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भारत सरकार

जल संसाधन मंत्रालय

केंद्रीय भुमिजल बोर्ड

GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

महाराष्ट्र राज्य के अंतर्गत थाने जिले की

भूजल विज्ञान जानकारी

GROUND WATER INFORMATION
THANE DISTRICT
MAHARASHTRA

By

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CENTRAL REGION, NAGPUR

2013

Ground Water Information
Thane District

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THANE DISTRICT AT A GLANCE

I. General Information

i.	Geographical Area:	9,337 sq km.
	Administrative divisions	
ii.	Talukas:	15 - Talasari, Dahanu, Vikramgarh, Jawahar, Mokhada, Wada, Palgarh, Vasai, Thane, Bhiwandi, Shahapur, Kalyan, Ulhasnagar, Ambarnath, Murbad.
iii.	Towns:	37
iv.	Villages:	1748
v.	Population (2001census)	81,28,833
vi.	Normal Annual Rainfall:	1900 to 2600 mm

2. Geomorphology

Major Physiographic Units	a) Alluvium/Valley/Beach sand/ Channel Bar b) Denudational Hills of Sahaydri hill ranges c) Highly Dissected Basaltic plateau d) Highly Dissected Basaltic plateau e) Moderately Dissected Basaltic plateau f) Slightly Dissected Basaltic Plateau
Major drainage	: Tributaries of Vaitarna and Ulhas River.

3. Land use (2010-2011)

Area under forest:	330348 ha. (35.38%)
Net area sown:	363191 ha
Area sown more than once:	37391 ha.
Net irrigated area:	19226 ha.

4. Soil Type Sandy Loam Soil, Black Colored Soil, Lighter Colored soils, Coastal Soil

5. Principal Crops (2010-2011)

Paddy	16143 ha
Fruits	19201 ha
Cereals	17857 ha

6. Irrigation by Different Sources	**Nos**	**Potential created (ha)**
Dug wells	15967	
Tube wells and Bore wells	180	13845 (TW&BW)
Tanks and ponds	23	
Other Minor surface sources	111	5381 (Total SW)
Net Irrigated area	19226 Ha	
% of Net area irrigated to total Cropped area	5.33%	

7. Ground water Monitoring Wells of CGWB

Dug wells	42
Piezometers	04

8. Geology

Quaternary to Recent:	Alluvium
U. Cretaceous to L. Eocene:	Deccan Trap Basalt

9. Hydrogeology

Deccan Trap:	Weathered, vesicular, fractured and jointed basalt form aquifer. The depth of weathered mantle ranges from 1 to 8m and potential fractures normally are limited to 20 to 60m depth range.
Alluvium:	Coastal alluvial sediment with calcareous materials occurs in the western part of the district along the coast. The fluvial alluvium occurs along the river drainage. The thickness of alluvium varies from few meters to 20m.
Depth to water level	
Pre monsoon (May 2011)	0.50 to 14.60 m.bgl
Post monsoon (Nov.2011)	1.20 to 6.90 m.bgl
Water level trend	
Pre monsoon (2002-2011)	0.010-0.568 m/year (Raise) 0.0102-0.8233 m/yr (Fall)
Post monsoon (2002-2011)	0.0003-0.6147 m/year (Raise) 0.0148-0.104 m/yr (Fall)

10. Ground water Exploration by CGWB

Wells drilled	EW	27
(till Jan 2012)	OW	6
	Pz	4
	Total	37
Depth Range	32 to 201m, gbl	
Discharge	0.14 to 10 lps	
Storativity	0.0082 to 0.0986.	
Transmissivity	7.28 to 177.60 m^2/day	

11. Ground water Quality

The quality of ground water is generally alkaline and is good for domestic except high nitrate concentration in few wells. For irrigation point of view the ground water falls in medium to high salinity and it should be irrigation with proper soil and crop management practices. The quality of ground water in basaltic lava flows is comparatively better than in alluvial sediments. Localized nitrate contamination is observed in rural areas.

12. Dynamic Ground Water Resources (2008-09)

i.	Net annual groundwater availability:	67314.56 ham
ii.	Gross groundwater draft:	7595.79 ham
iii.	Net GW available for future irrigation:	58463.54 ham
iv.	Stage of ground water development:	11.28 %
v.	Category of groundwater development:	Safe

13. Awareness and Training Activities

Mass awareness Programme	1
Water Management Training Programme	Nil

14. Artificial Recharge and Rainwater Harvesting

Projects completed	Nil
Technical Guidance	Nil

15. Ground water Control and Regulation

Over-exploited Taluka	Nil
Semi-critical Taluka	Nil
Notified Taluka	Nil

16. Major Ground water Problems and Issues

The Basaltic rocks due to poor storage and transmission capability get fully saturated during monsoon but a situation of rejected recharge results in post-monsoon and early summer months. These aquifers also drain naturally due to high water table gradient formed by sloping and undulating topography. Effect of seawater ingression has been observed in coastal part of Dahanu, Vasai-Virar talukas.

