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भारत सरकार
जल संसाधन मंत्रालय
केंद्रीय भूजल बोर्ड

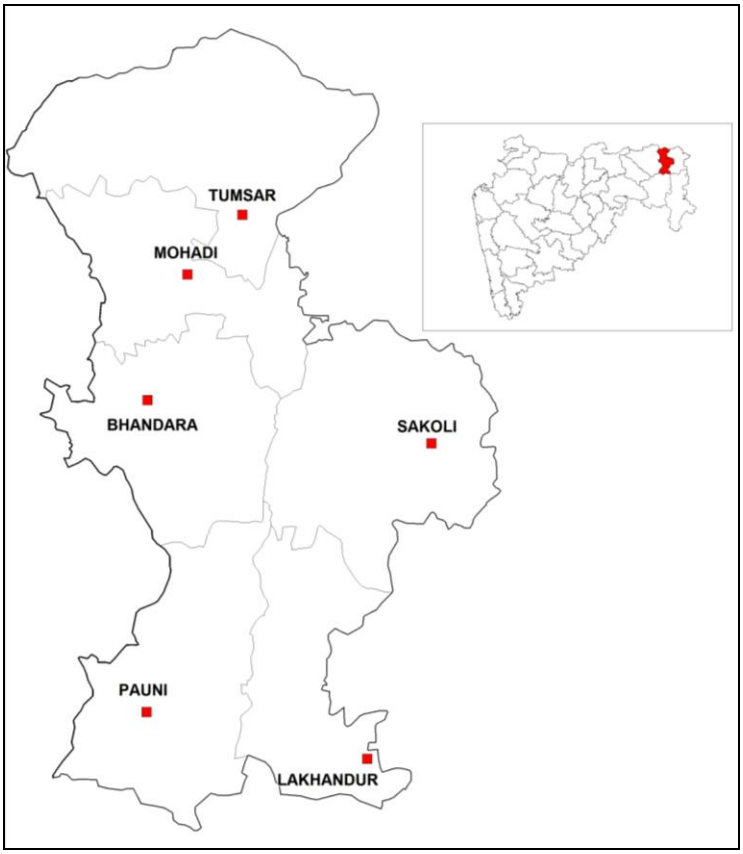
GOVT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

महाराष्ट्र राज्य के अंतर्गत भंडारा जिले की

भूजल विज्ञान जानकारी

GROUND WATER INFORMATION

BHANDARA DISTRICT
MAHARASHTRA



By
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द्वारा
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मध्य क्षेत्र, नागपुर
CENTRAL REGION
NAGPUR
2013

BHANDARA DISTRICT AT A GLANCE

1.	**GENERAL INFORMATION**		
	Geographical Area	:	3716.65 sq. km.
	Administrative Divisions (As on 31/03/2011)	:	Taluka- 7, Bhandara, Mohadi, Tumsar, Lakhni, Sakoli, Pauni, Lakhandur
	Villages	:	870
	Population (2011)	:	1198810
	Normal Annual Rainfall		1250 to 1500 mm
2.	**GEOMORPHOLOGY**		
	Major Physiographic unit	:	Two; Structural units like hills and ridges, denudational units like pediments and fluvial units
	Major Drainage	:	One: Wainganga River and its tributaries like Bagh, Chulbandh, Panghodi Suz, Gadhavi, Chandan, Bavanthadi
3.	**LAND USE (2010-11)**		
	Forest Area	:	645.58 sq.km
	Cultivable Area	:	1924.97 sq.km
	Net Area Sown	:	1713.35 sq.km
4.	**SOIL TYPE**	:	Rich alluvial soils occur widely. They are clayey loamy in texture, very deep, sticky and retentive of moisture.
5.	**PRINCIPAL CROPS (2010-11)**		
	Rice	:	1718.63 sq. km.
	Total Pulses	:	292.13 sq. km.
	Total Oil Seeds	:	109.29 sq. km.
	Wheat	:	106.32
6.	**IRRIGATION BY DIFFERENT SOURCES (2006-07) (No.'s/ Potential Created in ha)**		
	Dugwells	:	9480/13480
	Borewells	:	308/485
	Tanks or Ponds	:	2505/67146
	Other Minor Surface Sources	:	491/2835
	Area under Surface water irrigation	:	70610
	Area under Ground water irrigation	:	20814
7.	**GROUND WATER MONITORING WELLS (May-2011)**		
	Dugwells	:	28
	Piezometers	:	2
8.	**GEOLOGY**		
	Age		Formation
	Recent	:	Alluvium and Laterite
	Proterozoic (Vindhyan, Dongargarh, Sausar and Sakoli Super Group)		Quartzite and Shale; Andesite, Sandstone granite, Rhyolite; Muscovite-biotite-schist, Granite, Tirodi Gneiss; Schist, Phyllites, Quartzite;
	Archeans (Amgaon Super Group)	:	Granite & Gneisses.
9.	**HYDROGEOLOGY**		
	Water Bearing Formation	:	Weathered Granite and Gneisses

	Pre-monsoon Depth to Water Level	:	1.80 to 15.80 m bgl (May-2011))
	Post-monsoon Depth to Water Level)	:	0.70 to 18.00 m bgl (Nov-2011)
	Pre-monsoon Water Level Trend (2001-2010)	:	Rise: 0.0026 to 0.4371 m/year Fall: 0.0294 to 0.5208 m/year
	Post-monsoon water level trend (2001-2011)	:	Rise: 0.0001 to 0.3710 m/year Fall: 0.0007 to 0.4228 m/year
10.	**GROUND WATER EXPLORATION (March 2011)**		
	Wells Drilled	:	EW- 19, OW-8,
	Depth Range	:	55.15 to 222.23 m bgl
	Discharge	:	2.50 to 8.98 lps
	Storativity	:	1.5×10^{-4} to 8.70×10^{-4}
	Transmissivity	:	10.43 to 59.54
	Aquifers Tapped	:	Weathered Granites and Gneisses
11.	**GROUND WATER QUALITY (May 2011)**		
	EC (µS/cm)	:	250-2500
	Cl (ppm)	:	-
	F (ppm)	:	0.03-0.72
	NO_3 (ppm)	:	0.1 - 190
	Type of Water	:	Ca-Cl and Ca-HCO_3
	General Water Quality	:	Suitable for both drinking and irrigation purposes.
12.	**DYNAMIC GROUND WATER RESOURCES (March 2009)**		
	Net Annual Ground Water Availability	:	856.03 MCM
	Annual Ground Water Draft (Irrigation+Domestic)	:	141.17 MCM
	Allocation for Domestic and Industrial requirement up to next 25 years	:	39.34 MCM
	Stage of Ground Water Development	:	28.12 %
13. AWARENESS AND TRAINING ACTIVITY			
	Mass Awareness Programme (MAP)	:	One
	a. Date	:	13/03/2003
	b. Place	:	Warthi
	c. Participants	:	350
	Water Management Training Programme (WMTP)	:	Nil
14	**MAJOR GROUND WATER PROBLEMS AND ISSUES**		
	Falling water level trends are observed in almost entire Tumsar, Mohadi, Bhandara and Pauni talukas and major parts of Sakoli and Lakhandur talukas.		

