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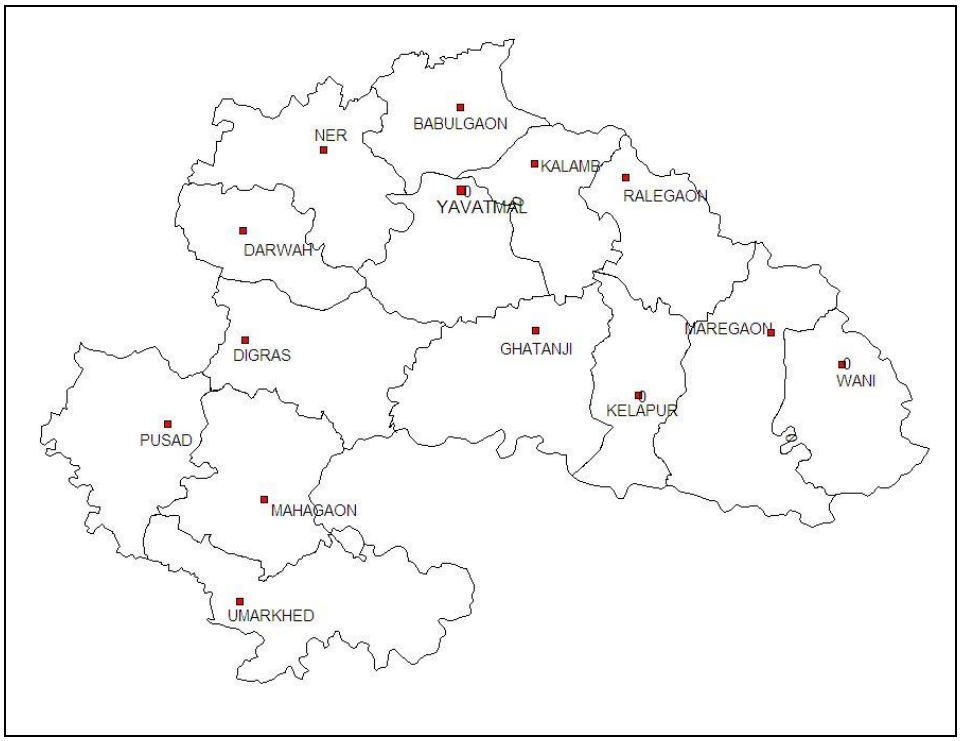
भारत सरकार
जल संसाधन मंत्रालय
केंद्रीय भूजल बोर्ड

GOVT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

महाराष्ट्र राज्य के अंतर्गत यवतमाल जिले की भूजल विज्ञान जानकारी

GROUND WATER INFORMATION YAVATMAL DISTRICT MAHARASHTRA



By
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द्वारा
कार्तिक डोंगरे
वैज्ञानिक ग

मध्य क्षेत्र, नागपुर
CENTRAL REGION, NAGPUR
2013

YAVATMAL DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Area		13519 sq. km
Administrative Divisions (As on 31/03/2011)	:	Taluka-16; Yavatmal, Ner, Babhulgaon, Kalamb, Darwha, Digras, Pusad, Umarkhed, Mahagaon, Arni, Ghatanji, Kelapur, Ralegaon, Maragaon, Zhari- Zhamni and Wani
Villages	:	2108
Population (As per census 2011)	:	27,75,457
Male		14,25,593
Female		13,49,864
Literacy		87.00%
Sex Ratio		941
Average Annual Rainfall	:	850 mm to 1150 mm

2. GEOMORPHOLOGY

Major Physiographic unit	:	Three; Satpuda hill range, Plateau and Penganga and Wardha plain
Major Drainage	:	Two; Wardha and Penganga,

3. LAND USE (2010-11)

Forest Area	:	2397 sq. km.
Net Area Sown	:	8746 sq. km.
Cultivable Area	:	10095 sq. km.

4. SOIL TYPE

Three types of soils, Shallow coarse, Medium black and Deep black

5. PRINCIPAL CROPS (2010-11)

Wheat	:	160 sq. km.
Cotton	:	3867 sq. km.
Jowar	:	1092 sq. km.
Soyabean	:	1664 sq. km.
Pulses	:	1791 sq. km.

6. IRRIGATION BY DIFFERENT SOURCES (2010-11)

Nos./Potential Created (ha)

Dugwells	:	40945 / 94807
Tubewells/Borewells	:	805 / 1921
Tanks/Ponds	:	71 / 10095
Other Minor Surface Sources	:	7072 / 18360
Net Irrigated Area	:	52193

7. GROUND WATER MONITORING WELLS (As on 31/03/2011)

Dugwells	:	46
Piezometers	:	19

8. GEOLOGY

Recent	:	Alluvium
Upper Cretaceous-Lower Eocene	:	Deccan Trap Basalt
Cretaceous	:	Lameta Beds
Upper Carboniferous - Permian	:	Gondwana
Pre-Cambrian	:	Vindhyan /Pakhals/Penganga Beds
Achaean	:	Granites/ Gneisses

9. HYDROGEOLOGY

Water Bearing Formation	:	Aquifers belonging to Archean, Penganga Beds, Gondwana, Lameta and Deccan Traps
Premonsoon Depth to Water Level (May 2011)	:	1.00 to 16.60 m bgl
Postmonsoon Depth to Water Level (Nov. 2011)	:	0.90 to 15.20 m bgl
Premonsoon Water Level Trend (2001-2010)	:	Rise: 0.008 to 0.368 m/year Fall: 0.01 to 0.93 m/year
Postmonsoon Water Level Trend (2001-2010)	:	Rise: 0.03 to 0.32 m/year Fall: 0.009 to 0.91 m/year

10. GROUND WATER EXPLORATION (As on 31/03/11)

Wells Drilled	:	EW-78, OW-23, Pz-19
Depth Range	:	19.45 to 470.00 m bgl
Discharge	:	0.13 to 49.40 lps
Transmissivity	:	2.26 to 202.00 m^2/day

11. GROUND WATER QUALITY

Good and suitable for drinking and irrigation purpose, except high fluoride (>1.5 mg/l) contamination in parts of Kelapur, Maregaon and Wani talukas.

Type of Water	:	Ca-HCO_3 & Ca-Cl

12. DYNAMIC GROUND WATER RESOURCES- (As on 31/03/2008)

Annual Replenishable GW Resources	:	1361.65 MCM
Total draft (Irrigation + Domestic)	:	421.02 MCM
Projected Demand (Domestic + Industrial)	:	114.78 MCM
Stage of Ground Water Development	:	29.85 %

13. AWARENESS AND TRAINING ACTIVITY

Mass Awareness Programme	:	One
a. Date	:	27/12/04
b. Place	:	Pahapal
c. Participants	:	500
Water Management Training Programme	:	Two
a. Date	:	12 to 13/03/04 & 28 to 29/10/04
b. Place	:	Yavatmal.
c. Participants	:	50 &140

14. ARTIFICIAL RECHARGE & RAINWATER HARVESTING

Projects Completed	:	Nil
Projects under Technical Guidance	:	Nil

15. GROUND WATER CONTROL & REGULATION

Over Exploited Taluka	:	None
Critical Taluka	:	None
Notified Taluka	:	None

16. MAJOR GROUND WATER PROBLEMS AND ISSUES

Parts of the district i.e., Kelapur, Maregaon and Wani talukas are affected by the high fluoride concentration in ground water.

Ground Water Information
Yavatmal District

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Yavatmal District

1.0 Introduction

Yavatmal district is one of the eleven districts of Vidarbha Region of Maharashtra. It is bounded on east by Chandrapur district, on south by Andhra Pradesh State and Nanded district on west by Washim and Hingoli districts and on north by Amravati and Wardha districts. Wardha River forms the northeastern boundary of the district. The district lies between 19°26' and 20°42' north latitudes and 77°18' and 79°9' east longitudes. It falls in parts of the Survey of India Toposheets No. 55L, 55I, 56E, 56I, 56M, covering 13519 sq.km, area.