GROUND WATER INFORMATION
THANE DISTRICT.

I. Introduction

Thane is the northern most district of Konkan region of Maharashtra. It is second most populated district and one of the few industrially developed districts of the State. Thane district is situated between western ghat on eastern side and Arabian Sea coast on western side. On the northern side, it is bounded by forest area of Gujarat and on the southern side it is bounded by Bombay City. The district lies between north latitude 18°25" and 20°12" and east longitude 72°27" and 73° 29". It falls under Survey of India topo sheets 46D, 46H, 47A and 47E. The area, of Thane district is 9337 sq.km and occupies 3.11% of the total area of Maharashtra State. It extends for about 140 km from north to south and 101km from east to west. District head quarter is located at Thane town which is taluka head quarters also. Thane, Kalyan, Ulhas nagar, Ambernath and Bhiwandi are the industrially important talukas and are having urban culture. About 3/5th of the population lives in urban areas. The economy of the district is dependent on agriculture, especially in rural areas. Jawahar and Suryamal are the hill stations. Arnala fort, Mahim, Varjeshwari are the places famous for the tourism.

Thane district is divided into three sub-divisions viz., Thane, Bhiwandi and Dahanu, which are further, divided into 15 talukas and 1748 villages. In addition to these, there are 23 uninhabited villages. Out of the total villages 1203 villages are tribal. There are as many as 925 Village Panchayats. The total population of Thane district as per 2001census is 81,28,833. Rural population is 22,28,873 (27.4%) and the rest is urban. Schedule Caste and Schedule Tribe population is 2,71,797 (3.3%) and 9,51,205 (11.7%) respectively. The male population is 43,77,806 and female population is 37,51,027.

A location map showing taluka boundaries, taluka head quarters, ground water monitoring stations and physical features is shown in fig 1.

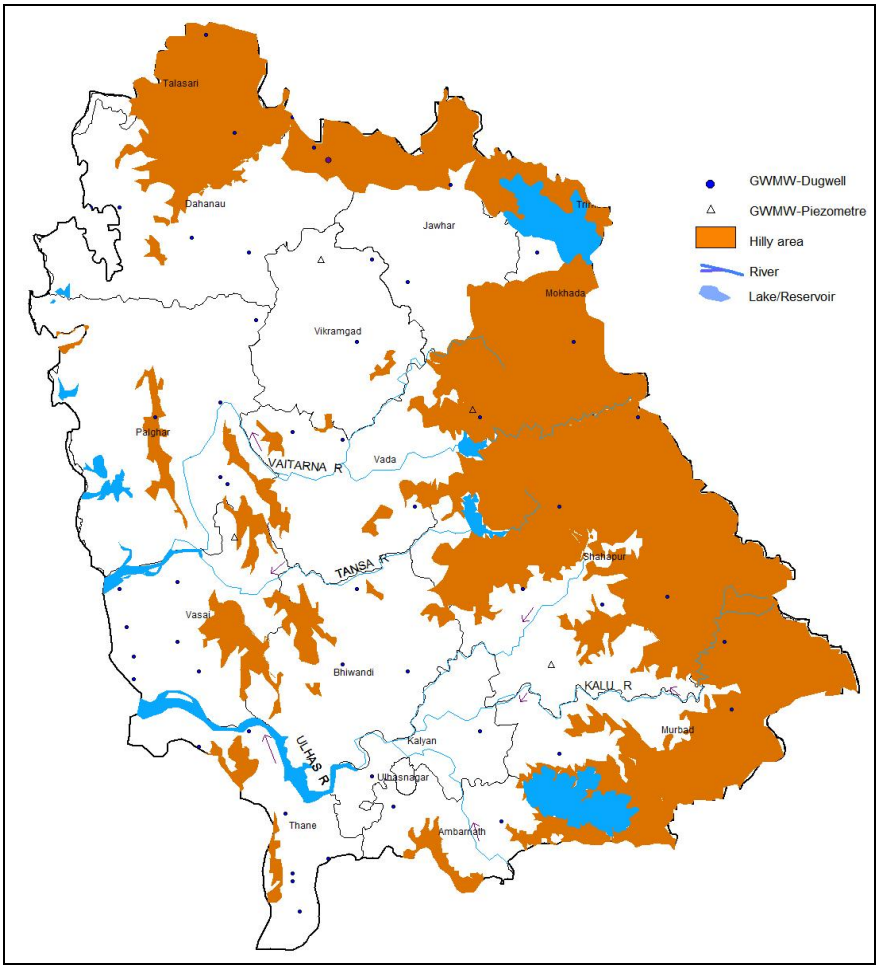

Figure 1: Location

Studies taken by CGWB

Central Ground water Board has taken up studies in the district since 1975 to evaluate the ground water resources and design management strategies for development and utilization of available water resources. Ground water exploration has been started in 2009 to delineate the deep potential aquifers in the district with special focus on tribal area. The brief details of the studies carried in the district are mentioned in the following paragraphs.

