

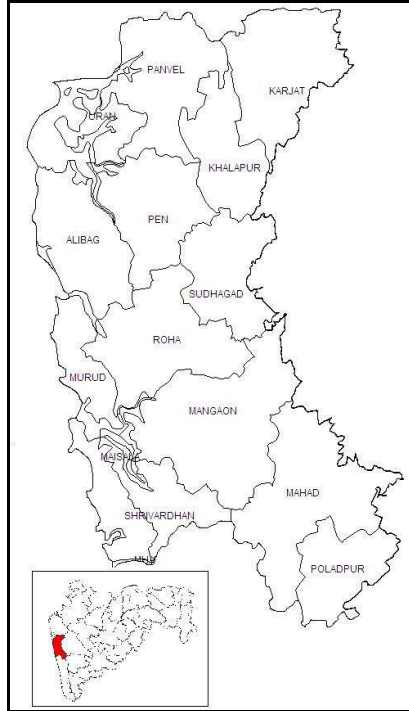


**भारत सरकार
जल संसाधन मंत्रालय
केंद्रीय भूजल बोर्ड**

**GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD**

**महाराष्ट्र राज्य के अंतर्गत रायगढ जिले की
भूजल विज्ञान जानकारी**

**GROUND WATER INFORMATION
RAIGARH DISTRICT
MAHARASHTRA**



**By
Sourabh Gupta
Scientist-D**

**द्वारा
सौरभ गुप्ता
वैज्ञानिक - घ**

**मध्यवर्ती क्षेत्र
नागपुर
CENTRAL REGION
NAGPUR
2009**

RAIGARH DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Area	:	7152 sq. km
Administrative Divisions (As on 31/03/2007)	:	Taluka – 15; Alibagh, Panvel, Uran Karjat, Khalapur, Pen, Sudhagad Mahad, Roha, Mangaon, Poladpur Mhasala, Shriwardhan, Murud and Tala
Villages	:	1919
Population	:	22,08,000
Normal Annual Rainfall	:	2200 mm to 5000 mm

2. GEOMORPHOLOGY

Major Physiographic unit	:	3; Eastern Sahayadri Hilly zone, Central low lying fertile zone, Coastal zone.
Major Drainage	:	4; Ulhas, Patalganga, Kundalika and Savitri

3. LAND USE (2000-01)

Forest Area	:	1486 sq. km
Net Area Sown	:	1356 sq. km
Cultivable Area	:	3286 sq. km

4. SOIL TYPE

Medium Black and Deep Black soil.

5. PRINCIPAL CROPS (2000-01)

Rice	:	1350 sq. km.
Pulses	:	134 sq. km.
Mango	:	131 sq. km.
Oil Seeds	:	40 sq. km.

6. IRRIGATION BY DIFFERENT SOURCES (2000-01) –

Nos. / Potential Created (ha)

No of Dugwells (irrigation)	:	4598 / 1791
No of Tubewells / Borewells	:	475 / 404
Tanks/Ponds	:	196 / 6263
Other Minor Surface Sources	:	1141 / 3273
Net Irrigated Area	:	10536 ha

7. GROUND WATER MONITORING WELLS (As on 31/05/2007)

Dugwells	:	28
----------	---	----

8. GEOLOGY

Pleistocene – Recent	:	Alluvium
Upper Cretaceous-Lower Eocene	:	Basalt (Deccan Traps)

9. HYDROGEOLOGY

Water Bearing Formation	:	Basalt- weathered/fractured/ jointed vesicular/massive, under phreatic condition and semi-confined to confined conditions. Alluvium- Sand and Gravel, under phreatic condition.
Premonsoon Depth to Water Level (May-2007)	:	0.55 to 8.60 m bgl

Postmonsoon Depth to Water : 0.30 to 3.28 m bgl
Level (Nov.-2007)
Premonsoon Water Level Trend : Rise : Negligible to 0.35 m/year
(1998-2007) Fall : Negligible to 0.48 m/year
Postmonsoon Water Level Trend : Rise : Negligible to 0.12 m/year
(1998-2007) Fall: Negligible to 0.14 m/year

10. GROUND WATER EXPLORATION (As on 31/03/07)

Wells Drilled : EW-31, OW-11
Depth Range : 46.50 to 201.30
Discharge : Traces to 29.16 lps
Storativity : 3.34×10^{-4} to 6.00×10^{-5}
Transmissivity : 40.80 to 50.52 m² / day

11. GROUND WATER QUALITY

Good and suitable for drinking and irrigation purposes.

Type of Water : Ca-HCO₃

12. DYNAMIC GROUND WATER RESOURCES (As on 31/03/2004)

Net Annual Ground Water : 159.83 MCM
Availability
Annual Ground Water Draft : 70.01 MCM
(Irrigation + Domestic)
Allocation for Domestic and : 31.51 MCM
Industrial requirement up to next
25 years
Stage of Ground Water : 46.16%
Development

13. GROUND WATER CONTROL AND REGULATION

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

14. MAJOR GROUND WATER PROBLEMS AND ISSUES

About 32000 ha of land in parts of Uran, Alibagh, Pen, Panvel, Murud, Roha, Mangaon, Mahad, Mhasala, Shrivardhan talukas along the coast and creek have been rendered saline due to breach in age old bunds. In affected areas, ground water quality has also become saline therefore rendering it unsuitable for irrigation. The prominent hill ranges, isolated hillocks, undulation etc., in the district give rise to higher runoff, rather than natural recharge. The formations due to poor storage and transmission characteristics get fully saturated during the monsoon and a situation of rejected recharge is resulted. These aquifers then are drained naturally due to slopping and undulation topography. As a result, the dugwells becomes dry by the month of February onwards.

Ground Water Information Raigarh District

Contents

1.0	Introduction.....	2
2.0	Climate and Rainfall	4
3.0	Geomorphology and Soil Types	5
4.0	Ground Water Scenario.....	5
4.1	Hydrogeology.....	5
4.2	Water Level Scenario.....	5
4.3	Aquifer Parameters.....	9
4.4	Yield of Wells.....	9
4.5	Ground Water Resources.....	10
4.6	Ground Water Quality	13
4.7	Status of Ground Water Development	14
5.0	Ground Water Development Augmentation and Management Strategy.....	15
5.1	Ground Water Development.....	15
5.2	Water Conservation and Artificial Recharge	16
6.0	Ground Water Related Issues and Problems.....	16
7.0	Areas Notified by CGWA/SGWA	16
8.0	Recommendations.....	16

List of Figures

1. Location
2. Hydrogeology
3. Premonsoon Depth to Water Level (May 2007)
4. Postmonsoon Depth to Water Level (Nov. 2007)
5. Premonsoon and Postmonsoon Water Level Trend (May and Nov. 1998-2007)
6. Ground Water Resources (2004)

List of Tables

1. Studies undertaken by CGWB.
2. Salient Features of Ground Water Exploration.
3. Annual Rainfall Data (1999-2008).
4. Ground Water Resources (March- 2004).
5. Classification of Ground Water Samples for Drinking based on BIS Drinking Water Standards (IS-10500-91, Revised 2003).
6. Classification of Ground Water for Irrigation based on SAR and RSC.
7. Nature and Yield Potential of Aquifers.