Ground Water Information
Bhandara District

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Ground Water Information
Bhandara District

1.0 Introduction

The district comes under Nagpur division (Vidarbha) in Maharashtra State. It is newly formed district and carved out by the division of Bhandara district in May 1999. The Bhandara district as well as its offshoot district i.e., Gondia district is unique in Maharashtra and differs from the rest of the State in the following three ways.

I. The entire area of the district is underlain by crystalline rocks while rest of the State is covered by Deccan Trap basalt;
II. The district is essentially a rice-growing area, while wheat is the major crop over rest of the State;
III. It is endowed with the presence of large number of irrigation tanks known as 'Malguzari Tanks'.

Bhandara district is situated on North-Eastern side of Maharashtra State and share the State border with Madhya Pradesh. It covers an area of about 3717 sq.km and lies between 20°.38' and 21°.36' North latitudes and 79°27' to 80°.06' east longitudes. The adjoining districts are Gondia on eastern side, on northern side Balaghat district of Madhya Pradesh on western side Nagpur district and to the south is Chandrapur district.

The total population of the district is about 1198810 and the population density is about 322 souls per sq.km as per 2001 census. The literacy rate of district is approximately 67.67%. Basically district is divided into seven talukas namely Bhandara, Mohadi, Tumsar, Lakhani, Sakoli, Pauni and Lakhandur.

The district falls under the Wainganga basin with Wainganga River being the main River with tributaries like Bavanthadi, Chulbandh, Godora and Sun Rivers. A list of studies conducted in different parts of the district is presented in Table-1. A map of the district showing the taluka boundaries, taluka headquarters and locations of monitoring wells is presented as Figure-

1.

Table 1: Studies undertaken by CGWB (March 2007).

S. No.	Year	Surveyed area	Work done
1.	1986-87	Covering parts of Toposheet No's 55 O/16 & 55 P/13	Systematic Hydrogeological Survey
2.	1987-88	Site Selection for Rural Water Supply in Bhandara district.	Drought Relief Work in Maharashtra
3.	1991-92	Wainganga Basin, Bhandara district,	Reappraisal Hydrogeological Surveys

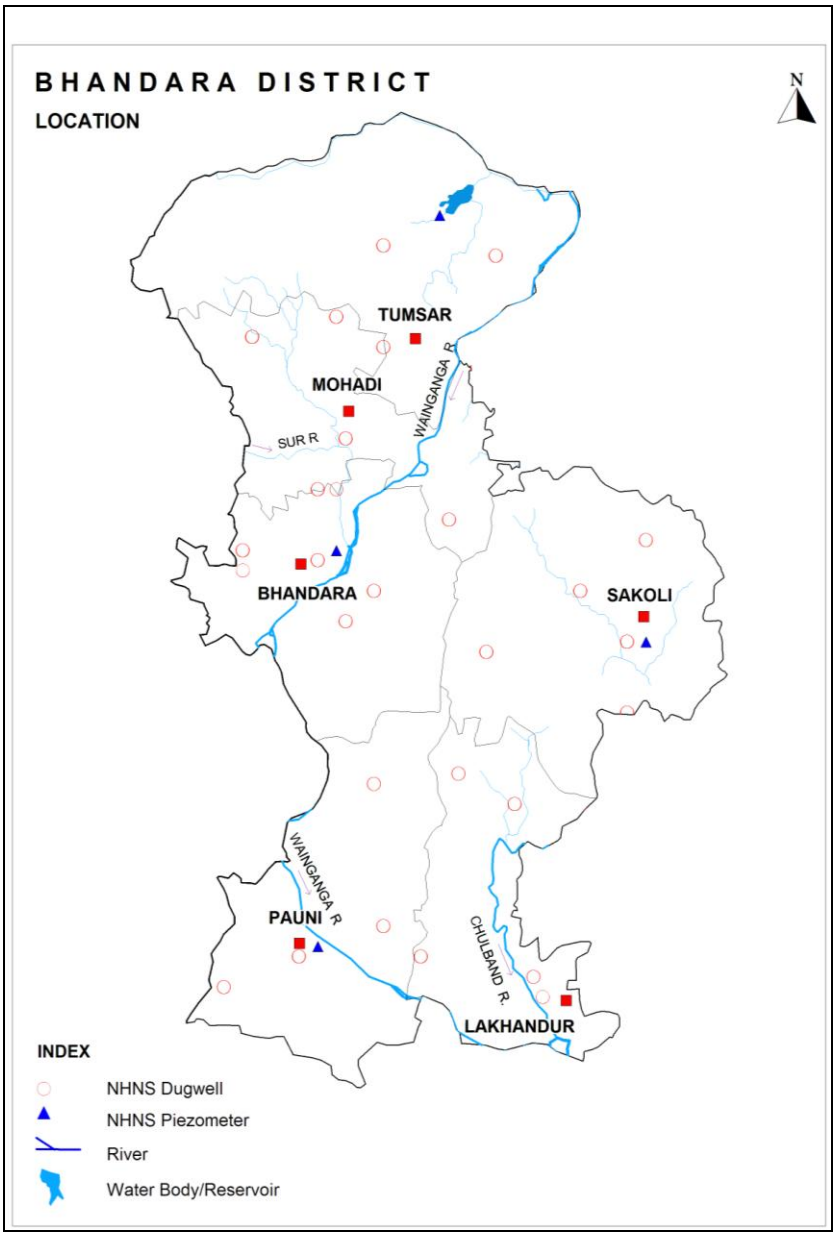

Figure-1: Location

Apart from above studies, the CGWB has also taken up 'Ground Water Exploration Programme' in the district. The exploratory drilling programme in the Bhandara district started in the year 1991-92 and a total of 19 exploratory wells and 8 observation wells have been drilled in the district over an area of 3716.65 Sq.km tapping weathered granites and gneisses. The drilling was carried out by a DTH Rig. The drilling was carried out down to depths of 55.15 to 222.23 m.bgl. The water-bearing zones were taped totalling to a thickness varying from 1 to 10 m. The shallowest zone was struck at 24.40 m bgl while the deepest zone at 154.00 m bgl. The static water level ranged from 3.75 to 12.10 m bgl. The yields range from 2.50 to 8.98 lps with four exploratory wells having yields of more than 3 lps. The transmissivity of these wells ranged from 10.43 to 59.54 m^2/day while the Storativity from 1.5×10^{-4} to 8.70×10^{-4}. The specific capacities of these tube wells ranged from 0.26 to 0.59 lpm/m of drawdown for discharge of discharge of 2.49 to 12.00 lps. The salient features of ground water exploration are given in **Table-2**.

