district is drought prone.

Fig.- 2: Annual Rainfall and Rainfall from Long Period Average in Nalgonda district



3.1 Physiography

The Nalgonda district represents a true picture of hard terrain physiography with residual hills, valleys, plains etc. Physiographically the terrain is contiguous to the Mysore plateau, which slopes from west and northwest to southeast. Northwestern part of the district slopes from west to east, the eastern parts from north to south and the southwestern and central parts from northwest to southeast. In general, the area slopes from northwest to southeast. The general elevation varies from about 480 to 800 m above mean sea level. However, the hills located in the western part of the district attain an elevation of about 670 m.

3.2 Drainage

The area is drained by the River Krishna along with tributaries Musi, Aler, Dindi, Halia and Peddavagu rivers. Krishna River forms the southern boundary of the district and enters the south western part of the district and flows along the southern boundary for a distance of about 85 kms. The Musi River is the main tributary of river Krishna. The Paler River drains eastern part of the district. The directions of all the three river

courses are controlled by two major lineaments in east-west and northwest-southeast directions. All other lower order streams and nallas are controlled by minor lineaments. The district divided into 64 micro-basins. The major river Krishna is perennial and all other rivers are seasonal and ephemeral. The overall drainage pattern in the district is dendritic to sub-dendritic and rectangular.

3.3 Soil

The soil comprises of red soil, black soil, alkaline soil and alluvium. The red soil constitutes 85 % of the area. Black soil is found over the limestone area, in the south-eastern part of the area. Alkaline soil occurs as limited patches in the central part. Alluvial soil occurs along Alair, Musi and Kargal rivers.

4.0 HYDROGEOLOGY

The Archaean crystalline rocks, which occupy 90% of the district, comprise granites, gneisses, schists and intrusives. The consolidated metasedimentary rocks of Cuddapah and Kurnool system comprising limestones, quartzites and shales occupy 9% in the southern part of the district. The unconsolidated deposits comprising alluvial sands, clay, occur as isolated and narrow patches along the major rivers and streams occupying around 1% of the area.

4.1 Ground Water in Crystalline rocks

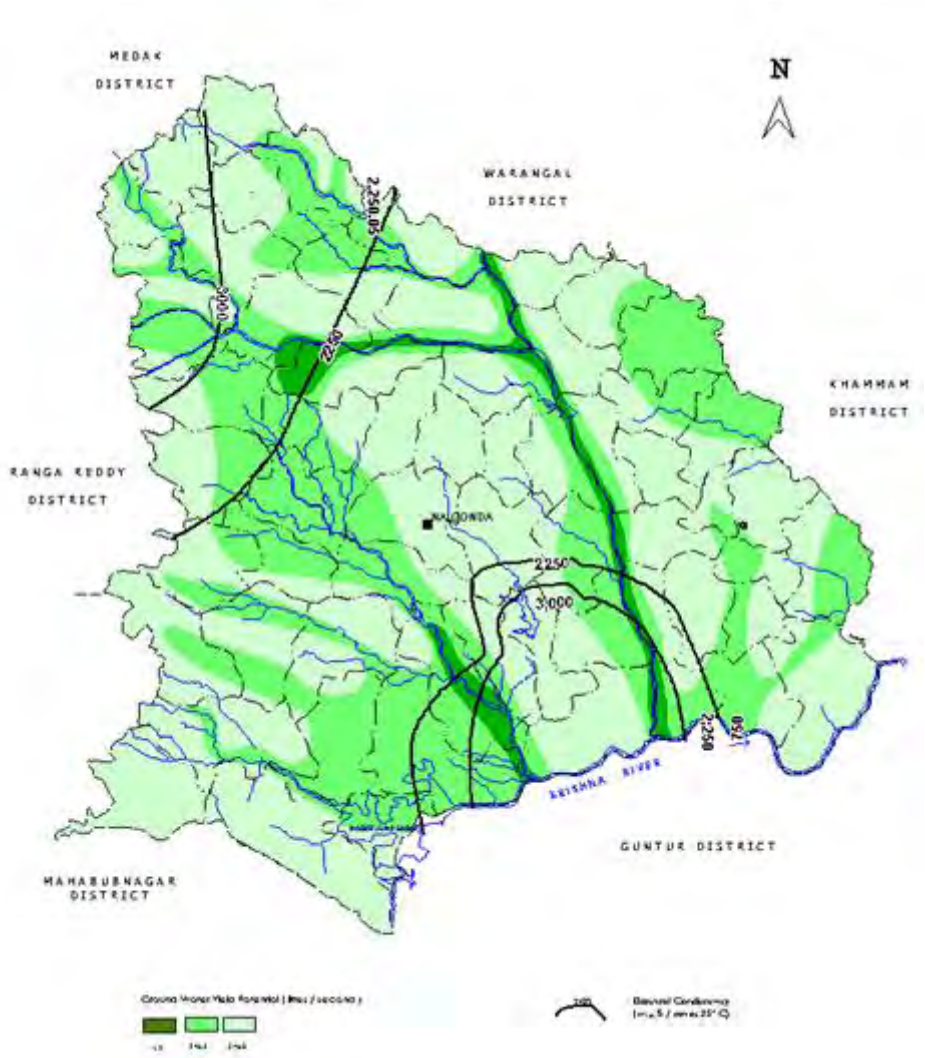
The crystalline rocks inherently devoid of primary porosity, however, subsequently, with dynamic process of weathering, the rocks undergo fracturing and fissuring and joints over a period of time, lead to the development of secondary porosity, which forms the repository for ground water. The ground water occurs under water table conditions in weathered zone and semi-confined and confined conditions in fractured zone.

The phreatic aquifer is developed by means of open dug wells with depth ranging from 6-15 m and dug-cum-bore wells up to 60m. The yield of irrigation wells range from 100 to 150 cu.m/day. At places, it is upto 200 cu.m/day. Hydrogeological conditions of the district are shown in Fig.-3a and 3b.