Ground Water Information

Raigarh District

1.0 Introduction

Raigarh district is one of the four coastal district situated along the western coast of the State and is located between north latitude 17°51'00" and 19°08'00" and east longitudes 72°50'00" and 73°40'00". It is bounded by Thane district in the north, Ratnagiri district in the south, Pune district in the east and Arabian sea forms the western boundary having a length of about 250 km.

The district covers an area of 7152 sq. km and has been divided into four revenue division's viz., Alibag, Panvel, Mahad and Mangaon which are further divided into fourteen talukas viz., Alibag, Panvel, Uran, Karjat, Khalapur, Pen, Sudhagad, Mahad, Roha, Mangaon, Poladpur, Mahasala, Shriwardhan and Murud. It has total population of 22,07,929 with density of 309 persons/sq.km as per 2001 census. The district has 19 towns and 1919 villages out of which 60 villages are un-habitated. Ulhas, Panvel and Patalganga are the three main rivers in northern part. Kundalika River is the main river in central part whereas in the southern part Savitri River is the main river.

As per land use details (2000 – 01) the district has an area of 1486 sq.km occupied by forest. The cultivable area of district is 3286 sq.km whereas net sown area is 1356 sq.km.

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

Table 1: Studies undertaken by CGWB.

S. No.	Officer	AAP	Type of Survey / Study
1.	Shri J. S. Sharma	1983 – 84	Systematic Hydrogeological Surveys in parts of Raigarh district.
2.	Shri K. Srinivasan	1984-85	Systematic Hydrogeological Surveys in parts Raigarh district.
3.	Shri K. Srinivasan	1985-86	Systematic Hydrogeological Surveys in parts Raigarh district.
4.	L.J. Balachandra	2000-01	Reappraisal Hydrogeological Studies in northern parts of Raigarh district.
5.	A.B. Kawade	2000-01	Reappraisal Hydrogeological Studies in southern parts of Raigarh district.

In addition to the above a report on "Ground Water Resources and Development Potential of Raigarh District, Maharashtra" was compiled during year 1998-99 by Shri D. B. Shetye, Senior Hydrogeologist. Ground water Exploration in the district has been taken up in different phases since 1996 in areas occupied by Deccan Trap Basalt. A total of 31 exploratory wells (EW), 11 observation wells (OW) have been drilled till March 2008.

A map of the district showing taluka boundaries, taluka headquarters, physical features and location of monitoring wells in presented in Figure–1.

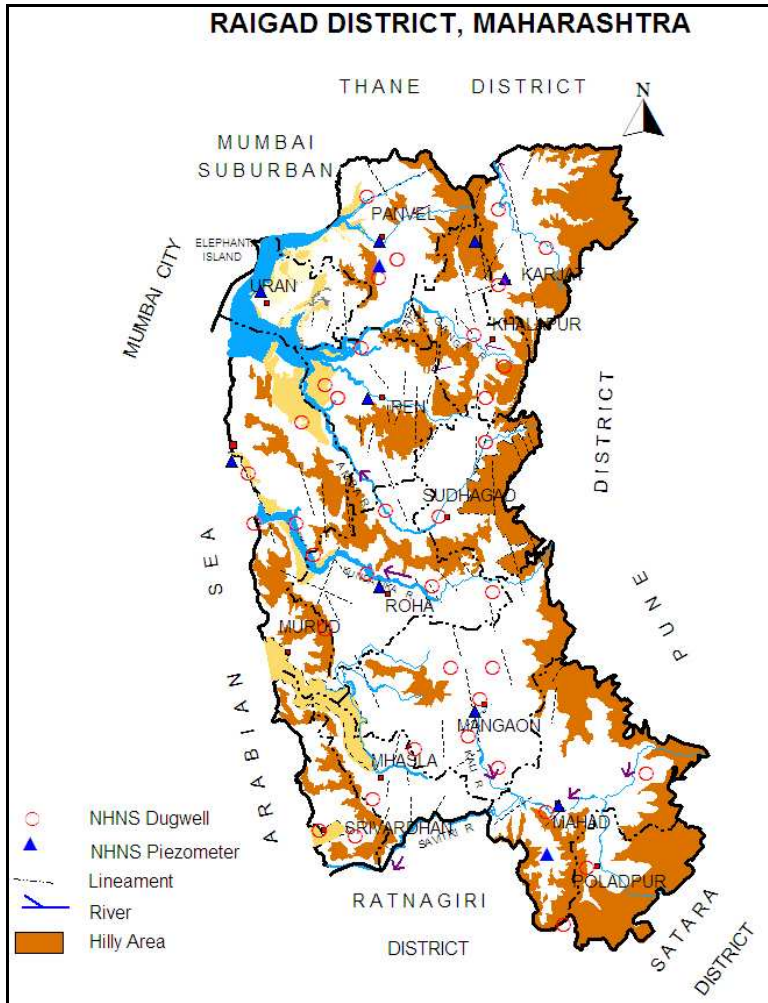


Figure 1: Location

Table 2: Salient Features of Ground Water Exploration.

S. No.	Taluka	Wells Drilled		Depth (m bgl)	SWL (m bgl)	Discharge (lps)	Zones encountered (m bgl)
		EW	OW				
1.	Mahad	3	2	75.00 – 200.00	1.75 – 13.25	0.05 – 8.75	10.00 – 101.60
2.	Poladpur	2	2	150.00 – 200.00	4.50 – 9.00	Traces – 12.18	16.00 – 137.00
3.	Mangaon	5	2	184.30 – 200.00	0.98 – > 85.00	1.37 – 8.75	12.00 – 196.00
4.	Roha	5	0	184.00 – 200.00	1.00 – > 50.00	Traces – 0.78	-
5.	Alibagh	2	0	200.00	-	Traces – 0.14	20.00 – 21.00
6.	Tala	2	0	193.30 – 200.00	6.20 – 6.32	0.78 – 2.16	10 - 150
7.	Pen	3	3	126.00 – 175.00	2.69 – 16.69	3.40 – 29.16	79.00 – 172.00
8.	Panvel	1	0	200.00	8.11	0.24	95.00

9.	Khalapur	1	1	116.00 – 140.00	8.93 – 9.00	1.73 – 15.00	54.00 – 79.00
10.	Sudhagarh	2	1	46.50 – 145.50	2.35 – 4.92	0.38 – 7.76	17.00 – 139.00
11.	Karjat	2	0	200.00	6.00	Traces – 0.38	-
12.	Mhasala	1	0	200.00	5.20	1.80	-
13.	Murud	1	0	75.00	4.50	5.94	16.00 - 18.00
12.	Total	30	11	46.50-200.00	0.98 - >85.00	Traces to 29.16	12.00 – 196.00

It is observed from Table-2 that drilled depth of the wells ranged from 46.50 to 200.00 metre below ground level (m bgl) with discharge ranging from traces to 29.14 litres per second (lps). Out of 30 exploratory wells drilled in the district, 10 wells (about 33%) are high yielding with discharge of more than 3 lps. Water bearing zones were encountered between the depth of 12 and 196 m bgl, thus indicating the presence of water bearing zones even at deeper depths beyond 100 m bgl. The static water levels ranged from 0.98 to >85 m bgl.