Table 2: Salient Features of Ground Water Exploration (March 2011).

S. No.	Salient Features	Details
1	No. of exploratory wells drilled	EW-19, OW-8
2	Depth range (m.bgl)	55.15 to 222.23
3	Depth Range of zones encountered	24.40 to 154.00
4	Thickness of individual zone (m)	1 to 10
6	SWL range (m.bgl)	3.75 to 12.10
6	Yield range (lps)	2.50 to 8.98
7	No./ % of boreholes with yield more than 3 lps	4/27%
8	Formation	Weathered Granites and Gneisses
9	Transmissivity (m^2/day)	10.43 to 59.54
10	Storativity	1.5×10^{-4} to 8.70×10^{-4}

2.0 Climate and Rainfall

The climate of the district is characterized by a hot summer and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. The mean minimum temperature is 6°C and mean maximum temperature is 45°C.

The normal annual rainfall in the district ranges from 1250 to 1500 mm. The rain fall generally increases from the west towards the east and from

north to south. It is minimum in the northern part of the district around Tumsar and Chandpur and increases westwards and south wards and is maximum around Lakhani. The south-west monsoon arrives over the district by about the second week of June. The rainfall during the period from June to September constitutes about 90 percent of the annual normal rainfall. July and August are the months with heavy rainfall, July being the rainiest month. The variation in the annual rainfall from year to year is small.

The average annual rainfall for the period 2002 to 2011 varies from 1064.8 mm (Mohadi) to 1312.8 mm (Bhandara) and the same is presented in Table-3. Thus it is observed that the average rainfall in the district during the period has decreased as compared to normal rainfall.

Table 3: Annual Rainfall Data (2002-2010).

Taluka	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
Bhandara	1707.3	2171.5	1184.2	1601.5	1076.4	1062.0	1049.9	932.3	1349.5	994.0	1312.8
Lakhandur	1311.3	1147.0	833.2	1530.2	1148.2	1502.0	866.48	1085.8	1619.5	1438.1	1248.7
Lakhani	624.3	1544.8	586.6	1402.2	695.0	1572.3	1032.9	1119.1	1926.4	1072.8	1157.6
Mohadi	1173.4	976.1	654.1	1855.5	871.5	1111.8	928.8	831.7	1271.6	973.7	1064.8
Pauni	1005.9	1138.6	726.9	1488.8	1060.1	1537.0	884.58	906.5	1680.5	1222.7	1165.1
Sakoli	1341.3	1542.8	845.6	1583.6	1264.1	1313.0	907.3	1034.9	1733.0	1234.2	1279.9
Tumsar	1061.2	1227.9	525.3	1899.4	1106.0	1092.6	945.5	972.6	1331.3	854.8	1101.6

3.0 Geomorphology and Soil Types

3.1 Geomorphology

The district forms part of Wainganga sub-basin and has an undulating terrain with elevations ranging from 263 to 315 m amsl. Physiographically, the district can be broadly divided into two units viz; the one controlled by structural features i.e. the structural origin and the other controlled by differential weathering i.e. the denudation origin. The structural hills and ridges are more common in the eastern and southern parts of the district, while the denudational features like pediments/pediplains are seen in north-central, west central and south-west portions.

3.2 Soil

The soils of the district are varied, arising out of the tropical sub-humid weathering of crystalline metamorphic and igneous rocks. They are essentially residual, though along the southern extremes of the Wainganga valley, downstream of Pauni, alluvial soils predominate.

Kali or black regur soils derived from the weathering of basalts are generally rare in the district. Kanhar or very rich alluvial soils occur widely; these soils crumble readily and are easy to work. They are clayey loams in texture, very deep, sticky and retentive of moisture; they bear double crops. Morand soils are coarser in texture and occur farther away from the rivers, in relatively higher ground in comparison to the Kanhar soils. They generally have an admixture of sands or lime or both.

The Khardi soils are dark in colour with a considerable admixture of lime; they are generally and shallow. They are poor soils. The Sihar, is a reddish yellow soil derived from crystalline rocks as a result of oxidation under tropical humid conditions and cracks very little in the hot weather. It degrades into the Khardi.

Most of the cultivable soils of the district belong to the Morand and Sihar types, both of which are light and slightly acidic. The Sihar are the best rice soils of the district while the Morand soils are devoted to rabi crops like wheat and linseed and kharif jowar. Poor lateritic Bardi soils are found in foothills and sloping areas. Along the immediate banks of rivers, black Kachhar soils, reddish and sandy Marhani soils, and sandy Retari soils are found; these soils are mostly immature. The Marhani soils are devoted to garden crops.

4.0 Ground Water Scenario

4.1 Hydrogeology

Bhandara district is unique in Maharashtra in the sense that the entire area of the district is occupied by metamorphic and igneous rocks. The district is underlain by various types of rock formations from the oldest Granites and Gneiss of the Precambrian to the Recent Alluvium. A map depicting the hydrogeological features is shown in Figure-2.

4.1.1 Hard Rock Areas

4.1.1.1 Archeans

The granites and gneiss are found along a wide NE-SW tract in the north central part of the district, just north of Bhandara town. The gneiss comprises biotite-hornblende gneiss, amphibolites, granulites and migmatite. The biotite gneiss is often referred to as Tirodi gneiss. It is composite in character and forms the basement for younger metamorphosed sedimentary rocks.