Fig.3a Geology - Nalgonda District


0
34.00
Kilometres
Scale: 1:850,100
N
Observation Well
Exploratory Well
Piezometer
Village having fluoride > 1.5 mg/l
Srisailam Quartzite
Nargi Limestone
Peninsular Gneissic Complex
Banaganapalli Quartzite

Fig.3b Hydrogeology - Nalgonda District



4.2Ground Water in Meta Sediments

The Meta sediments of Kadapa and Kurnool group occur along the southern boundary of the district. In the shale formations, the ground water occurs along bedding plains, cleavages, joints and weathered zones etc. In limestones, the ground water occurs mainly in solution channels, caverns and joints etc. The depth of open wells in shales and limestones varies from 5 to 20 m, whereas it is 50-60m in bore wells. The yield ranges between 2 and 3 lps.

4.3 Ground Water in Unconsolidated Formations

The ground water occurs under water table condition alluvial formations along the River Aler. The depth of the dug well ranges from 3 to 6 m.

4.4 Shallow Aquifer System

The shallow aquifer system constitutes weathered mantle limited to a maximum depth of 40m. The depth of phreatic and semi-confined aquifers (fractures) ranges between 7 m (Miryalaguda) and 24 m (Madugulapally). The majority of the aquifer zones

encountered within the depth range of 10.0 and 20.0 m bgl. The discharge of the shallow bore wells ranges between 0.5 and 2.0 liters per second (lps). The transmissivity of the wells ranges from 5 to 23 sq.m/day. The pink granite aquifers are more potential than that of grey granites.

The shallow aquifers are exploited by means of large diameter dug wells for irrigation. Specific capacity of the wells in gneissic granite ranges from 41.1 lpm to 260.3 lpm per meter drawdown, whereas the wells tapping weathered and jointed gneissic granites have specific capacities vary from 169.3 to 319.7 lpm/dd. In general, specific capacity of wells ranges between 17.8 to 114.0 lpm/dd.

4.5 Deeper Aquifer System

The deep exploratory drilling by Central Ground Water Board revealed that the fractures are of vertical to sub-vertical and also of horizontal in their disposition. It has been found that about 80% of the aquifer zones are encountered within the range of 40-60 m depth. About 20% of the fractured zones are encountered beyond 60m down to 150m depth. In the aquifer zones, within 60m depth, the ground water occurs under semi-confined conditions, whereas in deep seated aquifers found under semi-confined to confined conditions. The transmissivity of aquifer ranges between 5 and 400 sq.m/day (Anantaram, Bhongir Mandal). The general range of transmissivity varies from 10 to 60 sq.m/day in the granitic terrain. The specific capacity of the fracture zone ranges from 5.0 lpm/m.dd to 10 lpm/m.dd. The storativity of the aquifer zones is found to be from 1.5 x 10-5 to 1x 10-3. It has been observed that the aquifers in the pink granite found to be more potential than that of basic rocks.

Deeper aquifers are by and large encountered at a depth of 40-80 m, occasionally fracture zones exist beyond 120 m. The yield of the aquifer ranges between 1 to 4 lps, occasionally upto 19 lps at Anantaram, (Bhongir Mandal), which is located along East West lineament.

5.0 WATER LEVELS

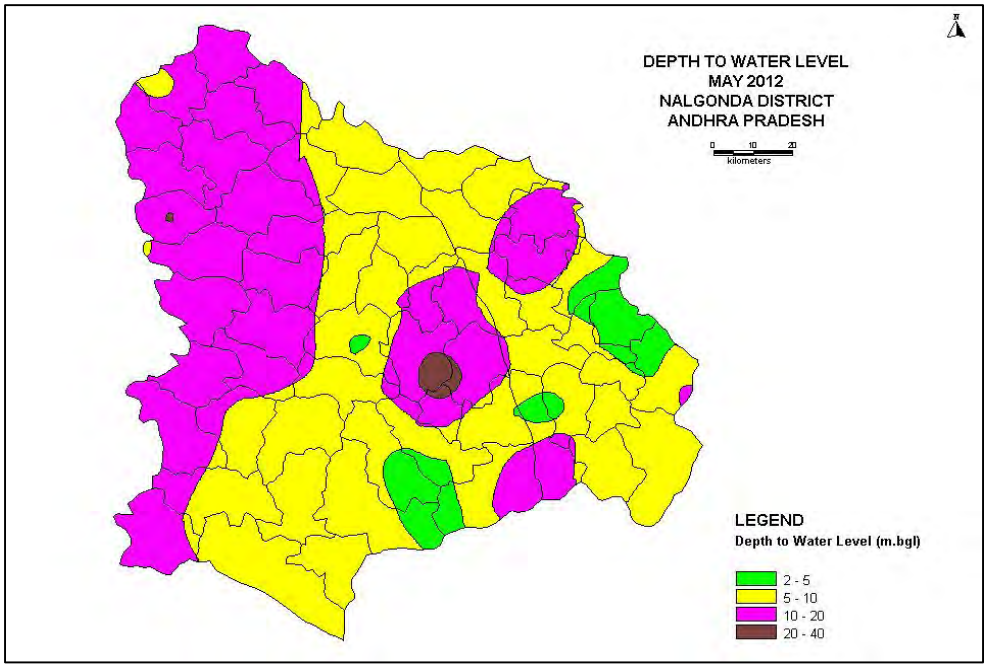
5.1 Pre-Monsoon

The water level during pre-monsoon-2012 (Fig.4) shows the depth to water level was in the range of 5 to 10 meters below ground level in the north-central and south-east parts. In the western and south-west part, the water levels are found between 10 to 20 m bgl. More than 20m depth range was found as isolated patches in central and western parts of the district. The shallow water level of 2.30 m bgl during pre-monsoon was observed at Mothey whereas deeper levels of 26.10m bgl were at Madugullapalli.