Systematic geological studies in the district were carried out by G.S.I. geologists, S/Shri, S.M. Godbole, Y.C. Joshi in the year (1975-76,1978-80,1980-81). Systematic hydrogeological surveys were carried out to generate scientific data for planning of ground water development programs, by hydrogeologist of C.G.W.B, i.e., S/Shri R.P Singh (1983-84,1984-85), S.K Sehgal (1984-85), S.P. Bagade (1985-86), S.K Bansal (1988-89), R.P Singh (1988-89), Dr. P.K. Naik (1989-90) and P.K. Jain (1989-90). S/Shri L.J. Balachandra and S.C. Paranjpe (1998-99) carried out the Reappraisal hydrogeological survey in the entire district

Ground water management studies were carried out in middle and western parts of the district during the year 2010-11 by Dr A G S Reddy.

Ground water exploration is started in the basaltic terrain of the district in 2009 by deploying 200m deep capacity DTH rig. The exploration work was carried out by Shri U V Donde and Dr A G S Reddy under the supervision of Shri Sourabh Gupta.

Shri D.Y. Shetye has studied the seawater intrusions in coastal aquifers in the year (1998-99). Dr. P.K.Naik, S/Shri A.N. Tiwari B.N. Dehury carried out ground water pollution studies (2002-03) Tarapur MIDC. Besides above Shri V.V. Rane (1962-63 and 1968-69) carried out studies on hot springs of the district.

Geophysical resistivity survey for locating ground water possibilities has also been carried out in some parts by S/Shri L.K.Das, A.K. Das and R.C.Pathale (1982-83), Geophysicist from G.S.I.

The District hydrgeological Report "Ground water resources and development potential of Thane District" was prepared by Shri Sourabh Gupta in the year 2004-05 which encompass all the data information regarding water resources, irrigation, agriculture along with guidelines for better management of available water resources in the district.

2.0 Hydrometeorology

Climate of the district is characterized by high humidity throughout the year, an oppressive summer followed by well distributed and heavy rainfall during the southwest monsoon season. The cold season starts from December to February followed by summer from March to May. The southwest monsoon season is from June to September while October and November constitute the post monsoon season. The mean daily maximum temperature is 32.9°C and mean daily minimum temperature at 26.8°C.The normal annual rainfall over the district ranges from 1900 mm to 2600 mm. The Taluka-wise annual rainfall for the past ten years is presented in Table 1. The rainfall analysis carried out for the past 50 years (1961-2010) using Thane IMD data indicate that probability of incidence of moderate drought is 18%, severe and acute drought is nil and probability of receiving normal rainfall and excess rainfall are 64% and 18% respectively.

Table.1: Cumulative Annual Rainfall (mm) for the Period: 2001 to 2011.

Taluka	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Thane	1849	1892.3	2524	2368.6	3439.9	3175	3086.72	2705.4	2152.1	3427.2	3184.6
Kalyan	2612	2688.9	2680.8	2505.7	4012	3620	2655.3	2941.7	1957	3226	2909.8
Murbad	3162.7	3663.5	4602	5837	5958.3	3266.9	2507.83	2716.7	1909.4	2419.3	2770.8
Bhivandi	2098	2232	2335	2394	3640.4	2887.62	2544.6	2991	1668	2762	2909.1
Vasai	2706.7	2497	3003	3195	3883.8	3899.7	3423.6	3690	2181	3170	2857.6
Wada	2361.9	3166.7	2388.2	2568.3	3304.7	3278.1	2539.12	2904.3	1775	2680.5	2886
Shahapur	2256.8	2222.3	2616	2553.6	3353.4	3331	2554.22	2643.2	2001.3	2470.1	2787.6
Dahanu	1914.5	2077.6	2102.4	1682.6	2432.9	2418.3	2110.11	2294.52	2781.7	2840.4	2197.1
Palghar	2610.2	2101.6	2286.9	2206.7	2997	2610.9	2026.95	2788	2719.8	3169.9	2297.4
Javhar	2037.2	1773.3	3004.2	3223.7	3810.9	3794.5	2888.92	2993.3	2172	3075	3932.2
Mokhada	1968.2	2315.6	2418.8	3170.74	3244.7	3185.4	2563.29	2851.7	2067.1	2494.1	2737.8
Talasari	2220	2228.1	2198.4	2605.1	2704.7	2951.65	2756.5	2609.9	2288	3443	3236.4
Ulhasnagar	2078.1	1656.3	1752.2	1810.8	2822.4	2418.12	2719.48	2885.1	2047.9	3063.5	2882.9
Ambarnath	2302.4	2308.9	2176.6	2301.7	3868.1	2853.7	1365.06	1498.6	1447	2598.3	2490.9
Vikramgad	2316.4	2252.8	2684.2	2739.3	3431	3286.1	2654.55	2932.4	2106.2	2984.8	3100