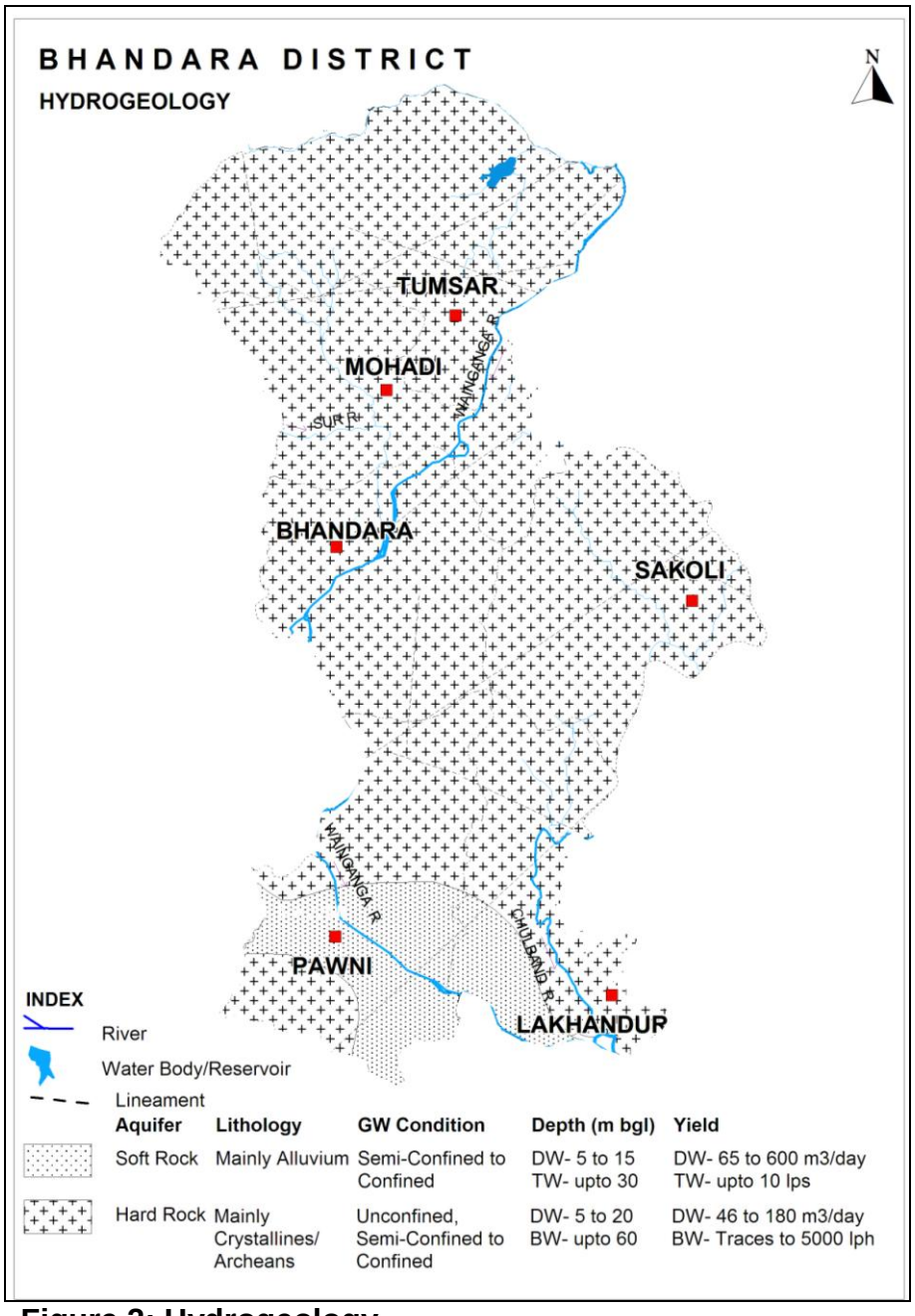

Figure 2: Hydrogeology

4.1.1.2 Dharwars

The calc-granulites, mica and hornblende schist's with associated quartzite's form the Sausar Group. This is predominant in the north-eastern side of the district, occupying northern part of Tumsar taluka. The other dominant group of Meta sediments is termed as Sakoli Group and forms an important suite of rocks consisting mainly of low grade metamorphics such as phyllites, chlorite schist and quartzite's. The outcrop of these rocks has a triangular shape, known as 'Bhandara triangle', with its apex near Gondia and its base stretching in the SE-SW direction occupying major points of Bhandara, Lakhani, Sakoli and Lakhandur talukas.

4.1.1.3 Vindhyans

A small occurrence of Vindhyan formation is seen in the extreme southern part of the district in parts of Pawni taluka. This formation consists of hard and compact quartizitic sandstone.

4.1.2 Soft Rock Areas

4.1.2.1Gondwanas

Lower Gondwana sediments belonging to Kamthi Group are exposed in a narrow outcrop in the southern part of the district in parts of Lakhandur taluka at its border with Chandrapur district. These are composed of conglomerate, sandstone, shale and clay.

4.1.2.2 Alluvium

Adjoining the course of Wainganga River and Chulbhand River, a number of patches of Alluvium are found with an areal extent ranging from 20 to 50 sq.km, the largest of which has an extent of 300 sq.km occupying major parts of Pawni taluka. The thickness of alluvium varies from 6 to 30 m.

4.1.3 Ground Water Occurrence

The Pre-Cambrian crystalline rocks are the major water bearing formations in the district. The weathered portions of crystalline rocks together with joints and fracture zones act as good aquifers. Ground water occurs under water table conditions in the weathered mantle and then in the fractured, well-jointed and sheared zones. Dugwells, dug cum borewells and bore wells are the common ground water abstraction structures. Ground water occurs under water table conditions and semi-confined to conditions in these formations. Water table conditions prevail in the weathered mantle and the

fractures, jointed and sheared zones. At places where the argillaceous litho-units like phyllites and mica schist's act as a confining medium, the ground water is found to occur under semi-confined conditions.

In Gondwana, ground water occurs in the weathered mantle and the fairly well-jointed portions of these rocks which comprise pink coloured argillaceous quartzitic sandstones and carbonaceous shales. The weathered mantle constitutes a better aquifer in view of its high degree of porosity.

Ground water occurs under water table conditions or phreatic condition in the weathered mantle and the joints and fractures of the country rock. It occurs under semi-confined state in the area where carbonaceous shale form aquicludes. It also occurs in the porous material of the sandstones.

In the alluvium bordering major rivers especially the Wainganga, ground water occurs in the sand and gravel, present in the lower horizons. The upper horizon mainly consists of clay and fine silt. Ground water occurs in the alluvium under phreatic semi-confined conditions in the inter-granular pore spaces of sand and gravel.

4.1.4 Water Level Scenario

Central Ground Water Board periodically monitors 28 Ground Water Monitoring Stations (GWMS) stations in the district four times a year i.e. during January, May (Pre-monsoon), August and November (Post-monsoon). The same is discussed below.

4.1.4.1 Premonsoon Depth to Water Level (May-2011)

The depth to water level in the district during May 2011 ranges between 1.80 (Varti) and 15.80 m bgl (Ajgaon). Depth to water level during premonsoon (May 2011) has been depicted in Figure-3. Shallow water levels in the range of 5 to 10 m bgl are seen in major part of the district, i.e., in major parts of Tumsar, Mohadi, Bhandara, Pauni and Lakhandur taluks. Deep water levels in the range of 10 to 20 m bgl are observed in major parts of Sakoli and Pauni talukas.