5.2 Post-monsoon

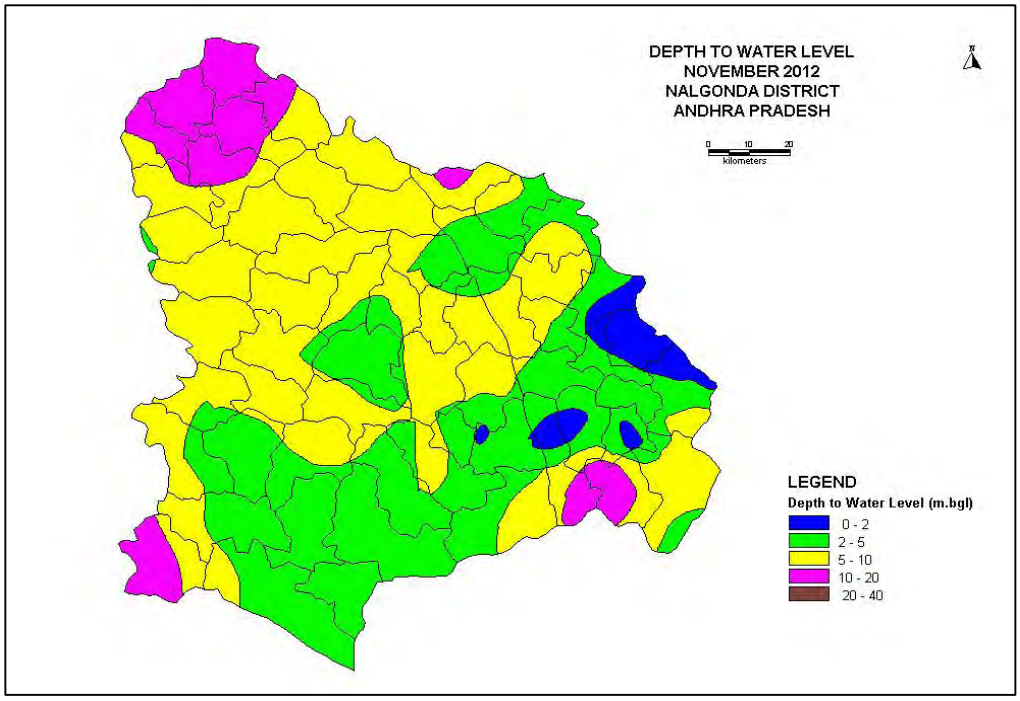
The depth to water level map post-monsoon 2012 shows (Fig.5) that water level of 2m exists in eastern and central parts of the district. The water level between 2 and 5m bgl was noticed in the southern and central parts of the district.

Fig.-4 Depth to Water Level in Nalgonda District Pre-monsoon(May 2012)



The water level between 5 and 10m bgl was found north to north-west parts of the district. The deep-water levels more than 10m were found in northern, southern and south western parts of district. The minimum depth to water level during post-monsoon of 0.54 m bgl was observed at Mothey Pz; whereas maximum of 16.17 m bgl was at Gundlapalli (Dindi) Pz.

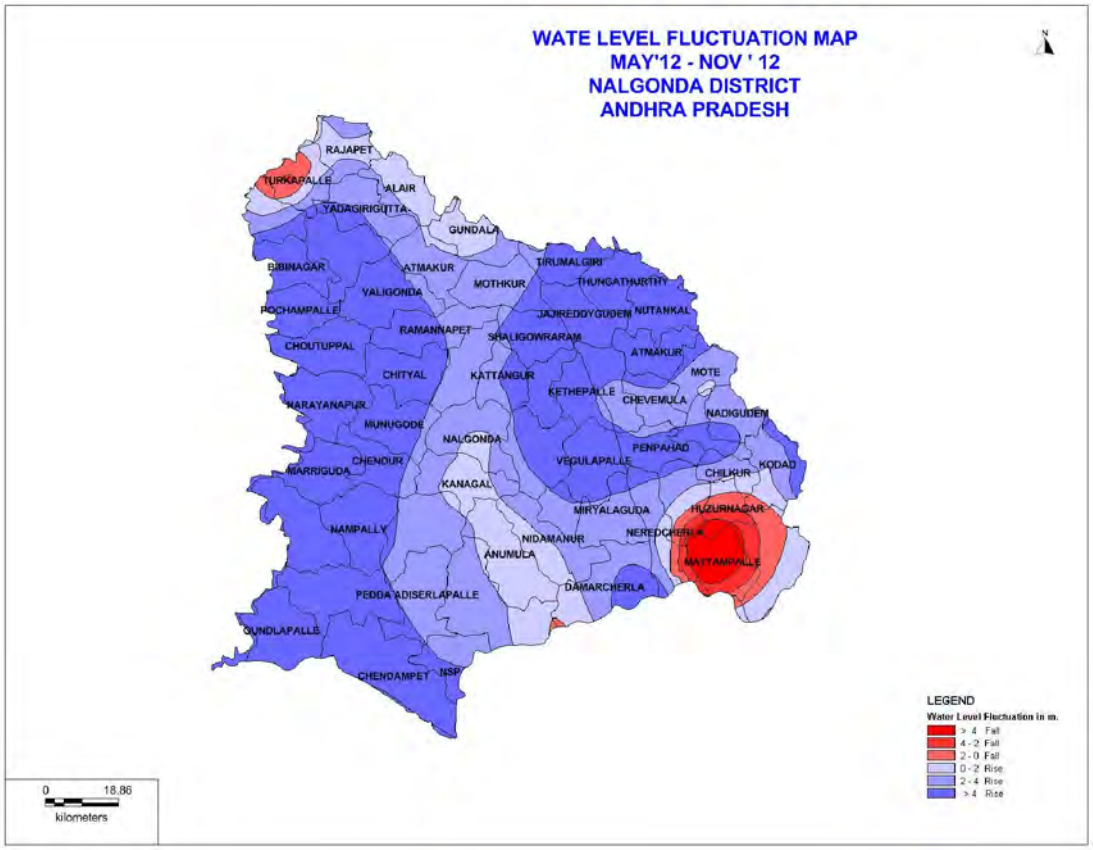
Fig.-5 Depth to Water Level in Nalgonda District Post monsoon (Nov 2012)



5.3 Water Level Fluctuation

Rise of water levels from 0 to 2m during post-monsoon was observed at northern, southern and eastern part and >2m rise was noticed in western, southern and north-east part of the district. Majority of the area shows rise in the range of 2-4m. Fall in water level of more than 2m was observed at northwestern and southeastern parts of the district. The water level fluctuation between May and Nov 2012 was presented in Fig.6.