2.0 Climate and Rainfall

The climate of the district is typical of west coast and characterized with plentiful and regular seasonal rainfall, oppressive weather in summer and high humidity throughout the year. The mean minimum temperature is 17.7°C and mean maximum temperature is 31.8°C.

The analysis of long term rainfall data indicates that normal annual rainfall over the district ranges from 2200 mm to more than 3000 mm in the plains and it is above 5000 mm in the hills. The minimum rainfall is in the northwest around Uran (2197 mm) and maximum around Mahad (3360 mm). The average annual rainfall data for the period 1999-2008 was also compiled and is given in Table-3. It ranges from 2113 (Uran) to 3942 mm (Poladpur).

Table 3: Annual Rainfall Data (1999-2008). (mm).

Taluka	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Avg.
Alibag	1911.20	2650.80	1660.70	1497.20	2484.90	2550.20	2325.20	2456.30	3451.82	2443.42	2361.65
Karjat	3299.10	3601.50	2931.70	3117.50	3243.00	3293.50	4808.00	4800.60	3465.80	2990.60	3495.72
Khalapur	4471.20	3415.60	2703.60	2446.90	3082.00	3094.40	4320.00	3838.20	3177.35	3489.90	3369.43
Mahad	3389.40	3085.00	2483.20	2474.00	2583.90	3379.70	4364.70	3625.50	5892.50	3205.70	3413.33
Mahasala	4861.20	3707.30	2704.50	2283.10	3525.90	3810.60	3877.10	3483.80	4224.00	2327.75	3463.94
Mangaon	3727.70	3864.00	2504.20	2539.20	3453.70	3811.10	3790.80	3665.20	3763.60	3847.00	3557.23
Murud	2159.10	3082.50	1497.50	1875.00	2659.30	3142.40	2734.90	2749.40	3531.65	2585.46	2666.02
Panwel	2059.30	3250.90	2579.30	2002.60	3021.90	2750.00	2778.50	3878.60	3055.70	3784.30	2868.09
Pen	3379.90	3625.90	2645.30	2651.60	2022.00	2196.80	3005.20	2724.70	3300.20	3357.90	2969.09
Poladpur	3657.20	3543.30	3966.30	3055.00	3305.00	3967.00	5390.00	4780.00	4202.70	3716.70	3942.38
Roha	3409.00	4108.00	2656.10	2452.80	3654.10	4006.20	4587.50	4011.50	3722.67	4010.00	3715.42
Shriwar-dhan	2978.70	2835.00	1826.30	1951.10	2307.20	2868.70	2791.80	2575.80	3394.80	2031.60	2565.70
Sudhagad	3814.00	3803.00	2488.70	2832.30	3680.00	3949.90	4577.20	4317.80	3806.90	2629.00	3662.35
Tala	3706.00	3149.40	2440.50	2554.90	3952.40	3838.40	4495.40	4145.00	3652.19	3178.04	3565.75
Uran	1387.60	2710.00	912.00	1324.50	2006.80	2160.30	2206.50	2437.40	2602.00	3104.30	2113.31

(Source: www.agri.mah.nic.in)

3.0 Geomorphology and Soil Types

The district has three physiographic divisions i.e. (i) Coastal zone in west covers about 20% percent of the district (ii) Central zone covers about 1/3 rd of the district, consisting of fertile land in low lying area (iii) Hilly zone in the eastern part highly uneven in altitude and covered with forest. This hill range is characterized by ruggedness and uneven topography, with crestline of peaks and saddles forming the eastern horizon. Ulhas, Panvel and Patalganga are the three main rivers in northern part. Kundalika River is the main river in central part whereas in the southern part Savitri River is the main river.

The soils in the district are formed from the Deccan Trap which is predominating rock formation with small out crops of Laterite at a few places in the Poladpur taluka and Matheran hill. The soils are grouped as Forest, Varkas, Rice, Khar or Saline, Coastal Alluvium and Laterite as per the location and topographical situation.

4.0 Ground Water Scenario

4.1 Hydrogeology

Deccan Trap Basalt of upper Cretaceous to lower Eocene is the major rock formation and intruded by a number of dykes. The western part of the district consisting Basalt flows are altered to Laterite. Recent deposits comprising Beach Sand and Alluvium occur along the coast and in the river mouth, however they do not form potential aquifer. A map depicting the hydrogeological features is shown as Figure–2.

4.1.1 Hard Rock Areas

4.1.1.1 Deccan Trap Basalt

Ground water in Deccan Trap Basalt occurs mostly in the upper weathered and fractured parts down to 10 – 15 m bgl under unconfined condition. The water bearing strata at deeper depth exists under semi confined to confined conditions. The dugwells in these areas show rapid decline in water level during postmonsoon period and practically go dry in peak summer. In foot hill zones the water table is relatively shallower near water course. The yield of dugwells tapping upper phreatic aquifer ranges between 45 to 60 m³/day, whereas that of borewells varies from 0.50 to > 20 m³/hr. depending upon the local hydrogeological conditions, however in most of the borewells it is up to 5 m³/hr.

4.1.2 Soft Rock Areas

4.1.2.1 Beach Sand/Alluvium

The Alluvial deposits are found along the coastal areas in few isolated patches having limited areal extent as Beach Sand and along the course of major rivers. In the alluvial deposits, primary porosity is due to the inter-granular pore spaces making sands and gravels good water bearing formations. The ground water occurs under phreatic/unconfined aquifer at relatively shallow depths of 3-5 m and their yield ranges from about 18 to 43 m³/hr.

4.2 Water Level Scenario

Central Ground Water Board periodically monitors 28 National Hydrograph Network Stations (NHNS) in Raigarh district, four times a year i.e. January, May, August and November.