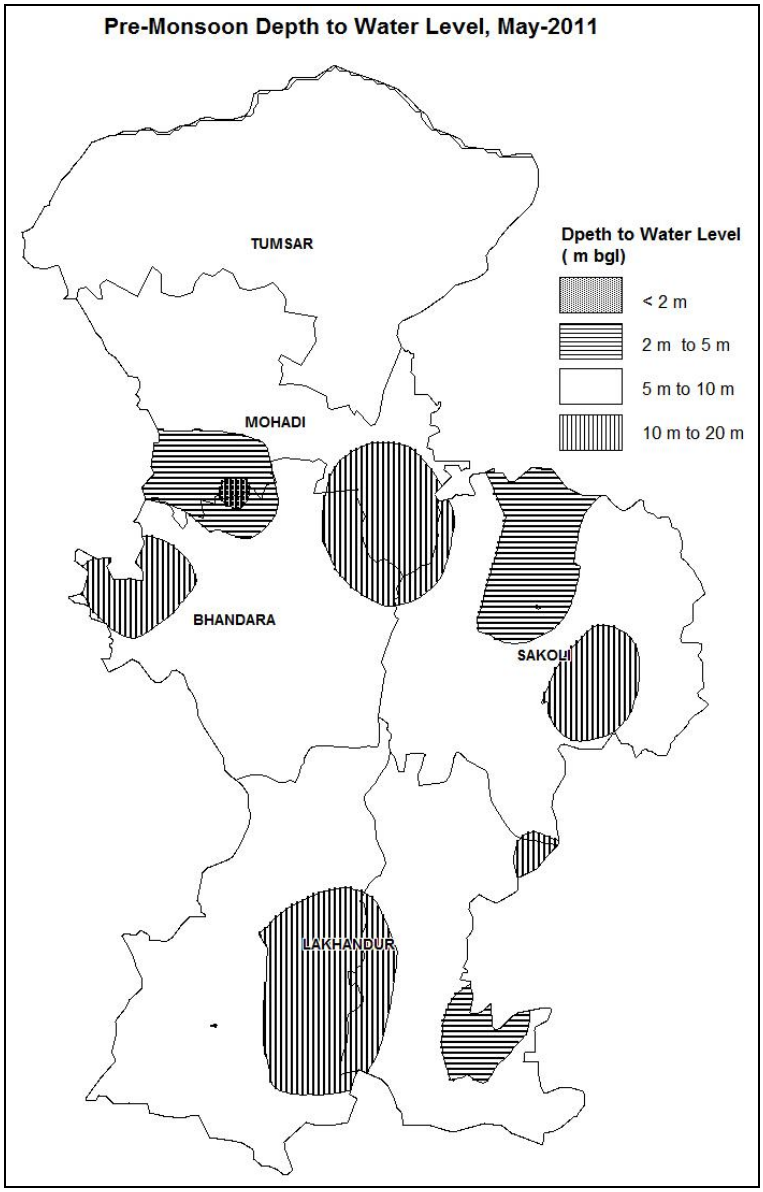

Figure-3: Premonsoon Depth to Water Level (May 2011)

4.1.4.2 Depth to Water Level – Postmonsoon (Nov.-2011)

The depth to water level during postmonsoon (Nov. 2011) ranges between 0.7 m bgl (Ajgaon) and 18.0 m bgl (Ekodi). Spatial variation in post-monsoon depth to water level is shown in Figure-4. Shallow water levels upto 5 m bgl occupy almost entire district. Water levels between 5 and 10 m bgl are observed in central and south central part of the district, covering parts of Bhandara, Sakoli, Pauni and Lakhandur talukas. Deeper water levels between 10 and 20 m are seen in parts of Pauni taluka.

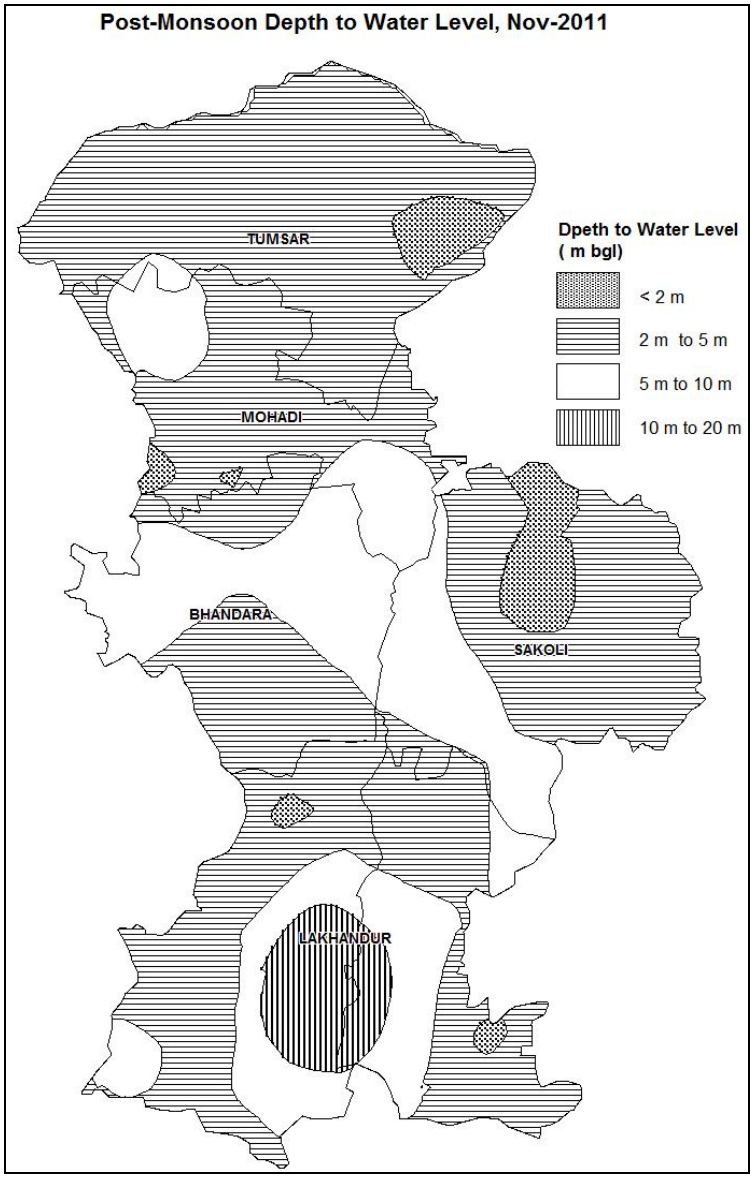

Figure-4: Depth to Water Level (Postmonsoon- Nov. 2011)

4.1.4.3 Seasonal Water Level Fluctuation– (May-Nov. 2011)

The water level fluctuation in district varies from 0.20 to 9.76 m. Major part of the district are showing fluctuation of more than 4 m in northern, eastern and south central parts occupying parts of Tumsar, Mohadi, Bhandara, Sakoli, Lakhandur and Pauni talukas. The next dominant range is 2 to 4 m fluctuation in parts of Mohadi, Bhandara, Sakoli and Pauni talukas, whereas fluctuation of 0 to -2 m is observed in small parts of Mohadi, Lakhandur and Pauni talukas.