Fig. 6 Water Level Fluctuation in Nalgonda District (May and Nov 2012)



5.4 Long-term water level trends

Rising trend (0.05 (Kodad-Pz) to 1.46 m/year (Chintapally-Pz) in water levels has been observed during pre-monsoon. Falling trend is also has been noticed ranging from 0.02 (Mukundapur EW) to 0.10 m/year (L B Nagar). Rising trend of 0.04 (Gunlapalli (Dindi)) to 2.91 m/year (Chintapally- Pz 2)) and falling trend of 0.04 (Huzur Nagar- Pz 2) to 1.21 m/year (Kodad- Pz 2) has been recorded during post and premonsoon periods respectively.

6.0 GROUND WATER RESOURCES

Based on the Ground Water Estimation committee (G.E.C-97) norms, ground water assessment was done in May 2011 using the data up to 2008-09. The ground water resources available in command area and in non-command area of the district are

775.50 MCM and 1245.59 MCM respectively. The groundwater utilization in command area and in non-command area of the district is 186.95 MCM and 147.23 MCM respectively. So, the resultant groundwater balance in command area in non-command area of the district, are 588.55 MCM and 298.36 MCM respectively. Overall the district falls under safe category with stage of development being at 56%. The stage of development in command area is 24% (safe) and in non-command area, it is 76% (semi-critical category). With respect to stage of development, 44 mandals are found to be safe, 10 semi-critical and 5 mandals viz., Thirumalgiri (104%), Jajireddi Gudem (107%), Nakrekal (102%), Suryapet (103%) and Kanagal (106%) are in over-exploited category. Categorisation of Mandals is shown in Fig.7. Semi-Critical, and Over-exploited mandals of Nalgonda district (other than safe categories) are listed Table-2. As per ground water assessment done in May 2011 by the resources data up to 2008-09, 78 Villages were identified as over exploited and were proposed for notification in Nalgonda District. The Mandal wise summarized details of ground water resources of Nalgonda District are given Table 3.

Table 2 Semi-critical and over-exploited mandals Nalgonda district (2008-09)

Semi-Critical	Over Exploited
1 Alair	1 Thirumalgiri
2 Thungathurthi	2 Jajireddi Gudem
3 Valigonda	3 Nakrekal
4 Bhongir	4 Suryapet
5 Kethepalle	5 Kanagal
6 Mothey	
7 Nalgonda	
8 Munugode	
9 Narayanapur	
10 Chandur	

Fig.7 Categorisation of Mandals in Nalgonda District (2008-09)

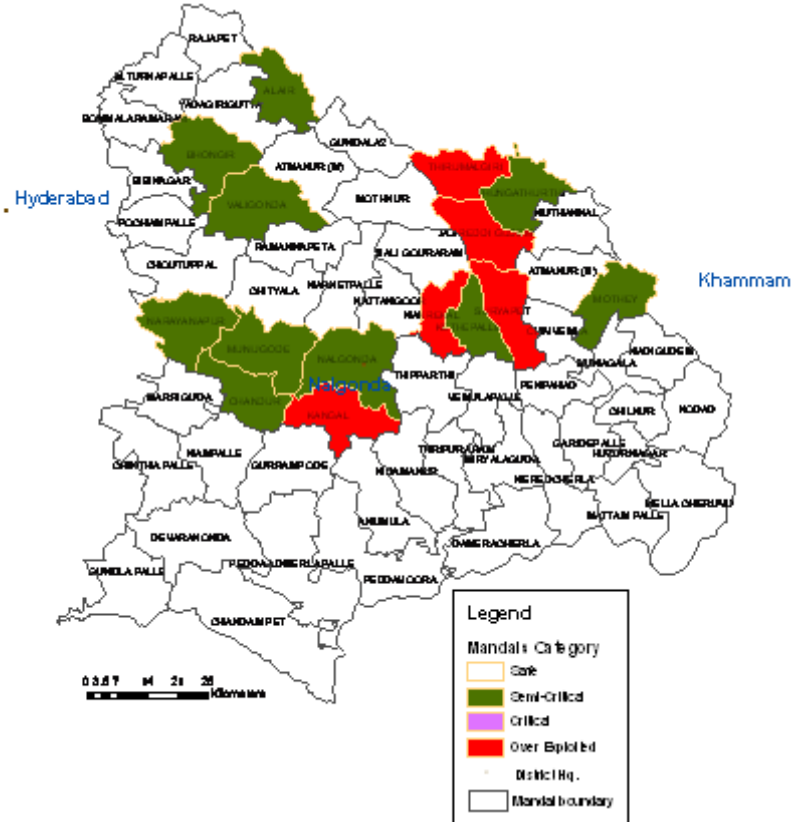


Table 3 Ground Water Resources in Nalgonda District (2008-09) (in Ha.m)