The district headquarters is located at Yavatmal Town. For administrative convenience, the district is divided in 16 talukas viz. Yavatmal, Wani, Maregaon, Pandharkawda, Ghatanji, Ralegaon, Babulgaon, Kalamb, Darwha, Ner, Digras, Pusad, Mahagaon, Umarkhed, Zhari Zhamni and Arni. It has a total population of 27,75,457 as per 2011 census. The district has 13 towns and 2108 villages. The district is well drained by Wardha and Penganga rivers and their tributaries.

Central Ground Water Board has taken up several studies in the district. A list of studies conducted in the district is presented in **Table-1**.

Table 1: Studies undertaken by CGWB.

S. No.	Officer	AAP	Type of Survey/Study
1.	S/Shri V.V. Sable K.R. Shrinivasan	1967-68	Systematic Hydrogeological Survey
2.	Shri V.A. Totre	1970-71	-do-
3.	Shri V.V. Sable	1971-72	-do-
4.	Shri V.V.S. Mani	1972-73	-do-
5.	S/Shri A.B. Deshmukh, J.N. Rai and Miss P. Tripathi	1975-76	-do-
6.	Shri N. Somasundaram	1981-82	-do-
7.	Dr. J. N. Rai	1981-82	-do-
8.	Shri S Sudarshana	1986-87	Reappraisal Hydrogeological Studies
9.	Shri S.K. Jain	1992-93	-do-
10.	Shri G Sudarshan	1992-93	-do-
11.	Shri D. Venkateshwaran	1993-94	-do-
12.	Shri S.Sudarshana	1993-94	-do-

13.	Shri D.Y. Sirsikar	1994-95	-do-
14.	Sh. B. R. Lamsoge	2005-06	-do-
15.	Sh D. N. Mandal	2005-06	-do-
16.	Sh P. Madhnure	2005-06	-do-
17.	Sh B. N. Warke	2005-06	-do-

To explore the ground water potential and aquifer properties, exploratory drilling was undertaken by the department during the year 1984 and the drilling programme was completed in the year 1995. Under this programme 78 Exploratory Wells (EW), 23 Observation Wells (OW), and 12 Piezometers (PZ) were constructed. The details of ground water exploration are presented in **Table 2**

Table 2: Salient Features of Ground Water Exploration.

S. No.	Taluka	Formation /Aquifer	Wells			Depth (mbgl)	SWL (mbgl)	Discharge (lps)	Zones (mbgl)
			EW	OW	PZ				
1.	Arni	Basalt	1	–	2	30.00–200.00	46.50–68.00	0.38	6.0-158.0
2.	Babul-gaon	Basalt	3	1	1	30.00–128.10	5.45–7.65	0.14–3.17	–
		Sandstone	1	–	–	85.40	–	–	–
3.	Darwah	Basalt	2	–	1	30.00–201.30	3.45	0.14	–
4.	Digras	Basalt	4	–	–	189.10–201.30	2.70–30.07	0.60	–
5.	Ghatanji	Basalt	3	–	–	173.70–201.30	30.07	0.60– 3.77	46.0-87.0
		Sandstone	1	1	–	201.30	4.00–4.75	1.37– 7.37	–
6.	Jhari-Jhamni	Basalt	1	2	–	77.00–190.55	6.43–6.50	12.18–14.88	12.0-77.0
7.	Kalamb	Basalt	1	–	1	30.00–103.70	–	–	–
8.	Kelapur	Basalt	3	3	2	30.00–152.50	5.70–50.00	3.77–19.66	27.0-130.0
		Limestone	1	–	–	201.30	–	1.37	9.0-80.0
9.	Maha-gaon	Basalt	3	1	–	123.25–200.00	1.90–9.80	1.05–7.76	10.0-138.5
10.	Maregaon	Basalt	1	1	–	46.95–48.00	13.36–14.00	5.94–14.50	40.8-87.0
		Sandstone	1	–	–	86.25	2.54	1.37	8.0-19.6
11.	Ner	Basalt	5	2	1	19.45–201.30	2.20–3.38	0.14–17.90	–
12.	Pusad	Basalt	4	–	–	201.30	3.00–23.80	0.14– 1.73	6.0-119.0

13.	Ralegaon	Basalt	1	1	–	130.0–158.0	–	3.17–7.76	15.0-75.0
		Limestone	1	–	–	201.30	–	1.05	136.0-140.0
14.	Umarkhed	Basalt	4	3	–	79.00–201.30	1.55–10.46	1.73–49.40	4.0-138.0
15.	Wani	Sandstone	31	7	4	31.80–470.00	0.50– 19.00	0.13– 11.60	10.0-470.0
16.	Yavatmal	Basalt	4	1	–	103.70–201.30	3.20–64.00	0.38–10.98	–
		Sandstone	2	–	–	34.30–43.95	6.85–7.39	1.37	24.0
	Total		**78**	**23**	**12**	**19.45–470.00**	**0.50–68.00**	**0.13–49.40**	**10.00-470.00**

Ground Water exploration was aimed at delineating the productive aquifers and ground water worthy areas down to the target depth of 470 metres below ground level (m bgl) in unconsolidated formations and up to 201 m bgl in consolidated formations. The yield ranges from 0.4 litres per second (lps) to 8 lps for a maximum drawdown of 30 m in unconsolidated formations and 0.14 lps to 49.48 lps for a maximum draw down of 49 m in consolidated formation. Productive zones in Basalt are observed down to 138 m bgl, whereas in Sandstone they are observed even down to 470 m bgl.

A map of the district showing the taluka boundaries, physical features and location of exploratory and monitoring wells is presented as **Figure-1**.