4.1.4.4 Water Level Trend (2001-2010)

Trend of water levels for premonsoon and postmonsoon period for last ten years (2001-2010) have been computed for 28 GWMS.

The analysis of trend indicates that during pre-monsoon period, rise in water level has been recorded at 11stations and it ranges between .0026 m/year (Ekodi) and 0.4371 m/year (Siroha). Fall in water level has been observed at 17 stations and it ranges between 0.0294 at Bhandara and 0.5208 m/year at Kharbi. During post-monsoon period, rise in water levels has been recorded at 14 stations and it ranges from 0.0001 m/year (Bhandara) to 0.3710 m/year (Sakoli), whereas at 14 stations, fall in water level ranging between 0.0007 m/year (Tumsarkhapa) and 0.4228m/year (Chicholi)) is observed.

4.2 Yield of Wells

The yields of wells are functions of the permeability and transmissivity of aquifer encountered and vary with location, diameter and depth etc. There are mainly two type of ground water structures i.e., dugwells and borewells in the district. Yields of dugwells vary according to the nature of formations tapped. The dugwells in Crystalline/Achaeans yield between 46 and 180 m^3/day for drawdown of 0.20 to 5.63 m. In Alluvium, the yield of dugwells is observed between 65 and 600 m^3/day for drawdown of 0.20 to 1.15 m. In exploratory wells drilled by CGWB the yield ranges from 2.50 to 8.98 lps. The borewells drilled by GSDA yield between 2000 and 5000 lph. It has been observed that the borewells drilled in granitic gneisses are more productive than drilled in Schist's/ Quartzite's.

4.3 Aquifer Parameters

Based on pumping tests conducted on exploratory wells, it is observed that in crystalline rocks the transmissivity ranges from 10.43 to 9.54 m^2/day and the storativity ranges from 1.5×10^{-4} to 8.7×10^{-4}.

4.4 Ground Water Resources

Based on GEC-97 methodology, Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the dynamic ground water resources of Bhandara district as on 2008-2009. The same are presented in **Table-4**, whereas the graphical representations of the resources on the map are shown in **Figure-5**. Ground water resources assessment was done for 3964.97 sq.km, area out of which 987.15 sq.km. is under command and 2977.82 sq.km is non-command.

As per the estimation, the net annual ground water availability comes to

be 856.03 MCM. The total annual ground water draft for all uses is estimated at 141.17 MCM with irrigation sector being the major consumer having a draft of 121.49 MCM. The allocation for domestic and industrial uses upto 2025 years is worked out at 39.34 MCM. The ground water availability for future irrigation is estimated at 345.21 MCM.

The stage of ground water development varies from 15.85 % (Bhandara) to 51.05 % (Pauni). The overall stage of ground water development for the district is 28.12% and falls in “Safe” category.

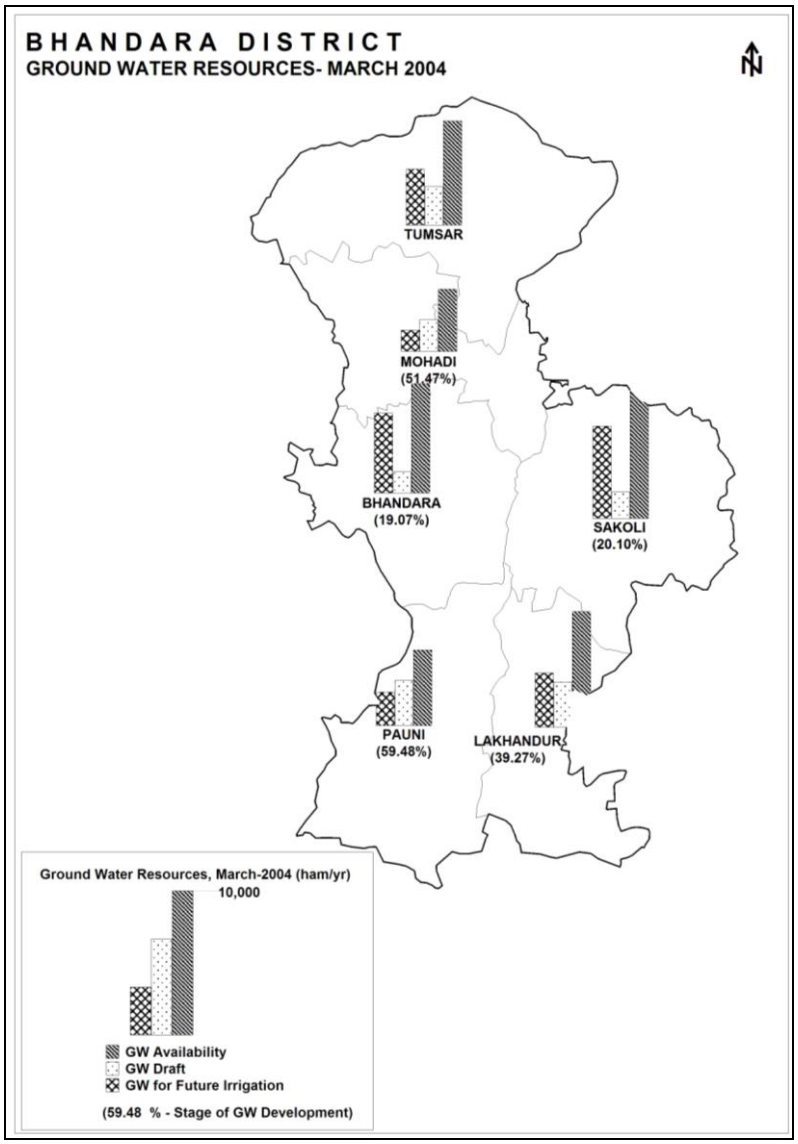

Figure 5: Ground Water Resources

Table-4: Taluka wise Ground Water Resources of Bhandara District as per GEC 1997 Methodology (2008-2009).