Sl. No.	Mandal	C/ NC/ T	Area in the Basin (Ha)	Total annual ground water recharge (Ha.m)	Provi sion for natural dis-charge (Ha.m)	Net annual ground water availa bility (Ha.m) [5-6]	Existing gross ground water draft for all uses (Ha.m)	Resultant Ground water Balance (7-8) (Ha.m)	Stage of ground water development {(8/7*100)} [%]	Premonsoon		Postmonsoon		Category
										Water level trend (cm/yr)	Is there a significant decline [Yes/No]	Water level trend (cm/yr)	Is there a significant decline [Yes/No]	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Bommalaramaram	C	0	0	0	0	0	0	0	0	0	0	0	
		NC	16751	2173	217	1956	1114	842	57	-13	No	-51	No	Safe
		T	16751	2173	217	1956	1114	842	57	-13	No	-51	No	Safe
2	M.Turkapalle	C	0	0	0	0	0	0	0					
		NC	19176	2313	231	2082	1746	336	84	-46	No	-22	No	Safe
		T	19176	2313	231	2082	1746	336	84	-46	No	-22	No	Safe
3	Rajapet	C	0	0	0	0	0	0	0					
		NC	19676	2273	161	2112	1481	631	70	-12	No	-28	No	Safe
		T	19676	2273	161	2112	1481	631	70	-12	No	-28	No	Safe
4	Yadagirigutta	C	0	0	0	0	0	0	0					
		NC	22685	2821	282	2539	1680	859	66	4	No	-1	No	Safe
		T	22685	2821	282	2539	1680	859	66	4	No	-1	No	Safe
5	Alair	C	0	0	0	0	0	0	0					
		NC	19791	2483	165	2318	1776	542	77	18	Yes	2	No	Semi-Critical
		T	19791	2483	165	2318	1776	542	77	18	Yes	2	No	Semi-Critical
6	Gundala	C	0	0	0	0	0	0	0					

		NC	20429	2662	154	2508	2250	258	90	0	No	4	No	Safe
		T	20429	2662	154	2508	2250	258	90	0	No	4	No	Safe
7	Thirumalgiri	C	0	0	0	0	0	0	0					
		NC	16550	2352	235	2117	2193	-76	104	-3	No	18	Yes	Over Exploited
		T	16887	2352	235	2117	2193	-76	104	-3	No	18	Yes	Over Exploited
8	Thungathurthi	C	0	0	0	0	0	0	0					
		NC	20286	2885	262	2623	1980	643	75	-3	No	18	Yes	Semi-Critical
		T	20696	2885	262	2623	1980	643	75	-3	No	18	Yes	Semi-Critical
9	Nuthankal	C	0	0	0	0	0	0	0					
		NC	20500	3372	235	3137	2166	971	69	-10	No	-7	No	Safe
		T	20500	3372	235	3137	2166	971	69	-10	No	-7	No	Safe
10	Atmakur (S)	C	0	0	0	0	0	0	0					
		NC	21360	3417	342	3075	2404	671	78	-10	No	-7	No	Safe
		T	21360	3417	342	3075	2404	671	78	-10	No	-7	No	Safe
11	Jajireddi Gudem	C	0	0	0	0	0	0	0					
		NC	19461	2960	296	2664	2843	-179	107	-3	No	18	Yes	Over Exploited
		T	19461	2960	296	2664	2843	-179	107	-3	No	18	Yes	Over Exploited
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
12	Sali Gouraram	C	0	0	0	0	0	0	0					
		NC	21540	3749	337	3412	2843	569	83	-64	No	-50	No	Safe
		T	21540	3749	337	3412	2843	569	83	-64	No	-50	No	Safe
13	Mothkur	C	0	0	0	0	0	0	0					
		NC	28692	4091	409	3682	2561	1121	70	-24	No	-22	No	Safe
		T	28692	4091	409	3682	2561	1121	70	-24	No	-22	No	Safe
14	Atmakur (M)	C	0	0	0	0	0	0	0					
		NC	23429	3017	302	2715	2005	710	74	-11	No	-7	No	Safe
		T	23429	3017	302	2715	2005	710	74	-11	No	-7	No	Safe
15	Valigonda	C	0	0	0	0	0	0	0					
		NC	29267	3706	200	3506	2602	904	74	14	Yes	-10	No	Semi-Critical
		T	29267	3706	200	3506	2602	904	74	14	Yes	-10	No	Semi-Critical
16	Bhongir	C	0	0	0	0	0	0	0					
		NC	24898	3579	352	3227	3038	189	94	13	Yes	-51	No	Semi-Critical
		T	24898	3579	352	3227	3038	189	94	13	Yes	-51	No	Semi-Critical
17	Bibinagar	C	0	0	0	0	0	0	0					
		NC	18384	2377	179	2198	1123	1075	51	-45	No	-39	No	Safe
		T	18384	2377	179	2198	1123	1075	51	-45	No	-39	No	Safe
18	Pochampalle	C	0	0	0	0	0	0	0					
		NC	18664	2265	113	2152	1180	972	55	-45	No	-39	No	Safe
		T	18664	2265	113	2152	1180	972	55	-45	No	-39	No	Safe
19	Choutuppal	C	0	0	0	0	0	0	0					
		NC	26335	3091	261	2830	1741	1089	62	-5	No	-24	No	Safe
		T	26365	3091	261	2830	1741	1089	62	-5	No	-24	No	Safe
20	Ramannapeta	C	0	0	0	0	0	0	0					
		NC	21148	2649	132	2517	1642	875	65	-1	No	-1	No	Safe
		T	21148	2649	132	2517	1642	875	65	-1	No	-1	No	Safe
21	Chityala	C	0	0	0	0	0	0	0					
		NC	23768	2697	234	2463	2067	396	84	-1	No	-9	No	Safe
		T	23768	2697	234	2463	2067	396	84	-1	No	-9	No	Safe
22	Narketpalle	C	0	0	0	0	0	0	0					
		NC	24349	3044	223	2821	2020	801	72	-1	No	-1	No	Safe
		T	24349	3044	223	2821	2020	801	72	-1	No	-1	No	Safe
23	Kattangoor	C	0	0	0	0	0	0	0					
		NC	19025	2672	262	2410	1842	568	76	-15	No	-18	No	Safe
		T	19025	2672	262	2410	1842	568	76	-15	No	-18	No	Safe
24	Nakrekal	C	0	0	0	0	0	0	0					
		NC	14889	2224	222	2002	2051	-49	102	27	Yes	-20	No	Over Exploited
		T	14889	2224	222	2002	2051	-49	102	27	Yes	-20	No	Over Exploited
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
25	Kethepalle	C	0	0	0	0	0	0	0					
		NC	14865	2516	252	2264	1751	513	77	27	Yes	-20	No	Semi-Critical
		T	14865	2516	252	2264	1751	513	77	27	Yes	-20	No	Semi-Critical
26	Suryapet	C	0	0	0	0	0	0	0					
		NC	20743	3547	355	3192	3277	-85	103	27	Yes	-47	No	Over Exploited
		T	20743	3547	355	3192	3277	-85	103	27	Yes	-47	No	Over Exploited
27	Chivvemla	C	0	0	0	0	0	0	0					
		NC	14867	2374	237	2137	1620	517	76	-1	No	-11	No	Safe
		T	14867	2374	237	2137	1620	517	76	-1	No	-11	No	Safe
28	Mothey	C	0	0	0	0	0	0	0					
		NC	18131	2802	280	2522	2464	58	98	12	Yes	-18	No	Semi-Critical