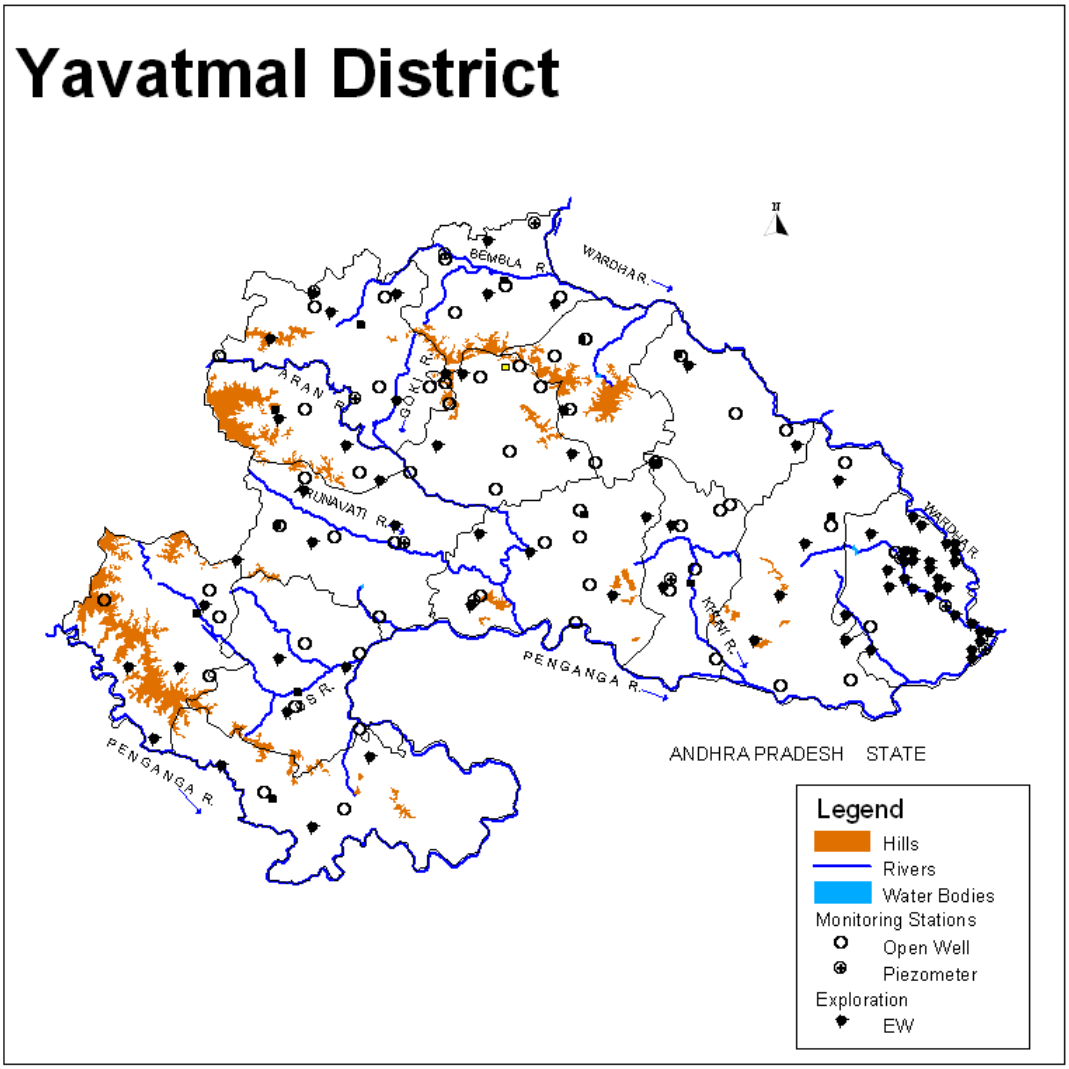

Figure 1: Location

2.0 Climate and Rainfall

The Climate of the district is characterised by a hot summer and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. The temperature rises rapidly after February till May, which is the hottest month of the year. The mean daily maximum temperature during May is 41.8°C and the mean daily minimum temperature during December is 15.1°C

The normal annual rainfall varies from about 850 to 1150 mm and it increases from NW to SE direction in the district and reaches maximum around Pandharkawada. The average annual rainfall for the last ten years 2002-2011 ranges from 527.87 mm (Arni) to 985.35 mm (Ralegaon) and the same is presented in **Table-3**. It is observed that the rainfall has decreased during the last 10 years period.

Table 3: Annual Rainfall Data (2002-2011). (mm)

Taluka	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
Yavatmal	1110.40	563.80	661.85	828.40	1288.30	865.86	684.00	540.20	1106.00	845.2	**849.40**
Babulgaon	761.00	762.00	462.00	612.00	897.30	772.00	456.54	438.50	1013.00	750.1	**692.44**
Kalamb	1212.00	1218.00	388.12	844.00	1336.00	888.10	483.00	338.40	841.00	578.3	**812.69**
Darwah	1063.00	594.00	423.66	522.00	1161.40	803.52	569.72	456.80	1209.50	701.4	**750.50**
Digras	986.30	472.00	462.00	656.00	1253.00	790.00	528.11	738.70	1246.00	864	**799.61**
Arni	939.00	408.00	282.05	402.00	736.60	468.05	495.00	342.10	708.50	497.4	**527.87**
Ner	424.00	345.00	329.00	361.00	1051.40	697.00	568.20	481.20	1109.00	911	**627.68**
Pusad	1325.10	734.80	477.74	687.00	1177.80	673.68	885.40	618.10	1335.80	818	**873.34**
Umarkhed	647.40	816.30	357.22	512.00	916.50	686.00	570.62	667.30	792.50	865	**683.08**
Mohagaon	1132.90	1081.00	463.48	1131.00	1051.50	932.50	690.61	638.00	1137.00	839.4	**909.74**
Wani	658.00	632.90	592.25	697.40	1173.90	958.50	850.80	566.00	1537.00	793	**845.97**
Maregaon	570.00	496.00	327.04	412.30	1257.00	1197.00	1207.18	631.00	1638.00	1062	**879.75**
Jhari Jamni	573.00	336.00	323.51	387.00	748.80	525.60	584.40	389.70	879.00	539	**528.60**
Kelapur	1053.00	742.00	830.00	624.00	1029.90	1007.02	631.13	725.50	1187.00	839.3	**866.88**
Ghatanji	1114.00	1130.00	438.00	712.00	1402.00	1027.00	853.00	547.20	541.00	774	**853.82**
Ralegaon	1044.00	1130.00	438.00	712.00	1263.10	1108.00	997.20	829.20	1472.00	860	**985.35**
District Avg.	**913.3**	**716.36**	**453.5**	**631.3**	**1109**	**837.5**	**690.9**	**559.2**	**1109.5**	**783.59**	**780.41**

3.0 Geomorphology and Soil Types

The northern fringe of the district is hilly and forms part of Satpura range. South of these hill ranges, covering almost entire north-central parts, constitutes the Alluvial plain. Southern part of the district is characterized by hilly rugged terrain as a part of Deccan Plateau. Purna is the main river flowing through the district. Other important rivers are Man, Murna and Kate.

Three types of soils are observed in the district i.e., (a) The shallow coarse soil which is reddish brown and brownish in colour, occurring in general at higher elevations along the ridges and also at the foothills zone of the major hills (b) The medium black soil is developed along the tributary drainage's and also along the intermediate gradient area. (c) The deep black soil, which is developed along the lower reaches of Wardha and Penganga riverbeds. They differ from medium black soil in depth and fertility.

The soils in the district are slightly alkaline, clayey loamy in texture and contain calcium carbonate.

4.0 Ground Water Scenario

4.1 Hydrogeology

Deccan Trap Basalt is the predominant water bearing formation, followed by Gondwana formation having Sandstone and Shale sequence. Penganga and Quaternary Alluvium aquifers are spread in limited areas. Archean aquifers are limited and have less significance in the area. A map depicting the hydrogeological features is shown in **Figure-2**.