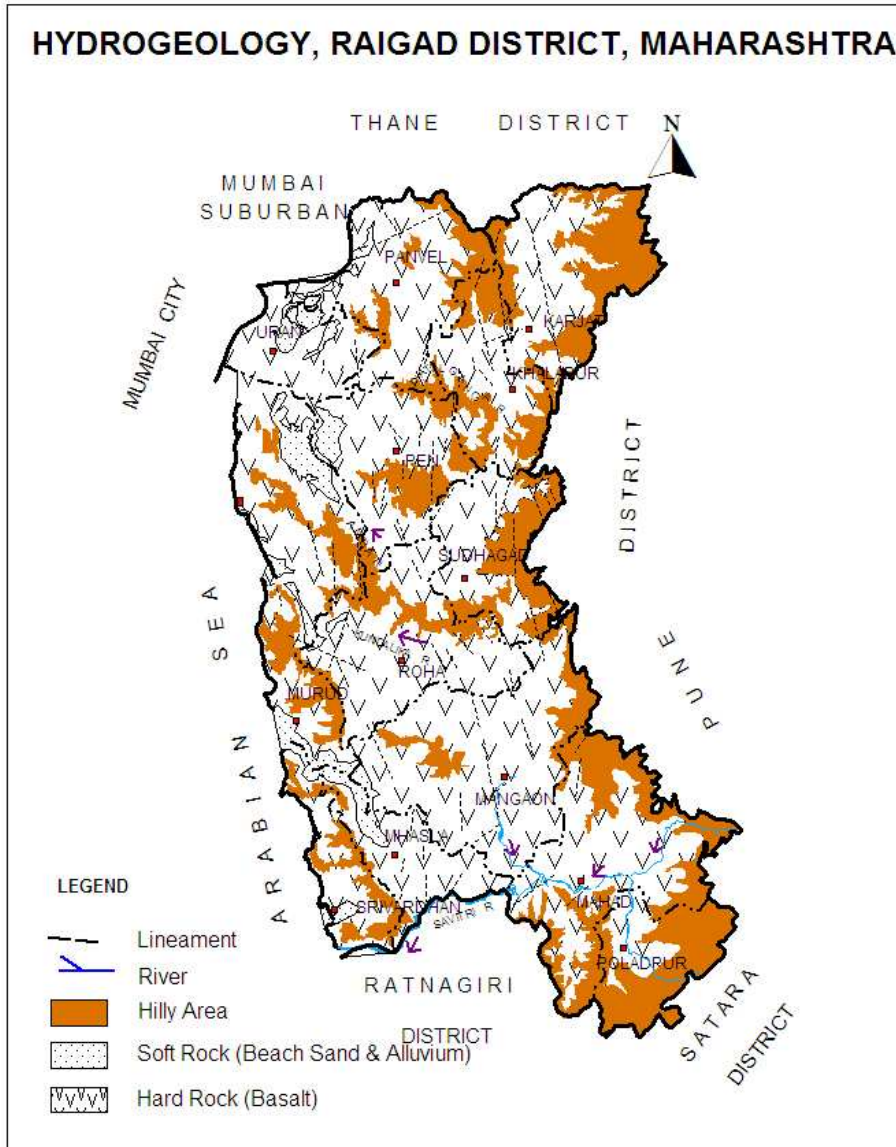


Figure 2: Hydrogeology

4.2.1 Depth to Water Level – Premonsoon (May – 2007)

The depth to water levels in the district during May 2007 ranges between 0.55 m bgl (Nagothan) and 8.60 m bgl (Chinchwad). Depth to water levels during premonsoon (May 2007) has been depicted in Figure–3. Shallow water levels i.e., less than 2 m bgl are seen in the central part of the district. The water levels 5 to 10 m bgl are seen in the southern part of the district i.e. around Poladpur and Mahad and also as scattered patches across the district. In the major part of the district water level ranges from 2 to 5 m bgl.

4.2.2 Depth to Water Level – Postmonsoon (Nov. – 2007)

The depth to water levels during postmonsoon (Nov. 2007) ranges between 0.30 m bgl (Kargaon) to 3.28 m bgl (Khalapur). Spatial variation in postmonsoon depth to water levels is shown in Figure–4. Shallow water levels of less than 2.0 m bgl are seen in major part of the district whereas water levels of 2 to 5 m bgl are seen as patches in north western part and along the eastern periphery of the

district around Khalapur, Karjat and Poladpur in southern part of the district. The water levels of 5 to 10 m bgl are restricted around south eastern part of the district.

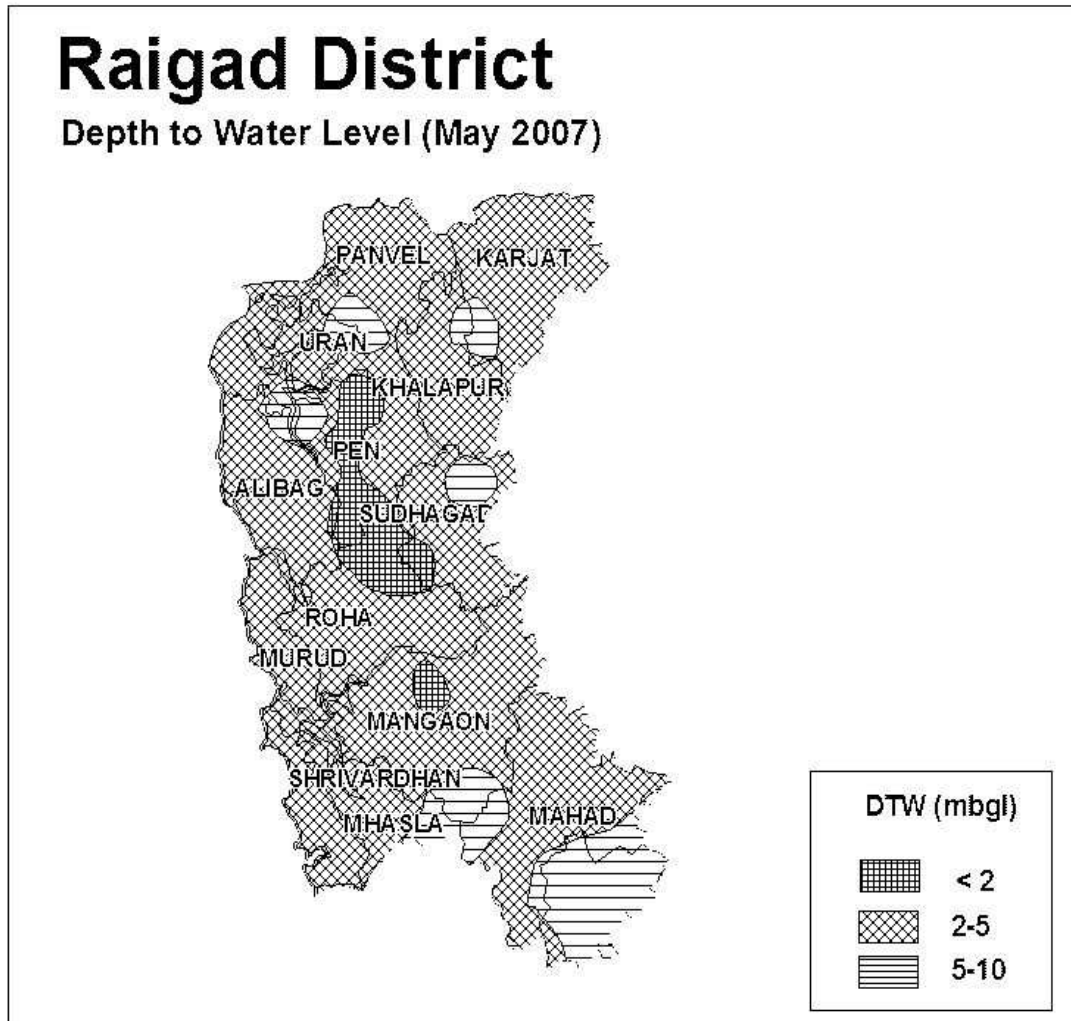


Figure-3: Premonsoon Depth to Water Level (May 2007).