Taluka	Area Type	Net annual Ground water Availability (ham/yr.)	Annual Ground water Draft (ham/yr.)			Allocation for Domestic & Industrial Requirement Supply up to next 25 years (ham/yr.)	Ground water Availability for Future Irrigation (ham/yr.)	Stage of Ground water Develop-ment (%)	Category
			Irrigation	Domestic & Industrial uses	Total				
Bhandara	C	4316.52	239.94	265.02	504.96				
	NC	4787.30	824.72	113.11	937.83				
	TOTAL	9103.81	1064.66	378.13	1442.79	748.84	7320.05	15.85	Safe
Mohadi	C	3245.71	855.66	225.52	1081.18				
	NC	2350.11	734.26	124.44	858.70				
	TOTAL	55595.82	1589.93	349.96	1939.88	661.68	3208.70	34.67	Safe
Tumsar	C	4233.83	889.75	179.81	1069.56				
	NC	3718.37	1229.31	153.56	1382.88				
	TOTAL	7952.20	2119.07	333.37	2452.44	702.70	5229.70	30.84	Safe
Pauni	C	267.76	25.66	94.21	119.87				
	NC	7267.36	3535.97	190.83	3726.81				
	TOTAL	7535.12	3561.63	285.05	3846.68	534.18	3430.37	51.05	Safe
Sakoli	C	2186.76	182.22	137.94	320.16				
	NC	4649.51	781.79	98.80	880.60				
	TOTAL	6836.28	964.01	236.74	1200.75	480.25	5428.97	17.56	Safe
Lakhandur	C	4224.85	82.07	26.28	108.36				
	NC	3968.30	1781.51	181.36	1962.87				
	TOTAL	8193.15	1863.58	207.64	2071.23	460.08	5889.55	25.28	Safe
Lakhani	C	1500.45	64.33	33.13	97.46				
	NC	38889.69	922.61	143.44	1066.05				
	Total	5390.14	986.95	176.57	1163.52	347.18	4014.45	21.59	Safe
	C	19975.88	2339.63	961.91	3301.55				
District Total	**NC**	**65627.64**	**9810.17**	**1044.68**	**10815.74**				
	Total	**85603.52**	**12149.80**	**2006.59**	**14117.29**	**3934.91**	**34521.79**	**28.12**	Safe

Here, C- Command, NC- Non-Command.

4.5 Ground Water Quality

CGWB is monitoring the ground water quality of the Bhandara district since the last four decades through its established monitoring wells. The objectives behind the monitoring are to develop an overall picture of the ground water quality of the district. During the year 2011, the Board has carried out the ground water quality monitoring of 19 monitoring wells. These wells mainly consist of the dug wells representing the shallow aquifer. The sampling of ground water from these wells was carried out in the month of May 2011 (pre-monsoon period). The water samples after collection were immediately subjected for the analysis of various parameters in the Regional Chemical Laboratory of the Board at Nagpur. The parameters analyzed, include pH, Electrical Conductivity (EC), Total Alkalinity (TA), Total Hardness (TH), Nitrate (NO_3) and Fluoride (F). The sample collection, preservation, storage, transportation and analysis were carried out as per the standard methods given in the manual of American Public Health Association for the Examination of Water and Wastewater (APHA, 1998). The ground water quality data thus generated was first checked for completeness and then the validation of data was carried out using standard checks. Subsequently, the interpretation of data was carried out to develop the overall picture of ground water quality in the district in the year 2011.

Suitability of Ground Water for Drinking Purpose

The suitability of ground water for drinking purpose is determined keeping in view the effects of various chemical constituents in water on the biological system of human being. Though many ions are very essential for the growth of human, but when present in excess, have an adverse effect on human body. The standards proposed by the Bureau of Indian Standards (BIS) for drinking water (IS-10500-91, Revised 2003) were used to decide the suitability of ground water. The classification of ground water samples was carried out based on the desirable and maximum permissible limits for the parameters viz., TA, TH, NO_3 and F prescribed in the standards and is given in **Table-5**.

Table-5: Classification of Ground Water Samples for Drinking based on BIS Drinking Water Standards (IS-10500-91, Revised 2003)

Parameters	DL	MPL	Samples with conc. < DL	Samples with conc. in DL-MPL	Samples with conc. >MPL
TA (mg/L)	200	600	15	4	-
TH (mg/L)	300	600	8	9	2
NO_3 (mg/L)	45	No relaxation	8	-	10
F (mg/L)	1.0	1.5	18	-	-

(Here, DL- Desirable Limit, MPL- Maximum Permissible Limit)

The perusal of **Table-5** shows that the concentrations of all the parameters except nitrate in most of the samples are within the maximum permissible limit of the BIS standards. It is also seen from the **Table-5** that the potability of ground water in the wells is mainly affected due to the Nitrate (NO_3) as its concentration exceeds more than MPL in 56% of samples. Overall, it can be concluded that the ground water quality in the wells monitored in the district is affected because of high NO_3 concentrations.

Suitability of Ground Water for Irrigation Purpose

The water used for irrigation is an important factor in productivity of crop, its yield and quality of irrigated crops. The quality of irrigation water depends primarily on the presence of dissolved salts and their concentrations. Electrical Conductivity (EC) and Residual Sodium Carbonate (RSC) are the most important quality criteria, which influence the water quality and its suitability for irrigation.

Electrical Conductivity (EC)

The amount of dissolved ions in the water is best represented by the parameter electrical conductivity. The classification of water for irrigation based on the EC values is as follows.

Low Salinity Water (EC: 100-250 µS/cm): This water can be used for irrigation with most crops on most soils with little likelihood that salinity will develop.

Medium Salinity Water (EC: 250 – 750 µS/cm): This water can be used if moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most cases without special practices for salinity control.

High Salinity Water (EC: 750 – 2250 µS/cm): This water cannot be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required and plants with good salt tolerance should be selected.

Very High Salinity Water (EC: >2250 µS/cm): This water is not suitable for irrigation under ordinary condition. The soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching and very salt tolerant crops should be selected.

The classification of ground water samples collected from monitoring wells for irrigation purpose was carried out and given below in **Table-6**.

It is clear from the **Table-6** that maximum number of samples (58%) falls under the category of high salinity water while nearly 5% of samples fall in very high salinity water category. This shows that the ground water in the pre-monsoon season from shallow aquifer in the district should be used for irrigation with proper soil and crop management practices..

Table-6: Classification of Ground Water for Irrigation based on EC.

Type	**EC (µS/cm)**	**No. of Samples**	**% of Samples**
Low Salinity Water	<250	Nil	Nil
Medium Salinity Water	250-750	7	37
High Salinity Water	750-2250	11	58
Very High Salinity Water	>2250	1	5
Total		**19**	**100.0**

Residual Sodium Carbonate (RSC)

Residual Sodium Carbonate (RSC) is considered to be superior to EC as a measure of sodicity particularly at low salinity levels. The classification of ground water samples based on RSC values for its suitability for irrigation purpose is shown below in **Table-7**.

Table-7: Classification of Ground Water for Irrigation based on RSC.

Type	RSC	No. of Samples	% of Samples
Good	<1.25	19	100
Doubtful	1.25-2.50	-	-
Unsuitable	>2.50	-	-
Total		**19**	**100**

The perusal of **Table-7** shows that the RSC values of ground water samples collected from the wells is less than 1.25 in 100% of wells, which reflects that the overall quality of ground water in the monitoring wells is good for irrigation purpose.