		T	18131	2802	280	2522	2464	58	98	12	Yes	-18	No	Semi-Critical
29	Nadigudem	C	10725	2165	206	1959	999	960	51	-16	No	-6	No	Safe
		NC	5522	795	72	723	359	364	50	-8	No	1	No	Safe
		T	16247	2960	278	2682	1358	1324	51	-13	No	-4	No	Safe
30	Munagala	C	7314	1654	99	1555	1512	43	97	10	Yes	2	No	Semi-Critical
		NC	8550	1141	114	1027	637	390	62	-12	No	-5	No	Safe
		T	15864	2795	213	2582	2149	433	83	-2	No	-2	No	Safe
31	Penpahad	C	1162	834	83	751	198	553	26	1	No	2	No	Safe
		NC	17385	2839	284	2555	1564	991	61	-12	No	-5	No	Safe
		T	18547	3673	367	3306	1762	1544	53	-11	No	-4	No	Safe
32	Vemulapalle	C	3933	1656	166	1490	769	721	52	-22	No	-16	No	Safe
		NC	16935	2742	274	2468	1870	598	76	-11	No	-14	No	Safe
		T	20868	4398	440	3958	2639	1319	67	-13	No	-15	No	Safe
33	Thipparthi	C	2961	1149	115	1034	650	384	63	-22	No	-16	No	Safe
		NC	22519	3089	309	2780	1961	819	71	-32	No	-24	No	Safe
		T	25480	4238	424	3814	2611	1203	68	-31	No	-23	No	Safe
34	Nalgonda	C	0	0	0	0	0	0	0					
		NC	37980	4439	347	4092	2931	1161	72	-27	No	13	Yes	Semi-Critical
		T	37980	4439	347	4092	2931	1161	72	-27	No	13	Yes	Semi-Critical
35	Munugode	C	0	0	0	0	0	0	0					
		NC	22250	2383	217	2166	2060	106	95	19	Yes	7	No	Semi-Critical
		T	22250	2383	217	2166	2060	106	95	19	Yes	7	No	Semi-Critical
36	Narayanapur	C	0	0	0	0	0	0	0					
		NC	25584	2605	260	2345	1710	635	73	19	Yes	7	No	Semi-Critical
		T	25584	2605	260	2345	1710	635	73	19	Yes	7	No	Semi-Critical
37	Marriguda	C	0	0	0	0	0	0	0					
		NC	22988	2480	248	2232	1385	847	62	-37	No	-63	No	Safe
		T	22988	2480	248	2232	1385	847	62	-37	No	-63	No	Safe
38	Chandur	C	0	0	0	0	0	0	0					
		NC	20082	2270	227	2043	1911	132	94	-79	No	22	Yes	Semi-Critical
		T	20082	2270	227	2043	1911	132	94	-79	No	22	Yes	Semi-Critical
39	Kanagal	C	0	0	0	0	0	0	0					
		NC	23356	2649	223	2426	2576	-150	106	-27	No	13	Yes	Over Exploited
		T	23356	2649	223	2426	2576	-150	106	-27	No	13	Yes	Over Exploited
40	Nidamanur	C	13150	3311	331	2980	941	2039	32	-24	No	1	No	Safe
		NC	12626	1560	156	1404	1256	148	89	-32	No	-24	No	Safe
		T	25776	4871	487	4384	2197	2187	50	-28	No	-11	No	Safe
41	Thripuraram	C	13829	3135	313	2822	589	2233	21	-34	No	-17	No	Safe
		NC	4326	557	56	501	292	209	58	-32	No	-24	No	Safe
		T	18155	3692	369	3323	881	2442	27	-34	No	-19	No	Safe
42	Miryalaguda	C	23265	6493	649	5844	1368	4476	23	-11	No	0	No	Safe
		NC	0	0	0	0	0	0	0					
		T	23265	6493	649	5844	1368	4476	23	-11	No	0	No	Safe
43	Garide Palle	C	17906	6472	647	5825	785	5040	13	-2	No	2	No	Safe
		NC	1148	89	4	85	54	31	64	-38	No	-29	No	Safe
		T	19054	6561	651	5910	839	5071	14	-5	No	0	No	Safe
44	Chilkur	C	11486	5975	589	5386	617	4769	11	-11	No	-7	No	Safe
		NC	0	0	0	0	0	0	0					
		T	11486	5975	589	5386	617	4769	11	-11	No	-7	No	Safe
45	Kodad	C	24252	8764	876	7888	1786	6102	23	-16	No	-6	No	Safe
		NC	0	0	0	0	0	0	0					
		T	24252	8764	876	7888	1786	6102	23	-16	No	-6	No	Safe
46	Mella Chervu	C	30393	12200	1220	10980	1215	9765	11	-2	No	2	No	Safe
		NC	2003	165	16	149	98	51	66	-38	No	-29	No	Safe
		T	32396	12365	1236	11129	1313	9816	12	-5	No	-5	No	Safe
47	Huzur Nagar	C	11047	4324	433	3891	1502	2389	39	0	No	-3	No	Safe
		NC	0	0	0	0	0	0	0					
		T	11047	4324	433	3891	1502	2389	39	0	No	-3	No	Safe
48	Mattapalle	C	12550	2126	213	1913	1154	759	60	-3	No	-9	No	Safe
		NC	5116	421	42	379	185	194	49	-38	No	-29	No	Safe
		T	17666	2547	255	2292	1339	953	58	-13	No	-15	No	Safe
49	Neredcherla	C	26059	14550	1455	13095	1988	11107	15	-13	No	-2	No	Safe
		NC	672	134	13	121	28	93	23	-5	No	2	No	Safe
		T	26731	14684	1468	13216	2016	11200	15	-13	No	-2	No	Safe
50	Dameracherla	C	32887	7828	783	7045	1906	5139	27	-34	No	-17	No	Safe
		NC	2108	149	15	134	42	92	31	-15	No	-23	No	Safe