4.2.3 Seasonal Water Level Fluctuation (May – Nov. 2007)

The fluctuation between May and Nov, 2007 water levels in the district range from 0.25 (Indapur) to 7.98 m (Chinchwad). In the major part of the district the fluctuation range is less than 2.0 m. The higher fluctuation of more than 2 m is observed in southern part i.e. around Mahad, Poladpur and as scattered patches around. Karjat, Chinchwad, Khutal and Chandora. The negative fluctuation i.e., fall in postmonsoon period has been observed in the range of 0.12 (Jite and Pali) to 0.18 m (Khalapur) in central part of the probably due to supplement well irrigation to paddy crop.

Raigad District

Depth to Water Level (November 2007)

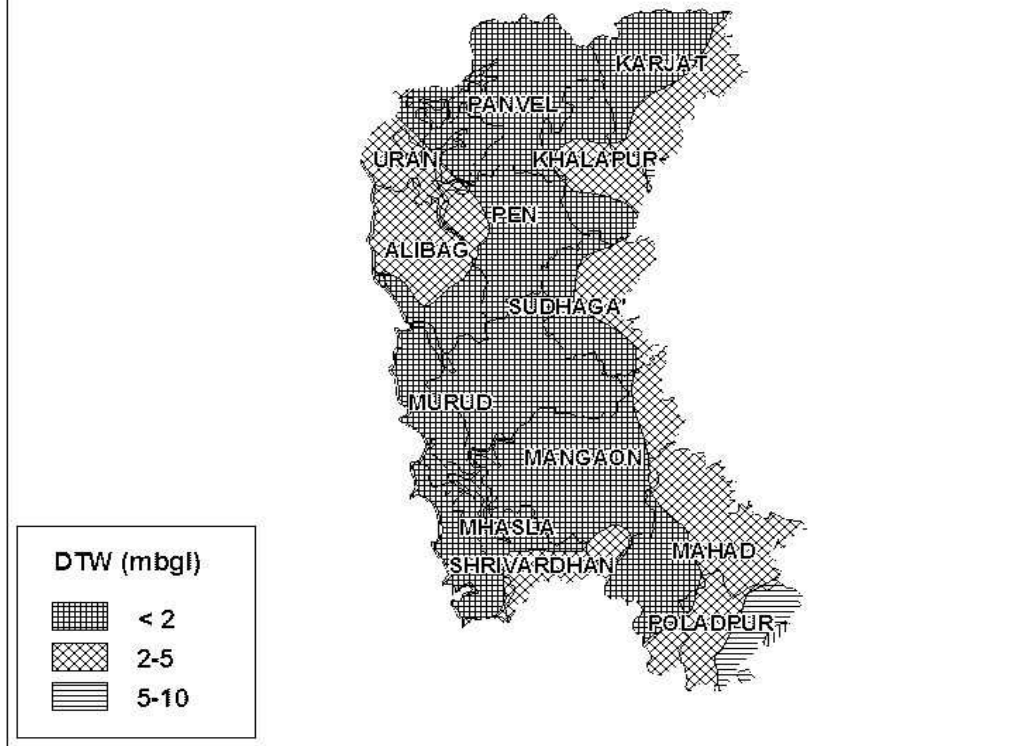


Figure-4: Premonsoon Depth to Water Level (May 2007).

4.2.4 Water Level Trend (1998 – 2007)

Trend of water levels for premonsoon and postmonsoon periods for last ten year (1998 – 2007) have been computed for 28 NHNS. Analysis of trend indicated that during pre-monsoon period, rise in water level has been recorded at 12 stations and it ranges between negligible (Phugaon) and 0.35 m/year (Veshwi). Fall in water levels has been observed at 16 stations and it ranges between negligible (Neral) and 0.48 m/year (Dapoli). During postmonsoon period, rise in water levels is observed at only 6 stations and it ranges from negligible (Saigaon Govalwadi) to 0.12 m/year (Neral), whereas the fall is observed at 22 stations and it ranges from negligible (Nagothan) to 0.14 m/year (Indapur). Thus in major parts of the district decline in water levels both during premonsoon and postmonsoon was observed.

The spatial distribution of premonsoon and postmonsoon water level trends is presented in Figure-5. The perusal of Figure-5 shows that during both the periods major part of the district shows declining water level trend in the range of 0 to 0.20 m/year. During premonsoon rising water level trend is observed in patches in north central part in parts of Uran, Khalapur and Pen talukas; in central part in major part of Murud taluka; and in southern part of the district in parts of Mhasala and Shrivardhan and almost entire Poladpur and Mahad talukas, whereas in postmonsoon period rising trend is further reduced/restricted to central part around Pen taluka and in northern part around Karjat talukas.

Raigad District

Trend of Water Level (1998-2007)

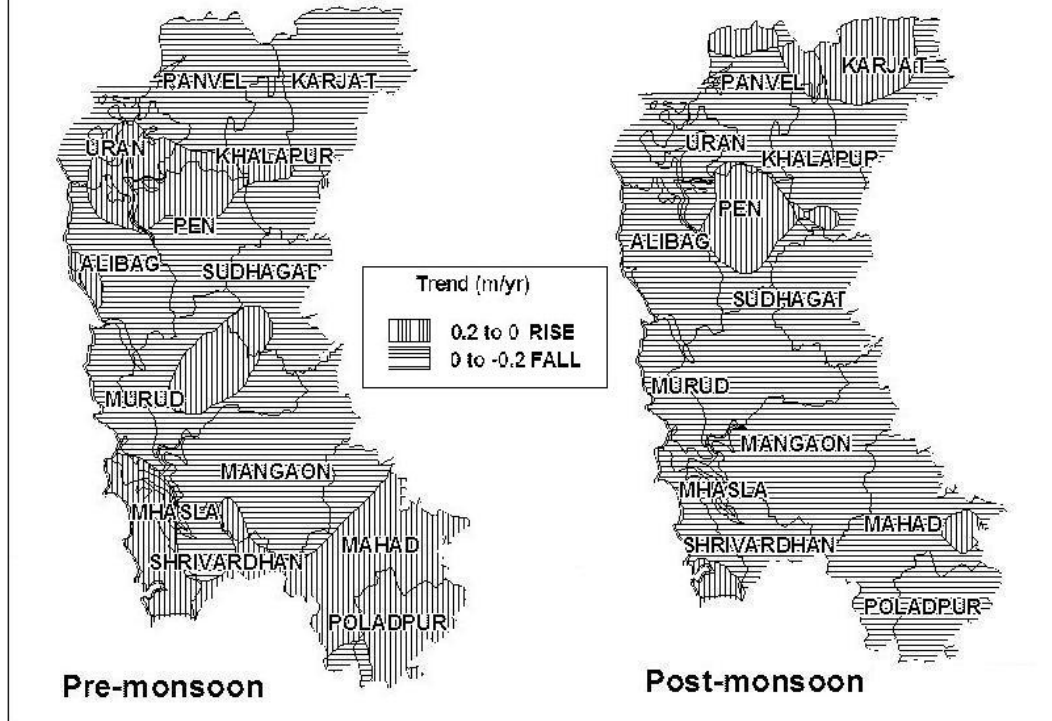


Figure-5: Premonsoon (L) and Postmonsoon (R) Water Level Trend (May and Nov. 1998-2007)