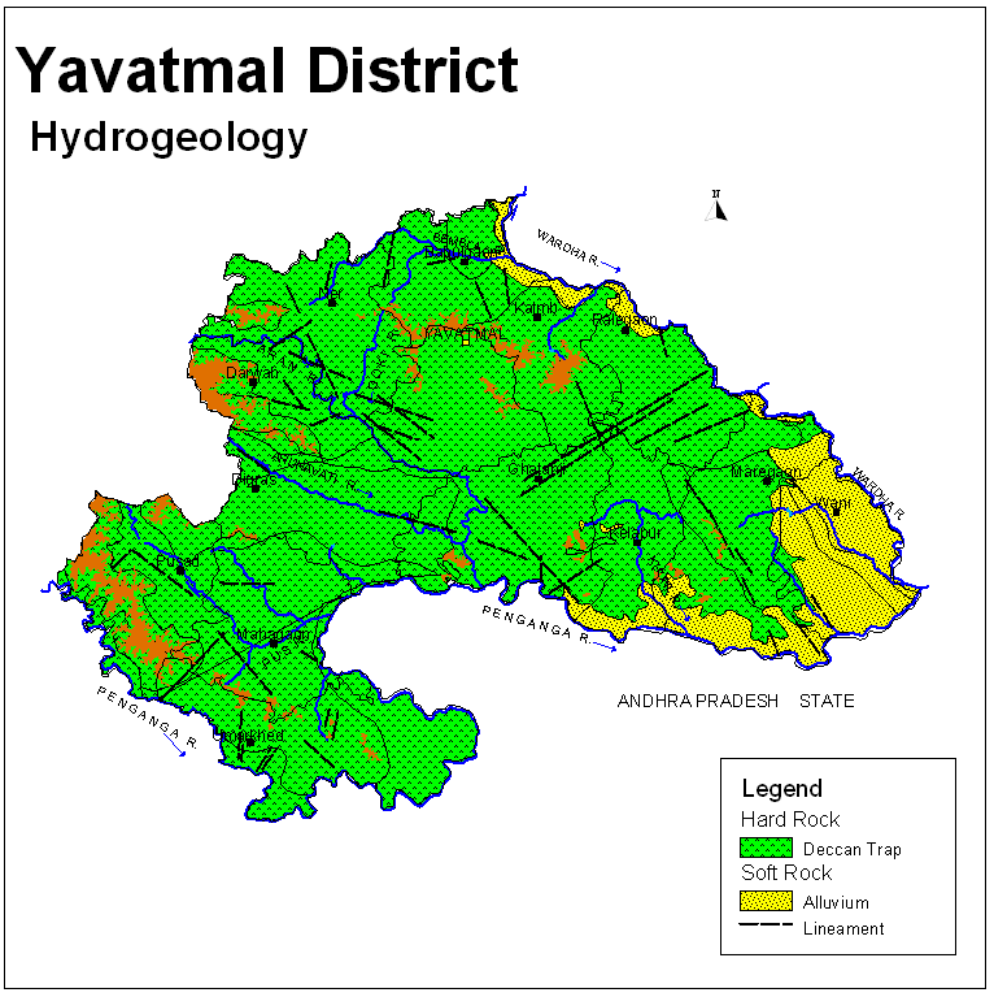

Figure 2: Hydrogeology

4.1.1 Archean

Achaeans, which comprise granites, granitic gneisses and schists occur in Umarkhed taluka. These rocks as such have limited ground water potential. In these rocks only weathered portions and jointed zones possess water-bearing capacity and ground water occurs under unconfined condition in the area.

4.1.2 Vindhyan

In Vindhyans, Limestones are water bearing formation while Sandstone, due to their hard and compact nature, have poor ground water potential and occur in southeastern peripheral parts of Wani taluka. The limestones as such are massive but wherever they are cavernous they are capable of holding water. The ground water occurs under unconfined condition in the area.

4.1.3 Gondwana

The Gondwana consists of Kamthi and Barakar Sandstone and Shale and occupy north-south extending elongated stretch in parts of Maregaon and Wani talukas. Sandstone is usually friable and possesses primary porosity due to its granular nature. They are most productive water bearing formations in the district. The ground water occurs under semi confined to confined conditions in the area and water bearing zones have been encountered down to depth of 470 m.

4.1.4 Deccan Trap Basalt

Deccan Trap Basalt is widely spread and forms important water bearing formation, which occupies almost entire district except south eastern part. On the whole, Deccan Trap Basalt exhibits a multi aquifer system. Based on the lithologs of 51 exploratory wells and Piezometers, it is observed that weathered Vesicular Basalt mainly forms the predominant shallow aquifer down to the depth of 20 m bgl. Massive Basalt is also encountered at the top thereby forming poor yielding aquifer and also restricting the ground water recharge to the underlying porous Vesicular Basalt. Fractured Basalt is also observed in certain places with limited to significant thickness. In Deccan Trap Basalt phreatic aquifer generally occurs down to 25 m, however, fracture zones have occurred within 80 m range except at few places where it occurs down to 158 m also.

4.1.5 Alluvium

Alluvium occurs in patches along the banks of Wardha and Penganga rivers and their major tributaries and consists of clay and silt with lenticular bodies of sand and gravel. In Ralegaon area, it is observed that sand zones are found in the depth range of 20-25 m bgl, while the top 15-16 m is full of clay and silt. Ground water in Alluvium occurs both under unconfined and

semi-confined conditions.

4.1.6 Water Level Scenario

Central Ground Water Board periodically monitors 74 National Hydrograph Network Stations (NHNS) stations in the Yavatmal district, four times a year i.e. in January, May (Premonsoon), August and November (Postmonsoon). The data on premonsoon and postmonsoon water levels along with fluctuation during 2011 and long term water level trends (2001-2010) are given in **Table- 4**.

Table 4: Water Level Data (2011) with Long Term Trend (2001-2010).

Sl. No.	Location	Pre-monsoon (m.bgl)	Post-monsoon (m.bgl)	Fluctuation (m)	Premonsoon Trend (m/yr)		Postmonsoon Trend (m/yr)	
					Rise	Fall	Rise	Fall
1	Pahur2	3.5	2.4	1.1	-	-	-	-
2	Bori (Arab)	14.2	12.5	1.7	-	-	-	-
3	Arni2	6	4.2	1.8	0.1447	-	-	0.2370
4	Sakhra (P1)	8.92	11.1	-2.18	-	0.0769	-	0.1105
5	Sakhra (WT)	-	6.2	-	-	0.4263	-	0.2084
6	Punwat	2.7	1.8	0.9	0.3681	-	0.1518	-
7	New Waghdara	16.6	15.2	1.4	-	-	-	-
8	Marwadi Khurd	6.1	1.5	4.6	0.1118	-	0.0521	-
9	Ladkhed	8.4	-	-	0.0243	-	-	0.3148
10	Parwa	3.5	2.5	1	-	0.1994	0.1620	-
11	Mohgaon Kasba	6.2	3.8	2.4	0.0974	-	-	0.0214
12	Mahagaon	3.6	2.6	1	0.3484	-	-	0.0509
13	Lonbhel	6.7	1.45	5.25	-	0.1375	-	0.0243
14	Pusad	5.2	4.1	1.1	-	0.2187	-	0.0992
15	Pahur	5.1	2.1	3	0.0219	-	-	0.0644
16	Mardi	6.1	3.4	2.7	-	0.0406	-	0.0581
17	Jodmoha	-	6.1	-	0.1038	-	0.1267	-
18	Ghatanji	10.2	4.8	5.4	-	0.0854	-	0.2264
19	Mandeo	12.6	1.8	10.8	0.2100	-	0.2048	-
20	Pahapal	6.15	2.75	3.4	0.0117	-	-	0.1009
21	Injhala	13.1	10.6	2.5	-	0.0829	-	0.5894
22	Talegaon	3.8	1.1	2.7	-	0.0141	0.2725	-
23	Mangrule	4.1	3.3	0.8	-	0.5257	-	0.1502
24	Akolabazar	8.35	5.8	2.55	-	0.1603	-	0.3065
25	Madkona	12.1	10.2	1.9	0.0656	-	-	0.0713
26	Jamwadi	2.58	2.7	-0.12	0.0086	-	0.1775	-
27	Vai (Lingi)	7.1	4.1	3	0.1959	-	-	0.0529
28	Mojhar	2.75	1.4	1.35	-	0.1433	-	0.0915
29	Wadhona	5.75	4.3	1.45	-	0.0506	-	0.2023