		T	34995	7977	798	7179	1948	5231	27	-33	No	-17	No	Safe
51	Anumula	C	19229	3436	344	3092	716	2376	23	-18	No	-6	No	Safe
		NC	14298	1545	129	1416	934	482	66	-14	No	-33	No	Safe
		T	33527	4981	473	4508	1650	2858	37	-17	No	-16	No	Safe
52	Peddavuru	C	0	0	0	0	0	0	0					
		NC	46172	4026	403	3623	2276	1347	63	-15	No	-22	No	Safe
		T	46172	4026	403	3623	2276	1347	63	-15	No	-22	No	Safe
53	Pedda Adiserla Palle	C	0	0	0	0	0	0	0					
		NC	31171	3075	308	2767	2015	752	73	-13	No	-32	No	Safe
		T	31171	3075	308	2767	2015	752	73	-13	No	-32	No	Safe
54	Gurram Pode	C	0	0	0	0	0	0	0					
		NC	30737	3126	313	2813	2050	763	73	-72	No	-74	No	Safe
		T	30737	3126	313	2813	2050	763	73	-72	No	-74	No	Safe
55	Nampalle	C	0	0	0	0	0	0	0					
		NC	26995	2845	285	2560	2131	429	83	-6	No	-33	No	Safe
		T	26995	2845	285	2560	2131	429	83	-6	No	-33	No	Safe
56	Chintha Palle	C	0	0	0	0	0	0	0					
		NC	27311	2580	233	2347	1415	932	60	-6	No	-33	No	Safe
		T	27311	2580	233	2347	1415	932	60	-6	No	-33	No	Safe
57	Devarakonda	C	0	0	0	0	0	0	0					
		NC	34883	3371	249	3122	1935	1187	62	-6	No	-53	No	Safe
		T	34883	3371	249	3122	1935	1187	62	-6	No	-53	No	Safe
58	Gundla Palle	C	0	0	0	0	0	0	0					
		NC	26489	2301	230	2071	1741	330	84	-36	No	-51	No	Safe
		T	26489	2301	230	2071	1741	330	84	-36	No	-51	No	Safe
59	Chandampet	C	0	0	0	0	0	0	0					
		NC	48035	3365	336	3029	1847	1182	61	-32	No	-58	No	Safe
		T	48035	3365	336	3029	1847	1182	61	-32	No	-58	No	Safe
	District Total	C	262148	86072	8522	77550	18695	58855	24	NA	NA	NA	NA	Safe
		NC	1116900	136852	12293	124559	94723	29836	76	NA	NA	NA	NA	Semi-Critical
		T	1379795	222924	20815	202109	113418	88691	56	NA	NA	NA	NA	Safe

C = Command; NC = Non-command; T = Total

7.0 GROUND WATER QUALITY

In general, the ground water in the district found to be suitable for domestic and irrigation purpose. The range of chemical constituents in ground water is furnished in the Table-4. The distribution of electrical conductivity in ground water is shown in the Fig.8.

Table-4 Range of chemical constituents in ground water – Nalgonda district

Chemical Parameters	Shallow aquifers	Deeper aquifers
Electrical conductivity	740 to 5300 micro Siemen/cm at 25° C	135 to 7390 micro Siemen/cm at 25° C
Fluoride	0.23 to 4.6 milligram/litre	0.200 to 4.380 milligram/litre.
SAR	SAR values are within permissible limit (less than 18)	The SAR values more than MPL was found only at Rajavaram
RSC	RSC values are within permissible limit. (less than 1.25)	77 % samples are within permissible limit. 23 % of samples are have beyond 2.50

Fig.-8 Distribution of Electrical Conductivity in Ground Water

Nalgonda District (May 2011)

8.0 STATUS OF GROUND WATER DEVELOPMENT

Large diameter dug wells either of rectangular or circular shape, are found in the district for irrigation purpose. The depth of the dug wells varies from 8 to 15 m bgl in non-command area, but most of the wells are dried up during summer. These wells have 1-2m water column, which would sustain pumping for 2-4 hrs. in two spells a day, by 5 H.P motor. The yield of the wells varies from 100 to 200 cu.m/day during post-monsoon period.The depth of bore wells vary between 40 and 60 m in non-command area, whose discharge would be 2 to 5 lps, with drawdown of 6-10m for a pumping of 6 hours. The depth of dug wells in command area varies from 8-10m with yields 75-200 cu.m/day.

The total gross area irrigated by various sources in 2009-10 stood at 353422 ha, out of which the area irrigated by ground water resources was 256426 ha, which constitutes 72.56 % to total gross irrigated area, whereas the area under surface water irrigation was 96594 Ha, which accounts for 27.33 % to gross irrigated area. Ground water plays a predominant role in the net irrigated area by constituting to 72.72 %, whereas surface water irrigation accounts for 27.20 % out of the total net irrigated area of 264766 Ha. Out of total geographical area (1424000 ha), the total gross irrigated area was 353422 ha (i.e. 24.82 %) and the total net irrigated area was 264766 ha (18.59 %). This indicates that the irrigation is mainly due to groundwater development.