4.3 Aquifer Parameters

Based on the exploratory drilling in the district aquifer parameters like transmissivity and storativity of the deeper aquifer in basaltic terrain varies from 40.80 to 50.52 m²/day and storativity varies from 3.34x10⁻⁴ to 5.934x10⁻⁵. The pumping tests on dugwells were conducted which are tapping alluvium, laterite and vesicular basalt, fractured basalt and weathered massive basalt. The specific capacity, transmissivity and storativity values as analysed by Ground Water Survey and Development Agency (GSDA) are found to be ranging in Alluvium from 27.18 to 670.54 lpm/m of drawdown, 9.96 to 88.54 m²/day and 0.013 – 0.053 respectively. In vesicular basalt the values range from 14.53 – 150.36 lpm/m of drawdown, 5.04 – 22.11 m²/day and 0.017 – 0.030 respectively, whereas in fractured basalt they range from 16.74 – 158.00 lpm/m of drawdown, 3.97 – 39.45 m²/day and 0.020 – 0.050 respectively. In moderate to highly weathered massive basalt the values of specific capacity, transmissivity and storativity range from 6.38 – 285.93 lpm/m of drawdown, 2.02 – 94.84 m²/day and 0.0095 – 0.057 respectively.

4.4 Yield of Wells

The yields of the wells are the functions of the permeability and transmissivity of aquifer encountered. This varies with location, diameter and depth of wells. There are mainly two types of ground water structures in the district i.e., dugwells and borewells. Yield of dugwells in Basalt varies according

to the nature of formations tapped. The yield of dugwells in phreatic aquifer ranges from 45 to 60 m³/day and pumping rarely exceeds 2 to 3 hours. As per the exploration data of CGWB, the discharge of the exploratory wells was found in the range of traces to 29.14 lps. Borewells drilled by GSDA down to the depth of 90 m tapping weathered and vesicular basalt are found to yield 0.5 to > 20 m³/hr, however most of the borewells yield upto 5 m³/hr. In the Alluvial area of coastal tract dugwells are capable of yielding 18 to 43 m³/hr. for 2 to 5 m drawdown for two to four hours/day.

4.5 Ground Water Resources

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Raigarh district based on GEC-97 methodology. The same is presented in Table-4. Taluka wise ground water resources are shown in **Figure-5**.

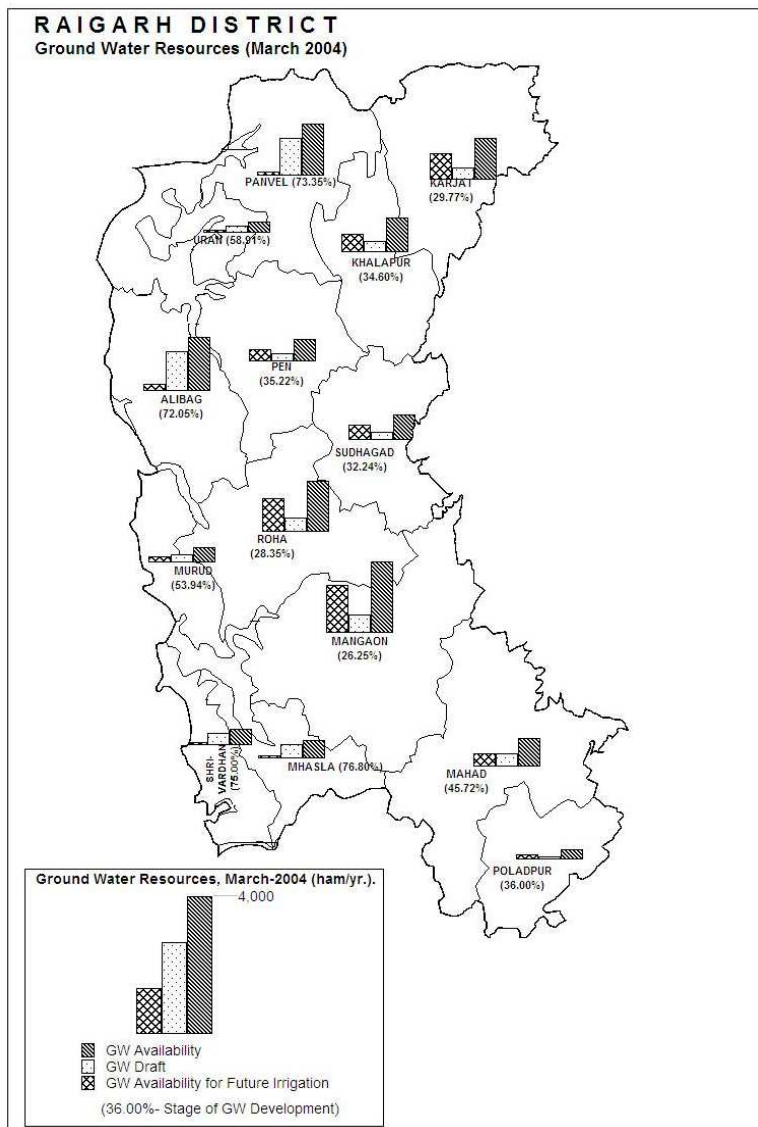


Figure-5: Ground Water Resources

Table-4: Ground Water Resources (March 2004).

Taluka	Area Type	Net Annual Ground water Availability (ham/year)	Annual Ground Water Draft (ham/year)			Allocation for domestic & industrial requirement supply up to next 25 years (ham/yr.)	Ground water Availability for future irrigation (ham/year)	Stage of Ground water Development (%)	Category
			Irrigation	Domestic & Industrial uses	Total				
Alibag	Command	92.32	9.22	1.69	10.90	3.37	79.73	11.81	Safe
	Non Command	1728.50	974.81	326.26	1301.07	589.66	164.04	75.27	
	Total	1820.82	984.02	327.94	1311.97	593.03	243.77	72.05	
Panvel	Command	60.65	28.82	6.27	35.09	12.53	19.30	57.85	Safe
	Non Command	1661.13	908.08	319.82	1227.90	639.63	113.41	73.92	
	Total	1721.78	936.90	326.08	1262.99	652.16	132.71	73.35	
Uran	Command	14.67	3.70	1.36	5.06	2.72	8.24	34.52	Safe
	Non Command	381.33	189.95	38.29	228.24	76.59	114.80	59.85	
	Total	396.00	193.65	39.66	233.30	79.31	123.04	58.91	
Karjat	Command	277.04	75.15	2.47	77.62	4.95	196.95	28.02	Safe
	Non Command	1123.21	240.66	98.53	339.19	197.06	685.49	30.20	
	Total	1400.25	315.81	101.00	416.81	202.01	882.44	29.77	
Khalapur	Command	126.56	32.15	11.86	44.01	23.73	70.68	34.78	Safe
	Non Command	1006.77	235.99	112.04	348.03	224.09	546.69	34.57	
	Total	1133.33	268.14	123.91	392.05	247.82	617.37	34.59	
Pen	Command	70.73	15.98	6.03	22.01	12.07	42.69	31.12	Safe
	Non Command	664.77	168.11	68.89	237.00	137.79	358.88	35.65	
	Total	735.51	184.09	74.93	259.01	149.86	401.57	35.22	
Sudhagad	Command	122.51	16.08	4.68	20.76	9.36	97.07	16.95	Safe
	Non Command	735.71	185.23	70.70	255.93	141.39	409.09	34.79	
	Total	858.22	201.31	75.38	276.69	150.75	506.16	32.24	
Mahad	Command	99.68	68.73	6.03	74.76	11.51	19.45	75.00	Safe
	Non Command	879.71	278.78	94.28	373.06	185.98	414.95	42.41	
	Total	979.39	347.51	100.31	447.82	197.49	434.40	45.72	