4.6 Status of Ground Water Development

The entire area is occupied by crystalline rocks of Archean age and as per 2001 census the district had 778 villages and 3 major towns. The drinking water to these villages is mainly from dugwells, borewells and tubewells in the area. As per the Minor Irrigation Census, the district has 14435 irrigation dugwells and borewells, which create an irrigation potential of 276.64 sq.km, out of which 239.90 sq.km is utilized. Apart from these irrigation wells, a number of small diameter domestic wells are located in the house holds are used mainly for domestic purposes.

The Ground Water Surveys and Development Agency under Rural Water Supply Scheme has drilled about 4980 successful borewells in the district and 6 tube wells (till March 2001), out of which 4879 fitted with hand pumps and 101 fitted with electric pumps.

5.0 Ground Water Management Strategy

Ground water has special significance for agricultural development in the district. Although the ground water development in the district is on lower side major parts of the district are experiencing declining of ground water levels. Thus there is a need to adopt an integrated approach of development of ground water resources dovetailed with ground water augmentation to provide sustainability to ground water development.

5.1 Ground Water Development

A major part of the district is underlain by crystalline rocks comprising of granitic gneisses, schist's, volcanics, etc. These formations act as good aquifers only where the thickness of the weathered mantle is high and they are affected by sets of open joints and fractures. Ground water development in the area is on moderate scale. There are three types of ground water structures i.e. dugwells, borewells and tubewells in the area. Dugwells normally able to sustain 3 to 6 hours of pumping per day and the duration of recuperation vary from 3 to 9 hours. A large number of dug-cum-borewells are present in this district, the depth of the bores ranges from 15 to 30 meters from the bottom of the well. Topographic lows and the areas where the thickness of weathered mantle is high are usually the favourable zones for such wells. The nature and yield potential of the aquifers occurring in different areas is given below in **Table-8.**

Table-8: Nature and Yield Potential.

S. No.	Taluka	Main Formation	Yield Potential	Feasible Structures
1	Bhandara	Schist's/Quartzite Granite Gneisses	Low to High	DW, DCB, BW
2	Mohadi	Granite Gneisses, Schist's/Quartzite	Low to Medium	DW
3	Tumsar	Schist's/Quartzite Granite, Gneisses	Medium High	DW, DCB DW, DCB, BW
4	Pauni	Alluvium Vindhyan Sandstone Schist's/Quartzite, Granite Gneisses	Medium to High Medium to High Low to Medium Medium	DW, DCB, TW DW, DCB, TW DW, DCB DW, DCB
5	Sakoli	Schist's/Quartzite Granite, Gneisses	Mainly low Medium	DW DW, DCB
6	Lakhandur	Alluvium GondwanaSandstone Schist's/Quartzite	Medium to High Medium Low to High (SE part)	DW, DCB,TW DW, DCB DW, DCB, BW

Here, DW- Dugwell, DCB- Dug-cum-Borewell, BW- Borewell.

From the perusal of Table-8, it is observed that ground water potential in Schist's/Quartzite aquifer is mostly low, whereas in Alluvium it is mainly medium to high.

Thus in the area occupied by Alluvium, the ground water development through the shallow tubewells is recommended. Weathered mantle below Alluvium also adds to the suitability of the area for development. Around

Sakoli and Lakhni, there is a considerable thickness of weathered mantle followed by fractured rock and is suitable for ground water development. A north-south trending patch of Alluvium along the river Chulband is also recommended for ground water development. In the areas occupied by Gondwana Sandstone in Lakhandur taluka, the ground water development is advisable through dugwells, DCB and shallow tubewells. The ground water development in granite gneisses of Bhandara, Tumsar, Pauni and Sakoli talukas can also be carried out through dugwells and DCB wherever thickness of weathered mantle is more.

5.2 Water Conservation and Artificial Recharge

Percolation Tanks and Cement Bandharas are the feasible artificial recharge structures in the district. The existing dugwells can also be used for artificial recharge; however, the source water should be properly filtered before being put in the wells. As the post-monsoon water levels are shallow in major part of the district, extreme care should be taken while selecting the sites for artificial recharge structures. The sites need to be located where the hydrogeological conditions are favourable, i.e., where sufficient thickness of de-saturated/unsaturated aquifer exists and water levels are more than 5 m deep in postmonsoon season. Such areas are restricted and are observed in parts Bhandara, Sakoli, Pauni and Lakhandur talukas.

Abandoned Malguzari tanks should be revived and proper care should be taken of the existing tanks by regularly de-silting them and avoiding reclamation of tanks for other purposes.

6.0 Ground Water Related Issues and Problems

The fall in water levels is observed in almost entire Tumsar, Mohadi, Bhandara and Pauni talukas and major parts of Sakoli and Lakhandur talukas. Thus, the future water conservation and artificial recharge structures needs to be prioritised in these areas.

7.0 Mass Awareness and Training Activities

Till March 2012, one MAP had been organized in the district at Warthi. The details are given in Table-10.

Table-10: Status of MAP and WMTP (March 2007).

S. No.	Item	AAP	Venue	Date	Participants
1	MAP	2002-03	Warthi	13/03/2003	350

8.0 Areas Notified by CGWA/SGWA

As per ground water resource estimation, all the talukas fall under "Safe" category, hence the area has not been notified either by CGWA or SGWA.

9.0 Recommendations

1. A major part of the district is underlain by crystalline rocks comprising of granitic gneisses, schists, volcanics, etc. These formations act as good aquifers only where the thickness of the weathered mantle is high and they are affected by sets of open joints and fractures. Therefore, the topographic lows and the areas where the thickness of weathered mantle is high are usually the favourable zones for dug wells and dug-cum-borewells.
2. Major part of the district is underlain by hard rock, where only dugwells are most feasible structures for ground water development. The sites for borewells need to be selected only after proper scientific investigation.
3. Borewells generally tap deeper fractures, which may not be sustainable. Besides, the borewells should only be used for drinking water supply and not for irrigation.
4. The overall stage of ground water development is low about 28.12%, hence there is plenty of scope for development of ground water resources, particularly in Alluvial and Gondwana sandstone aquifers in parts of Pauni and Lakhandur talukas.
5. As the post-monsoon water levels are shallow in major part of the district, extreme care should be taken while selecting the sites for artificial recharge structures. The sites need to be located where the hydrogeological conditions are favourable, i.e., where sufficient thickness of de-saturated/unsaturated aquifer exists and water levels

are more than 5 m deep. Such areas are restricted and are observed in central and south central part of the district, covering parts of Bhandara, Sakoli, Pauni and Lakhandur talukas.

6. Roof top rainwater harvesting by storing the water in storage tanks during rainy season for use during non-monsoon season should be encouraged in scarcity affected areas as well as in urban area.

7. Abandoned Malguzari tanks should be revived and proper care should be taken of the existing tanks by regularly de-silting them and avoiding reclamation of tanks for other purposes.