30	Umarda (Nursary)	5.6	3.95	1.65	0.0489	-	-	0.1114
31	Kotha	9.3	3.3	6	-	0.1205	-	0.1912
32	Savar	6.9	3.65	3.25	-	0.1918	-	0.3601
33	Chaparda	4.65	3.9	0.75	-	0.2130	-	0.0097
34	Dhanaj (Manekwada)	6.2	3.2	3	0.2266	-	-	0.0622
35	Sawali	8.5	2.85	5.65	-	0.1219	0.0771	-
36	Kalamb	10.6	8.4	2.2	-	0.2089	-	0.1479
37	Babhulgaon	5.5	-	-	-	0.0499	-	0.2761
38	Pandharkawda	1.6	-	-	-	-	-	-
39	Mojhar2	-	3.8	-	-	-	-	-
40	Ghatwadi	-	3.6	-	-	0.0529	-	0.1296
41	Pandharkawada	1	0.9	0.1	-	0.2809	0.0368	-
42	Arni	7	5	2	-	-	-	-
43	Dhanoda	9.6	6.7	2.9	-	0.1513	-	0.1416
44	Digras	5.95	2.3	3.65	0.2628	-	0.3222	-
45	Selodi	4.6	2.45	2.15	-	0.0790	-	0.0652
46	Mohada	7.5	6.1	1.4	-	0.2722	-	0.0316
47	Harsi	7.55	1.4	6.15	-	0.1055	-	0.1079
48	Wadgaon	6.6	2.3	4.3	0.3385	-	-	0.1206
49	Kolambi	5.25	1.75	3.5	-	0.2017	-	0.0958
50	Sindhi_PZ	-	1.7	-	-	-	-	-
51	Sangwi RLy_Pz	-	5.9	-	-	-	-	-
52	Darwha_Pz	-	2.3	-	-	-	-	-
53	Ghatanji_Pz	-	5.4	-	-	-	-	-
54	Kurli_Pz	-	3.3	-	-	-	-	-
55	Shiroli_Pz	-	12.1	-	-	-	-	-
56	Ner_Pz	-	1.8	-	-	-	-	-
57	Dhanaj (Manekwada)_Pz	-	2.9	-	-	-	-	-
58	Karanji_Pz	-	5.6	-	-	-	-	-
59	Pandharkawada_Pz	-	4.15	-	-	-	-	-
60	Saykheda_Pz	-	4.9	-	-	0.5022	-	0.4055
61	Ralegaon_Pz	-	6	-	-	0.0405	-	0.0779
62	Wadki_Pz	-	11.2	-	-	-	-	-
63	Umarkhed_Pz	-	3.85	-	0.0161	-	-	0.3945
64	Akolabazar_Pz	-	2.7	-	-	-	-	-
65	Bhari_Pz	-	2.4	-	-	-	-	-
66	Yelbara_Pz	-	2.8	-	-	-	-	-
67	Mukutban_Pz	-	8.3	-	-	0.8023	-	-
68	Patan_Pz	-	6.3	-	-	0.1530	-	0.6898
69	Kayar	-	-	-	-	0.1529	-	0.4286
70	Wani	-	-	-	-	0.2865	-	0.9127
71	Maregaon	-	-	-	-	0.9338	-	0.0249
72	Dhakni	-	-	-	0.2345	-	-	0.2865
73	Phul Sawangi	-	-	-	0.0317	-	0.0357	-
74	Mudana	-	-	-	-	0.0770	-	0.3154

4.1.6.1 Depth to Water Level – Premonsoon (May-2011)

The depth to water levels in the district ranges between 1.00 (Pandharkawada) and 16.60 (New Waghdara) m bgl during premonsoon. Depth to water level during premonsoon has been depicted in **Figure-3**. Shallow water levels within 10 m bgl are seen in almost entire district except few isolated patches in parts of Wani, Kalamb, Ghatangi, Darwha and Yavatmal talukas where water level ranges between 10-20 m bgl.

4.1.6.2 Depth to Water Level – Postmonsoon (Nov-2011)

The depth to water levels during postmonsoon ranges between 0.90 m bgl (Pandharkawda) and 15.20 m bgl (New Waghdara). Spatial variation in postmonsoon depth to water levels is shown in **Figure-4**. Shallow water levels within 10 m bgl are observed in entire district with dominant range being 2-5 m bgl. Very shallow water level of less than 2 m bgl is observed in south western part of Pusad taluka, Northeastern corner of Babulgaon taluka, central part of Ner and Yavatmal taluka. Water levels of 10-20 m bgl are observed in Darwha, Ghatangi, Ralegaon and part of Wani taluka.

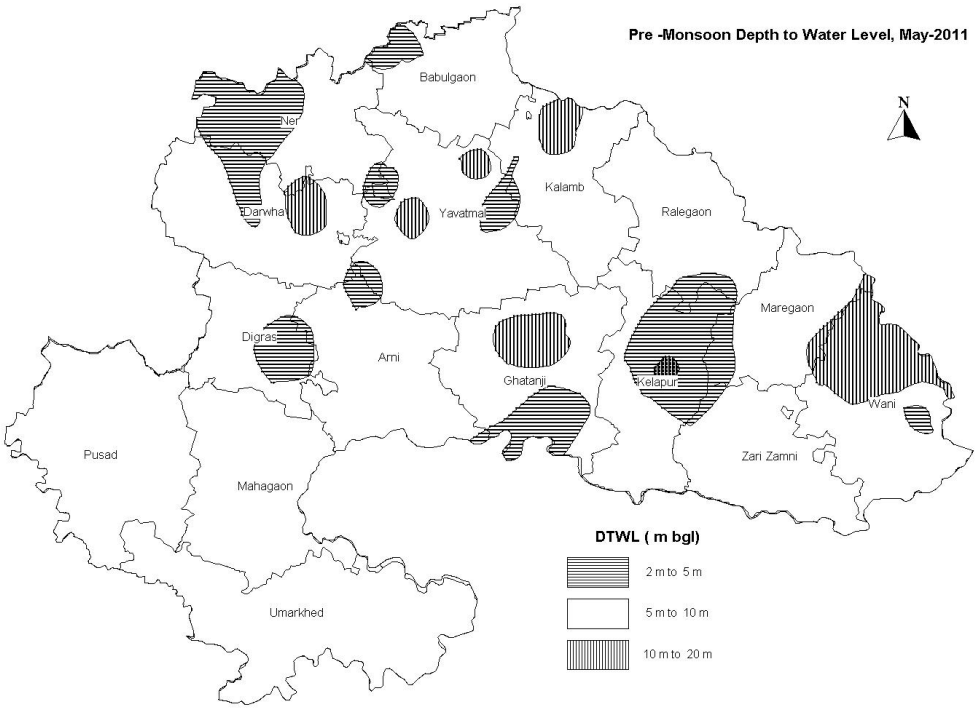

Figure 3: Depth to Water Level (Premonsoon- May 2011)

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

In major part of the district rise in water levels in the range of 0.75 m (Chaparda) to 10.80 m (Mandeo) is observed. Fall in water levels is observed only at Sakhra (-2.81 m) and Jamwadi (-0.12). In almost entire district rise in water levels has been observed. Rise in water levels in the range of 2 to 5 m is observed in major parts of the district. Rise of more than 5 m is observed in Pusad and parts of Arni and Yavatmal, Umarkhed, Babulgaon, Gahtangi Mahagaon talukas. Rise of 0 to 2 m is observed in isolated areas in, Yavatmal, Pusad, Mahagaon, Digras, Arni, Darwah, Ner, Kelapur, Wani, Maregaon, Kalamb and Ralegaon talukas.

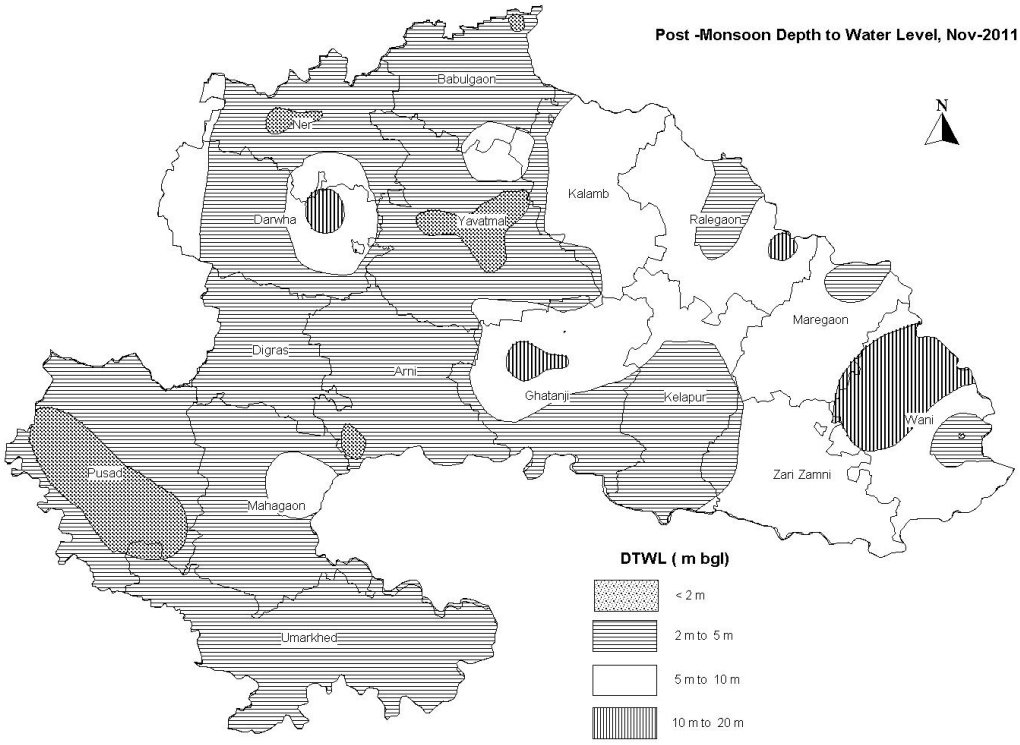

Figure 4: Depth to Water Level (Postmonsoon- Nov. 2011)