Taluka	Area Type	Net Annual Ground water Availability (ham/year)	Annual Ground Water Draft (ham/year)			Allocation for domestic & industrial requirement supply up to next 25 years (ham/yr.)	Ground water Availability for future irrigation (ham/year)	Stage of Ground water Development (%)	Category
			Irrigation	Domestic & Industrial uses	Total				
Roha	Command	501.68	46.48	4.09	50.57	7.11	448.08	10.08	Safe
	Non Command	1198.37	334.02	97.32	431.34	194.64	669.71	35.99	
	Total	1700.05	380.50	101.41	481.91	201.75	1117.79	28.35	
Mangaon	Command	450.35	28.42	2.95	31.36	3.75	418.18	6.96	Safe
	Non Command	1941.82	437.54	159.07	596.61	318.15	1186.14	30.72	
	Total	2392.17	465.95	162.02	627.97	321.90	1604.32	26.25	
Poladpur	Command	18.05	15.69	1.78	17.46	2.36	0.00	96.77	Safe
	Non Command	335.24	56.60	53.05	109.66	106.10	172.53	32.71	
	Total	353.29	72.29	54.83	127.12	108.46	172.53	35.98	
Mhasala	Command	42.25	26.32	3.15	29.46	3.81	12.12	69.74	Safe
	Non Command	585.29	405.06	47.35	452.41	94.69	85.54	77.30	
	Total	627.54	431.38	50.49	481.87	98.50	97.66	76.79	
Shriwardhan	Command	33.83	17.31	2.91	20.22	4.53	11.99	59.77	Safe
	Non Command	516.24	355.09	37.20	392.29	74.39	86.75	75.99	
	Total	550.07	372.41	40.10	412.51	78.92	98.74	74.99	
Murud	Command	107.21	22.91	1.43	24.33	0.94	83.36	22.70	Safe
	Non Command	392.00	210.79	34.14	244.93	68.27	112.94	62.48	
	Total	499.21	233.70	35.56	269.26	69.21	196.30	53.94	
District total	Command	2017.53	406.95	56.68	463.63	102.74	1507.84	22.98	
	Non Command	13150.10	4980.72	1556.94	6537.65	3048.43	5120.96	49.72	
	Total	15167.63	5387.67	1613.62	7001.29	3151.17	6628.80	46.16	

Ground water assessment is done for an area of 3747 sq. km of which 152.94 sq. km area is under command and 3594.65 sq. km area is under non-command. As per the estimation the total annual ground water recharge is 159.83 MCM with the natural discharge of 8.16 MCM, thus the net annual ground water availability comes to be 151.67 MCM. The gross draft for all uses is estimated of 70.01 MCM with irrigation sector being the major consumer having a draft of 53.87 MCM, whereas the domestic and industrial draft is to the tune of 16.13 MCM. The net ground water availability for future irrigation is estimated to be 66.28 MCM, whereas the allocation for domestic and industrial supply up to next 25 years is 31.51 MCM. Stage of ground water development varies from 26.25% (Mangaon) to 76.79% (Mhasala). The overall stage of ground water development for the district is 46.16%. All the 14 talukas and 17 watersheds of the district fall in "Safe" category.

4.6 Ground Water Quality

Central Ground Water Board monitors the ground water quality of the district through analysis of water samples collected from its National Hydrograph Network Stations (NHNS) which represent the shallow aquifer of the district only. The objective behind quality monitoring is to understand an overall picture of ground water quality of the district. During year 2007, CGWB has carried out the ground water quality monitoring at 24 NHNS.

The result of chemical analysis shows that the ground water in the district is alkaline in nature. The concentration of major ions indicates that among the cations, the concentration of sodium is highest followed by magnesium and calcium, while among the anions the concentration of bicarbonate ion is highest, followed by sulphate, chloride, and nitrate ions.

4.6.1 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. The classification of water was carried out as per the Bureau of Indian Standards (BIS) for drinking water to assess the suitability of ground water.

Table –5: Classification of Ground Water samples based on BIS Drinking Water standards (15 – 10500 – 91, Revised 2003)

Parameter	DL	MPL	Samples with conc. < DL	Samples with conc. in DL – MPL	Samples with conc. > MPL
TDS (mg/L)	500	2000	21	1	1
TH (mg/L)	300	600	23	Nil	1
Ca (mg/L)	75	200	23	1	Nil
Mg (mg/L)	30	100	22	2	Nil
Cl (mg/L)	250	1000	23	1	-
SO ₄ (mg/L)	200	400	22	1	1
NO ₃ (mg/L)	45	No relaxation	24	Nil	Nil
F (mg/L)	1.0	1.5	24	Nil	Nil

(Here, DL – Desirable limit, MPL – Maximum Permissible Limit.).

The perusal of Table-5 shows that 95% of the sample falls in desirable limit of water quality standard, therefore, water quality is good for drinking purpose, except the water at Dapoli NHNS (Roha taluka) where the concentration of Total

Dissolved Solids (TDS), Total Hardness (TH) and Sulphate (SO₄) are beyond permissible limit. The high concentrations of these constituents may be due to sea water ingress.

4.6.2 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 their concentrations.

Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the most important quality criteria, which influence the water quality and suitability for irrigation.

4.6.2.1 Sodium Absorption Ratio (SAR)

Sodium Absorption Ratio (SAR) is an expression pertain to cation make up of water and soil solution and is used for characterizing the sodium hazard of irrigation water. SAR value is used to calculate the degree to which irrigation water tends to enter into cation exchange section in the soil. The main problem with high sodium concentration is its effect of soil permeability. Sodium also contributes directly to the total salinity of the water and may be toxic to sensitive crops such as fruit trees. The higher value of SAR indicated soil structure damage.

4.6.2.2 Residual Sodium Carbonate (RSC)

Residual Sodium Carbonate (RSC) is considered to be superior to SAR as a measure of sodicity at low salinity levels. The classification of ground water samples based on SAR and RSC values for its suitability for irrigation purpose is shown below in Table – 6.

Table–6: Classification of Ground Water for irrigation based on SAR and RSC.