In 2008-09, the groundwater utilization in command area and in non-command area of the district was 186.95 MCM and 147.23 MCM respectively. Overall the district falls under safe category with stage of development being at 56%. The stage of development in command area is 24% (safe) and in non-command area, it is 76% (semi-critical category). With respect to stage of development, 44 mandals are found to be safe, 10 semi-critical and 5 mandals viz., Thirumalgiri (104%), Jajireddi Gudem (107%), Nakrekal (102%), Suryapet (103%) and Kanagal (106%) are in over-

exploited category.

9.0 GROUND WATER MANAGEMENT STRATEGY

Ever-declining ground water levels as a result of frequent dry spells and indiscreet sinking of bore wells, the ground water resources have been depleting and pushing the ground water scenario to the point of no return. In order to arrest the grave situation an effective groundwater management strategy shall be evolved in such a way that there is an optimal utilization of ground water resources maintaining the well spacing norms. Spacing norm for two adjacent bore wells in crystalline rocks is 250 m.

78 Villages were identified as Over Exploited by APWALTA-2002 and were proposed for notification in Nalgonda District, where ground water development is to be restricted. As per the stage of development, the 5 mandals viz., Thirumalgiri (104%), Jajireddi Gudem (107%), Nakrekal (102%), Suryapet (103%) and Kanagal (106%) have been categorized as over-exploited category, leaving no room for further groundwater exploitation. However, to augment the depleting groundwater resources artificial recharge may be implemented on urgent basis. Cropping pattern to harvest less water consuming crops like jowar, bajra, maize etc are to be practised instead of harvesting more water consuming crops like paddy, sugarcane etc. Alternative modern irrigation methods like drip irrigation, sprinkler irrigation are to be encouraged to sustain the existing ground water extraction structures.

The district has considerable command area spreading over 16 mandals and as many mandals are falling under safe category with a ground water balance of 886.91 MCM for development. In command area, the ground water development may be taken up by utilising ground water in conjunction with surface water for construction of shallow bore wells in order to enhance irrigation potential, reduce water logging conditions and to improve ground water quality as well. The farmers in the tail end areas of canal ayacut will also be benefited to a large extent if the ground water development is encouraged in the canal head reaches. This will satisfy the equitable distribution of water resources to the farmers in the command area.

The indiscreet ‘trend’ of sinking bore wells needs to arrested through administrative measures or even legal measures which are already existing in APWALTA Act. But, much effort has to be made in bringing awareness among public/farmers to desist from the present trend and follow the scientific guidelines through the designated departments.

9.1 Ground Water Development

Further groundwater development in the district should be restricted to the command area, by constructing dug wells of 10 to 15 m depth with radius of about 5m or shallow borewells of 165 mm dia. down to a depth of 30 to 40 m in the areas having water levels less than 5m below ground level. The selection of bore well site shall be made consciously based on geophysical and hydrogeological studies.

9.2 Water Conservation and Artificial Recharge

For ground water conservation and artificial recharge, number of structures have been constructed since 1995 by District Water Management Agency in a big way in the district under DPAP, IWDP, RIDF, APRLP, EAS, NEERU MEERU and other programmes in the non-command area. The forest department also carried out and contour trenching works.

The artificial recharge structures must be taken up in non-command area, particularly in the over exploited mandals for the benefit of farmers. As per the geomorphic conditions prevailing, the most suitable recharge structure is percolation tanks. In addition, check dams, gully controls and bunding may be taken up where considerable gradient and length of slope is available. All the works have to be on watershed basis, after careful study of the micro-basin parameters, surface run off and after meeting the needs of the existing structures. Roof top harvesting in urban and rural areas should be made mandatory to enhance groundwater recharge.

10.0 CONCLUSIONS

In non-command area, where further development of groundwater is possible it is mandatory for the farmers to take professional advice regarding selection of bore well sites and depth of well on geophysical and hydro-geological studies.

I. Groundwater conservation and artificial recharge structures are needed to be taken up, based on scientific lines, to arrest surface run off in order to enhance the groundwater storage so as to make the existing bore wells sustainable.

II. The spacing norms of 250m distance between two adjacent bore wells shall be observed

III. In the command area, especially in headwater reaches, conjunctive use of groundwater and surface water are to be encouraged for irrigation purpose to enhance yield potential and at the same time improving the water quality and minimizing the water logging threat. The tail-end farmers are also benefited with more canal supply, fulfilling the concept of equitable distribution.

IV. The authorities for optimum use of surface and groundwater are to be adopted watershed wise water management plans.

V. Mass awareness programmes are to be must widely conducted on regular basis in the ‘rural’ areas to educate the farmers regarding the water management to update their knowledge. Training for local government functionaries, NGOs, voluntary organizations engaged in watershed development activity are to be trained in scientific techniques in the selection of sites, design of structures, etc. for construction of rainwater harvesting and artificial recharge structures.

VI The area having F concentration more than permissible limit, are to be provided fluoride filtered water in subsidized rate by installing filter plants at different localities by providing financial support from Government.

VII. There should be a complete institutional credit cover to the small and marginal farmers for drilling deep bore wells in the scientifically identified ground water potential zones, for procuring water saving equipment like drip and sprinkler systems, etc.

VIII. In order to impart education to the farmers, regarding the cropping pattern, hybrid varieties, pesticides, irrigation techniques etc., 'Agri-clinics' are to be established in rural areas for every five villages in non-command areas.

Acknowledgements:

The author expresses his gratitude to G. Sudarshan, RD (I/C) for providing an opportunity and valuable guidance for preparing the brochure. The Author also expresses his deep gratitude to Dr. P. N. Rao, Scientist-D for providing necessary facilities during various stages of preparation of this brochure. The data provided by the State Ground Water Department, Panchayat Raj Department, Agriculture Department, Irrigation Department, District Water Management Agency and Directorate of Economics & Statistics, Govt. of Andhra Pradesh, for preparation of the report, is gratefully acknowledged.