4.1.6.4 Water Level Trend (2000-09)

Trend of water levels for premonsoon and postmonsoon periods for last ten years (2001-2010) have been computed for 54 NHNS and are given in **Table-4**. Analysis of trend indicates that during premonsoon period, rise in water levels has been recorded at 19 stations and it ranges between 0.008(Jamwadi) and 0.368 m/year (Punwat). Fall in water levels has been

observed at 35 stations and ranges between 0.01(Talegaon) and 0.91 m/year (Maregaon). During post monsoon period, rise in water levels has been recorded at 11 stations and it ranges from 0.03(Pandharkawda) to 0.32 m/year (Digras), whereas at 43 stations, fall in water levels ranging between 0.009(Chaparda) and 0.91 m/year (Wani) is observed. Thus in major part of the district, both during pre and postmonsoon periods declining trend of water levels has been observed.

4.1.7 Aquifer Parameters

Pumping tests of shallow aquifers (down to 20 m depth), reveal that the dugwells tapping weathered vesicular and weathered Massive Basalt have higher specific capacity in the range of 13.95 to and 513 lpm/m. The wells located in the Massive Basalt have the specific capacity in the range of 5 and 67 lpm/m. Jointed Basalt have specific capacity ranging from 14.53 to 83.85 lpm/m. Highly fractured and Jointed Basalt have specific capacity of 663.86 lpm/m. The wells tapping Limestone, Sandstone and Alluvial aquifers show moderate to high specific capacity ranging between 20 and 511 lpm/m.

During the course of ground water exploration, pumping tests were conducted at 11 exploratory wells. It was observed that in Deccan Traps the transmissivity varies from 18.74 to 202 m^2/day and storativity varies from $3.4x10^{-4}$ to $5.2x10^{-4}$. In Trap-covered Gondwanas/Vindhyans/Archeans, transmissivity varies from 3.61 to 19.24 m^2/day whereas storativity varies from $8.7x10^{-5}$ to 1.35 $x10^{-4}$.

4.2 Ground Water Resources

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Yavatmal district based on GEC-97 methodology. The same is presented in **Table-5**. The net annual available ground water resources are 1361.65 MCM and the ground water draft is 421.02 MCM. The ground water resources are shown in **Figure-5**.

Ground water development scenario varies in the district, while eastern part consisting of Wani and Jhari-Jhamni talukas are the least developed talukas with less than 15% of development. Pandharkawda, Kalamb, Maregaon and Ghatanji are the next developed talukas with the stage of development between 15 to 25%. Ground water development inYavatmal,

Ralegaon, Umarkhed, Ner, Mahagaon, Arni and Babulgaon talukas is 25 to 40%. Maximum ground water development is 45% in Pusad taluka. As per the GEC norms all the talukas and 64 watersheds falls in “Safe” category. The western part of the district covered by Deccan Trap Basalt have better ground water development as compared to the eastern part where the Gondwana or Trap covered Gondwana/Vindhyan/Penganga aquifers are observed. The overall stage of ground water development in the district is 30.92%. No taluka or watershed is categorised as “Over-Exploited”/”Critical”/”Semi-Critical” and the area has not been notified by CGWA or SGWA.

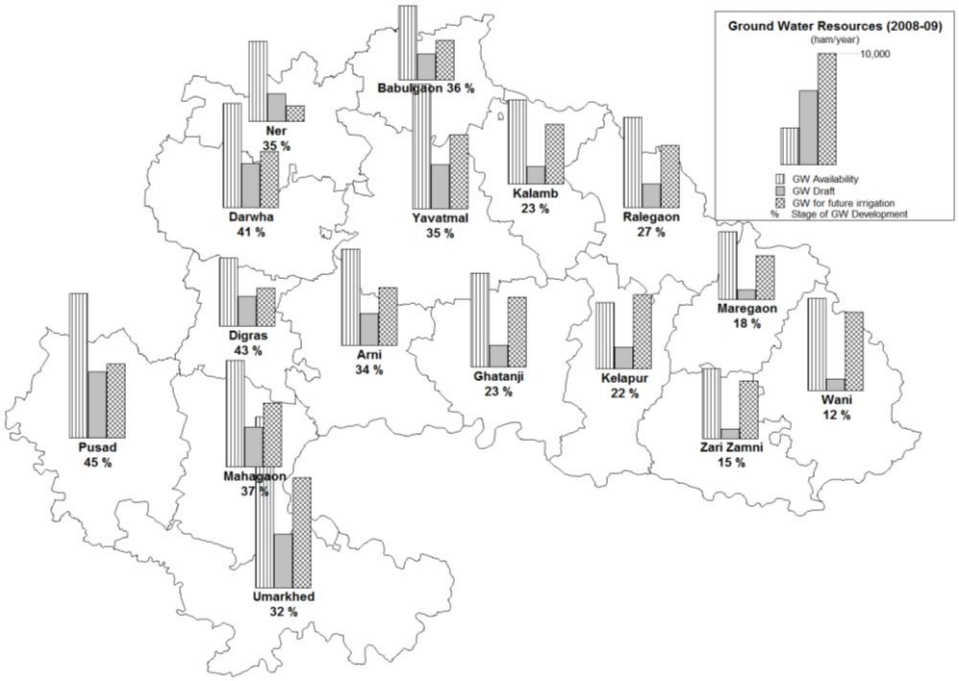

Figure 5: Ground Water Resources

Table-5: Taluka wise Ground Water Resources (March 2008).

Administrative Unit	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for All uses (11+12)	Provision for domestic and industrial requirement supply to 2025	Net Ground Water Availability for future irrigation development (10-11-14)	Stage of Ground Water Development {13/10 * 100}%	Category
Arni	8500.38	2563.63	317.53	2881.16	652.53	5126.25	33.89	Safe
Babulgaon	6498.54	1781.04	581.51	2362.55	1130.59	3531.58	36.36	Safe
Daravha	9209.99	3307.55	498.68	3806.24	1002.74	4860.02	41.33	Safe
Digras	6008.47	2311.95	270.54	2582.48	538.74	3294.83	42.98	Safe
Ghatanji	8301.51	1549.17	328.06	1877.23	663.91	6084.11	22.61	Safe
Kalamb	7282.32	1297.72	355.14	1652.86	725.34	5290.78	22.70	Safe
Mahagaon	9384.42	3096.26	360.61	3456.87	719.04	5534.93	36.84	Safe
Maregaon	5009.50	747.72	153.71	901.43	307.24	3885.69	17.99	Safe
Ner	6991.69	1978.77	476.72	2455.49	938.46	4116.51	35.12	Safe
Umarkhed	14873.34	4416.75	342.52	4759.27	694.91	9719.75	32.00	Safe
Pandharkavada	8520.69	1654.85	213.47	1868.32	429.73	6415.63	21.93	Safe
Pusad	12583.09	5309.13	399.53	5708.65	786.01	6569.43	45.37	Safe
Ralegaon	7979.72	1711.25	411.16	2122.41	815.75	5457.43	26.60	Safe
Wani	8051.81	687.15	279.64	966.80	559.51	6861.53	12.01	Safe
Yeotmal	10804.74	3250.62	545.66	3796.27	1102.47	6484.55	35.14	Safe
Zara Zamani	6164.95	699.74	204.64	904.38	411.27	5090.63	14.67	Safe
Total	**136165.16**	**36363.3**	**5739.12**	**42102.41**	**11478.24**	**88323.65**	**30.92**	**Safe**

4.3 Ground Water Quality

In the district, 14 water samples were collected from dug wells (shallow aquifers) during May 2010 and the results are given in Table 6.