SAR	< 10		10 – 18		18 – 26		>26	
Category	Good		Good to Permissible		Doubtful		Unsuitable	
Total Samples	No of Samples	%	No of Samples	%	No of Samples	%	No of Samples	%
24	23	96	1	4	-	-	-	-
RSC	< 1.25		1.25 – 2.50		> 2.50			
Category	Good		Doubtful		Unsuitable			
Total Samples	No of Samples	%	No of Samples	%	No of Samples	%		
24	24	100%	-	-	-	-		

The perusal of Table – 6 shows that out of 24 samples, 23 samples are having SAR value below 10 indicating that the possibility of sodium hazard is low if the water is used for irrigation purpose. The ground water sample collected from well located at Dapoli is having SAR value in the range of 10 to 18 and is under permissible category. The RSC value of all the samples is below 1.25, hence the water is suitable for irrigation.

4.7 Status of Ground Water Development

Ground water development depends on many factors viz., availability, crop water requirement, socio-economic fabric and on the yield of the aquifers existing in that area. Ground water in the district is predominantly used for irrigation as it is the major ground water utilizing sector. The ground water development in the

district is mostly through dugwells. The minor irrigation census data of 2000-01 indicates that the area irrigated by ground water is about 18 sq.km., whereas surface water accounts for about 87 sq. km. of the area and the net irrigated area stand at 105 sq. km. Thus it is clear that surface water is the major source of irrigation as it accounts for 83% of the net irrigated area. There are about 4598 dugwells in use in the district which create an irrigation potential of 18 sq. km. out of which almost entire irrigation potential of 17.73 sq. km. is utilized, whereas 475 borewells create an irrigation potential of about 4 sq. km. and entire irrigation potential is utilized.

5.0 Ground Water Development Augmentation and Management Strategy

Agricultural development in the district mainly depends on rainfall. The ground water development in almost entire district is on the lower side mainly due to the presence of hilly areas in major part of the district. The district also faces water scarcity during summer months in spite of heavy rainfall. There is thus a need to adopt an integrated approach of development of ground water resources dovetailed with ground water augmentation and rainwater conservation to provide sustainability to ground water development.

5.1 Ground Water Development

Physiography, geology and rainfall of the district plays a major role in the ground water resource availability and sustainability. The high, steep hill ranges, isolated hillocks, undulation etc give rise to high run off. The predominance of hard rock formation in the form of basaltic lava flows facilitates the run off rather than natural recharge due to the poor ground water storage and transmission capabilities. The formation due to poor storage and transmission characteristics gets fully saturated during monsoon and a situation of rejected recharge is resulted. These aquifers then are drained naturally due to slopping and undulation topography.

The district despite of high rainfall of (1500 – 3500 mm) faces water scarcity situation following January or February month. Development of ground water has taken place on a limited scale in Deccan Trap Basalt area. However, ground water development for irrigation purpose has taken place on a good scale in the Alluvial area of coastal tract. The irrigation wells are capable of yielding 5 to 12 lps for 2 to 5 m draw down in two to four hours a day.

The dugwells used for drinking and for irrigation are shallow in depth (4–8 m bgl). The yield as well as sustenance of these wells can be increased by deepening of wells by 4 to 6 m, if porous and permeable formation is likely to occur at depth.

Ground water resource estimation has indicated scope for further development in all the talukas. The net ground water availability for irrigation is about 66 MCM. In the eastern part of the district, which is occupied by hilly area with rugged topography, steep slope sand rock exposure is not suitable for ground water development. The coastal zone is already developed with more than 70% of existing irrigation wells in Murud, Alibagh and Shriwardhan talukas. Any further development in this zone may cause saline water ingress. The central part consisting of valley and plain is most suitable for ground water development and additional wells can be constructed in favourable areas. To develop the ground water resources in these parts dugwells are most feasible structures for

ground water development. The borewells should normally be avoided as they generally tap deeper fractures, which may not be sustainable. Besides, the borewells should only be used for drinking water supply and not for irrigation. The sites for borewells also needs to be selected only after proper scientific investigation so as to minimise the rate of failure.

5.2 Water Conservation and Artificial Recharge

In Basaltic area, the artificial recharge structures feasible are check dams, gully plugs, percolation tanks, nalla bunds, etc. The structures like gully plugs, contour bunds are most favourable in the hilly areas. In the highland area and wide lateritic plateau areas, contour trenching should be carried out to arrest the surface runoff and ensure recharge of rainfall runoff into the ground water reservoir. Existing dugwells can also be used for artificial recharge, however, the source water should be properly filtered before being put in the wells. These sites need to be located where the hydrogeological conditions are favourable, i.e., where sufficient thickness of unsaturated/de-saturated aquifer exists and water levels are deeper than 5 m. Occurrence of such areas are very limited in the district as seen from postmonsoon water level map.

Rainwater harvesting through village ponds, Roof top and individual tank storage are also appropriate and can render as supplementary source of water. Conservation of ground water source through sub-surface trench and regulating the flow of spring discharge can be effective in hilly area.

6.0 Ground Water Related Issues and Problems

About 32,000 ha of land in parts of Uran, Alibagh, Pen, Panvel Murud, Roha, Mangaon, Mahad, Mahasala and Shriwardhan talukas along the coast and creek have been rendered saline due to preaches in age old bunds. In affected areas, ground water quality has deteriorated which has rendered it unsuitable for irrigation. Rain-fed agriculture along with artificial recharge practices at feasible location should be initiated to improve the quality of ground water.

Physiography, geology and rainfall of the district play a major role in ground water availability. The prominent hill ranges, isolated hillocks, undulation etc., in the district give rise to higher runoff, rather than natural recharge. The formations due to poor storage and transmission characteristics get fully saturated during the monsoon and a situation of rejected recharge is resulted. These aquifers then are drained naturally due to slopping and undulation topography. As a result, the dugwells becomes dry by the month of February onwards. Therefore, it is recommended to conserve the water through storage in tanks, ponds and masonry structures.

7.0 Areas Notified by CGWA/SGWA

As per ground water resource estimation all the talukas fall under "Safe" category, hence till March 2007 the area has not been notified either by CGWA or SGWA.

8.0 Recommendations

1. Major part of the district is underlain by Deccan Trap Basalt where dugwells are most feasible structures. The dugwells may be constructed down to the depth of 15 m, so as to tap the weathered, vesicular / fracture and jointed basalt, normally available down to the depth of 15 m bgl.

2. In coastal area, the number of dugwells is sufficiently high. The draft of the wells should be maintained under control to keep the aquifer safe from sea water ingress.
3. The sites for borewell need to be selected only after proper scientific investigation. 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. In the district, hilly part give rise to higher runoff. The basaltic formation has poor storage and transmission capabilities. The water levels are less than 2.0 m bgl during postmonsoon. Under such situation the potential of artificial recharge is quite limited. It is therefore, recommended to conserve the water through storage in tanks, ponds and masonry structures.
5. Conservation of ground water flow is also recommended by constructing sub-surface trench down the slope of major water supply structure.
6. To enhance the ground water resources and for sustainable development, mass awareness programmes should be organized in large scale by district administration. Such programmes are necessary so as to educate the user regarding yielding capacity of aquifer and declining trend of water levels in the district. Similarly farmer should also be encouraged to adopt appropriate crop planning and irrigation practices.