Table 6. Chemical analysis results of Yavatmal district.

S.No.	District	Well No.	Village	pH	EC	TA	TH	NO_3	F	RSC
1	Yavatmal	G/YT-004	Babhulgaon	8.1	1310	660	605	25	0.19	1.10
2	Yavatmal	G/YT-005	Pandharkawada	8.0	980	320	285	22	0.93	0.70
3	Yavatmal	G/YT-007	Arni	7.8	890	255	215	36	0.01	0.80
4	Yavatmal	G/YT-010	Digras	8.2	1230	510	295	7	0.62	4.30
5	Yavatmal	G/YT-014	Wadgaon	7.9	1220	275	255	48	0.60	0.40
6	Yavatmal	G/YT-021	Ladkhed	7.6	1110	300	270	70	0.26	0.60
7	Yavatmal	G/YT-038	Pahapal	7.6	1260	215	365	157	BDL	-3.00
8	Yavatmal	G/YT-040	Injhala	7.8	1070	285	265	115	0.45	0.40
9	Yavatmal	G/YT-042	Mangrule	7.7	2000	485	410	33	0.72	1.50
10	Yavatmal	G/YT-045	Jamwadi	7.5	2900	160	1075	17	0.55	-18.30
11	Yavatmal	G/YT-051	Umarda (Nursary)	7.4	2900	175	990	1	0.49	-16.30
12	Yavatmal	G/YT-053	Savar	7.6	1400	195	330	219	0.45	-2.70
13	Yavatmal	G/YT-057	Chaparda	8.0	510	215	185	16	0.54	0.60
14	Yavatmal	G/YT-058	Dhanaj (Manekwada)	7.4	1980	325	520	173	0.32	-3.90

4.3.1 Suitability of Ground Water for Drinking Purpose Shallow Aquifer)

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., pH, TDS, TH, and NO_3 prescribed in the standards and is given in **Table-7**.

The **Table-7** shows that the concentrations of NO_3 in six samples (43%) are above maximum permissible limits. Fluoride concentration in all the samples are below the maximum permissible limit of the standards, while 21% of samples were found to have TH more than MPL.

Table-7 Classification of Ground Water Samples 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
pH	6.5	8.5	-	14	-
TDS (mg/L)	500	2000	-	12	2
TH (mg/L)	300	600	7	4	3
NO_3 (mg/L)	45	No relaxation	8	6	-
F (mg/L)	1.0	1.5	14	-	-

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

4.3.2 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 Residual Sodium Carbonate (RSC) is the most important quality criteria for determining the suitability of water for irrigation.

4.3.2.1 Residual Sodium Carbonate (RSC)

Residual Sodium Carbonate (RSC) is considered to be superior to SAR 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-8**.

Table-8 Classification of Ground Water for Irrigation based on RSC.

RSC	<1.25		1.25-2.50		>2.50	
C	Good		Doubtful		Unsuitable	
Total Samples	No. of Samples	%	No. of Samples	%	No. of Samples	%
14	12	86	1	7	1	7

The RSC values of ground water samples collected from the wells is less than 1.25 except in 12 wells, which reflects that the overall quality of ground water in the monitoring wells is good for irrigation purpose. The high value of RSC (>2.50) was found in the ground water of monitoring well from Digras village of the district and is unsuitable for irrigation purpose.

4.4 Status of Ground Water Development

The yields of wells are functions of the permeability and transmissivity of aquifer encountered and varies with location, diameter and depth etc. There are three type of ground water structures i.e. dugwells, borewells and tubes wells in the area. Their yield characteristics are described below.

Dugwells tapping Alluvium along Penganga River in Kelapur, Maregaon and Wani talukas have tremendous ground water yield. Yield of dugwells tapping Limestone is rather poor except few dugwells in Wani taluka. The average yield varies between 40 –150 m^3/day in winter and 5-50 m^3/day in summer. Dugwells tapping Gondwana formation have poor yield except around Kayar in Wani taluka. Dugwells tapping Basalt have shown drastic variation in yield in time and space. They provide seasonal irrigation except isolated patches in Ralegaon and Kelapur talukas where perennial irrigation practices are noticed. Most of the dugwells are located in geomorphic depressions and canal command area. The winter yield varies from 50 to 250 m^3/day and 15 to 100 m^3/day in summer season.

State Government has drilled large number of borewells fitted with hand pumps and electric motors for rural drinking water purposes in Deccan Trap area of the district. In all G.S.D.A, Government of Maharashtra, in the year 2003-04 were successfully operating 5082 borewells fitted with hand pumps and 269 borewells fitted with electric pumps under use for water supply in the district. Ground water development in the district is mostly through dugwells.

5.0 Ground Water Management Strategy

Ground water has special significance for agricultural development in the State of Maharashtra. Ground water development in some parts of the State has reached a critical stage resulting in 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

Ground water development scenario of the district is favourable for further ground water development in years to come. However, as the

development of ground water resources proceeds with increasing ground water withdrawal, the depletion of water table will accelerate resulting into drying or deepening of existing wells. There are many pockets in the district where water levels have deepened and also certain areas lack adequate natural replenishment. Therefore, artificial recharge measures would be required simultaneously so as to augment the ground water resources of the area. There is a need for assessing the scope and extent of artificial recharge potential available at present in the area so as to make a comprehensive management plans for the district.

The district is underlain by unconsolidated and consolidated formations, therefore, Direct Rotary (DR) and down the Hole Hammer (DTH) rigs respectively are suggested for deployment. The nature and yield potential of the aquifers occurring in different areas is given below in **Table-9**, whereas the map is presented as **Figure-6**.

Table 9: Nature and Yield Potential of Aquifers

Sr. No.	Taluka	Main Aquifers	Yield Potential	Type of wells Suitable
1	Arni	Basalt	Medium	Dugwell, DCB
2	Babulgaon	Alluvium/Basalt	Medium to High	Dugwell, DCB
3	Darwha	Basalt	Low to Medium	Dugwell, DCB
4	Digras	Basalt	Low	Dugwell, DCB
5	Ghatanji	Basalt	Medium	Dugwell, DCB
6	Jhara Jhamani	Basalt	Medium	Dugwell, DCB
7	Kalamb	Basalt	Medium	Dugwell, DCB
8	Kelapur	Basalt	Medium	Dugwell, DCB
9	Mahagaon	Basalt	Medium	Dugwell, DCB
10	Maregaon	Basalt	Medium to High	Dugwell, DCB
11	Ner	Basalt	Medium	Dugwell, DCB
12	Pusad	Basalt	Low to Medium	Dugwell, DCB
13	Ralegaon	Basalt	Medium	Dugwell, DCB
14	Umarkhed	Basalt	Medium to High	Dugwell, DCB
15	Wani	Alluvium/Basalt	Medium to High	Dugwell, DCB, Tubewell
16	Yavatmal	Basalt	Medium	Dugwell, DCB

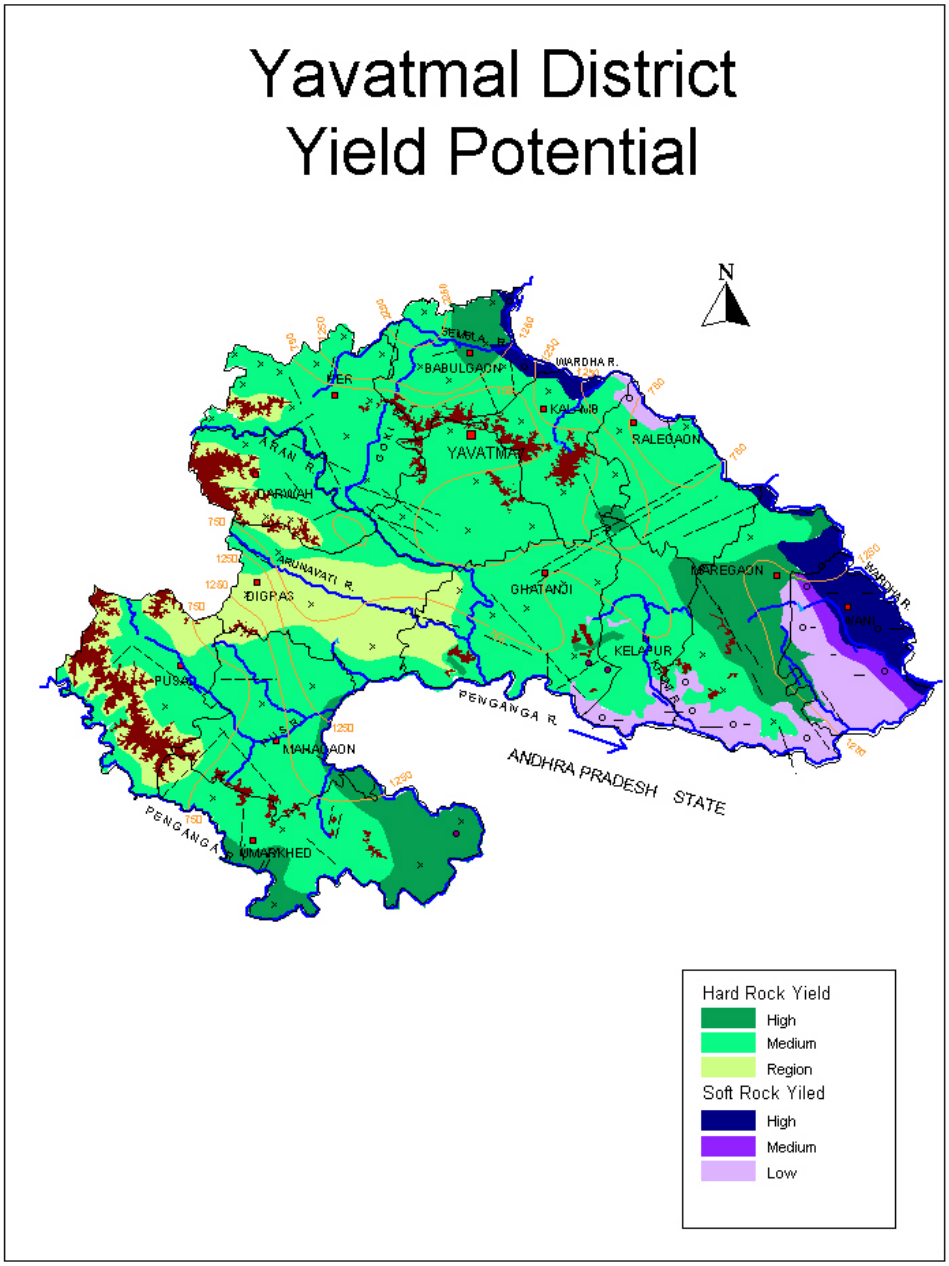

Figure 6: Yield Potential

5.2 Water Conservation and Artificial Recharge

As the district receives moderate rainfall, therefore availability of surface water is limited to monsoon period only. Small schemes of water conservation have been completed in the district to augment the water supply directly or indirectly. Total 221 percolation tanks have been constructed in the district, which are helping in augmenting the ground water supply by artificial recharge. 249 Kolhapur Type (KT) weirs provide additional storage for domestic use beyond monsoon months with a potential to irrigate 6386 ha in the district. Number of Under Ground Bandharas (UGB), Village Tanks and

Gabion structures have been constructed to check the ground and surface water flow in the district. In addition to these, number of Fracture Cement Sealing (FCS), bore hole blasting and hydro fracturing have been undertaken in the district by GSDA, Government of Maharashtra, for sustainable water supply.

The area having maximum potential for ground water recharge through artificial measures lies in Wani, Kelapur, Umarkhed, Ghatanji, Ner, Yavatmal and Darwha talukas. The suitable artificial structures recommended are recharge shaft, cement plugs, percolation tanks in soft rock formations and percolation tanks, cement plug, KT-weir, gabion structures in hard rock formations.

The volume of water for recharging the unsaturated zone (dry) of phreatic aquifers is estimated by multiplying the taluka wise area with the available unsaturated thickness and the average specific yield of the particular strata. Thus, the total storage potential of phreatic unsaturated aquifer varies from 9.04 MCM in Digras and Arni talukas to 142.56 MCM in Wani taluka.

6.0 Ground Water Related Issues and Problems

A detailed study of 26 villages of Kelapur (Pandharkawda) taluka carried out by CGWB has revealed that the high concentration of fluoride in ground water is occurring in deeper zones. The concentration of fluoride varies from place to place in different rock types vertically and laterally. High contents of fluoride ranging from 0.91 (Pimpri) to 13.41 mg/L (Dharna) have been found only in deeper zones whereas the shallow zone has not shown fluoride content beyond 0.93 mg/L (Pandharkawda). The villages like Dharna, Sakhra, Sonurli, Susuri, Wadhona (Bk.), Wadhona(Kh.), Runjha and Govarai have been found affected by Fluorosis. Mottled teeth, stiff joints and muscular pains are reported in these villages. The fluoride problems may be tackled by providing safe drinking water, educating and creating awareness in public and construction of hand pumps in phreatic zones and in the vicinities of surface water bodies preferably. Artificial recharge techniques can be used to dilute the fluoride concentration.

7.0 Mass Awareness and Training Activities

7.1 M.A.P. and W.M.T.P.

Till March 2011, one MAP and two WMTP had been organised in the district. The details are given in **Table-10**.

Table-10: Status of MAP and WMTP.

S. No.	Item	AAP	Venue	Date	No of Persons Attended
1	WMTP	2003-04	Yavatmal	12 to 13/03/04	50
2	WMTP	2004-05	Yavatmal.	28 to 29/10/04	140
3	MAP	2004-05	Pahaphal	27/12/04	500

7.2 Participation in Exhibition, Mela, Fair etc.

During the MAP and WMTP at Pahapal and Yavatmal, an exhibition depicting rainwater harvesting model, various ground water related posters, leaflets, literature and technical reports were displayed along with maps of Yavatmal district. The models, maps, posters were explained to the visitors in details.

8.0 Areas Notified by CGWA/SGWA

As per ground water resource estimation all the talukas fall under “Safe” category, hence till March 2008, the area has not been notified either by CGWA or SGWA.

9.0 Recommendations

1. Ground Water development has to take place very judiciously in Deccan Traps. Further ground water development should be taken up in difficult and scarcity areas. Ground water augmentation efforts may also be made by constructing percolation tanks, cement plugs and KT weirs at appropriate and need based location on scientific lines.
2. The additional potential of the phreatic aquifers may be harnessed appropriately considering the drinking water scarcity and irrigation needs of the area. It will generate many fold benefits to ameliorate the suffering

of underprivileged regions and economic up-liftment of the local populations.

3. Appropriate recharge schemes best suited in the area may be identified on the basis of local and site-specific surveys and terrain conditions.
4. A multi-sectoral approach is needed to study the ground water development, augmentation and management perspective. Therefore, all the aspects related to conjunctive use, ground water legislation, involvement of NGO, woman and community participation, mass awareness campaign, selection of appropriate pump sets, adoption of new irrigation methods, tissue culture technology will play an important role in conserving and developing the precious ground water water resources.