Source: www. mahaagri.com

3.0. Geomorphology and Soil types

The Thane district forms part of western slope of Sahayadri hill range. This hill range passes through the eastern part of the district. Major part of the district constitutes rugged and uneven topography, characterized by high hills and steep valleys. Physiographically, district can be divided into two broad divisions-Undulating Hilly Tract and Coastal Plain in western part.

The area is drained by innumerable streams and tributaries of Vaitarna and Ulhas River. The four main tributaries of river Vaitarna are Surya, Tansa, Deharaja and Pinjal Rivers. Ulhas River is the other important river in the district.

Most of the soils in the district can be considered as being derived from trap (Basaltic) rocks. The soil has been classified into three broad categories based on the characteristics and relationship with topographic set up. (1) Soil of Coastal Lands with Residual Hills - These soils are slightly deep, poorly drained, fine soils on gentle sloping land and very fine soil on sloping land. These soils are calcareous and occur along the coast of Vasai, Palgarh and Dahanu., (2) Lighter Colored soils - These soils are occurring on the undulating, elongated hills and

intervening valleys. These are medium to deep grayish in color, poor in fertility, clayey to loamy in nature, shallow in depth and coarse in texture. These soils are known as Varkas and are suitable for rice. These soils occur on the eastern part of the district. (3) Black Colored Soil- These soils occur on plains in the middle and eastern part of the district along the valleys.

4.0 Ground water Exploration

The CGWB has drilled 27 exploratory wells (EW) and 6 observation wells (OW) and 4 Piezometers as part of Groundwater Exploration Programme since 2009 and till June 2012. The total depth of the EW and OWs range from 142 to 201m whereas the depth of Piezometers vary from 31 to 100m. The discharge recorded varies from 10 lps to 0.016 lps. In general potential zones are encountered between 42 to 190m but mostly confined to 40 to 80m depth range. Weathered, fractured and vesicular basalt, belonging to Deccan traps, form the aquifer system in the eastern part of the District. The summarized results of groundwater exploration are presented in Table 2.

Till 2004, the GSDA has constructed 7429 bore wells in the district. The diameter of borewells range from 115 to 150 mm, whereas the depth ranges from 15 to 92 mbgl. Out of 7429 bore wells drilled, 1028 are considered successful having discharge of more than 4000 lph. Specific Capacity of these bore wells range from 5.75 to 80.30 LPM/of D.D, Transmissivity range between 7.28 and 177.60 m^2/ day, Storage coefficient vary from 0.0082 to 0.0986.

Table 2. Salient Features of Ground Water Exploration in Thane District.

S. n	Location	Taluka	Type of Well	Depth Drilled (mbgl)	Discharge (lps)	SWL (mbgl)	Draw down (m)	Zones Encountered (Mbgl)	Aquifer
1	Moroshi $19^0$18'00" $73^0$39'44"	Murbad	EW	200.00	0.38	12.00	>50	18.00-19.00	Fractured Massive Basalt
2	Talavali $19^0$17'09" $73^0$33'58"	Murbad	EW	200.00	0.38	1.40	>50	158.00-159.00	Fractured Massive Basalt
3	Mal $19^0$22'26" $73^0$36'14"	Murbad	EW	200.00	0.471	5.20	>50	15.00-16.00	Fractured Massive Basalt
4	Dolkhamb $19^0$29'20" $73^0$35'11"	Shahapur	EW	200.00	Traces	36.00	>50	122.00-123.00	DO

5	Khewatre-Mahaj 19^{0}14’23” 73^{0}34’40”	Murbad	EW	200.00	nil	-	-	-	-
6	Dongarnhave 19^{0}09’41” 73^{0}30’25”	Murbad	EW	143.20	10.00	5.50	16.50	142.00-143.00	Fractured Massive Basalt
7	Dongarnhave 19^{0}09’41” 73^{0}30’25”	Murbad	OW	142.00	1.37	6.00	27.90	28.70-29.70 123.00-124.00	Fractured Massive Basalt
8	Moroshi 19^{0}18’00” 73^{0}39’44”	Murbad	EW	200.00	0.38	12.00	>50	18.00-19.00	Fractured Massive Basalt
9	Murbad 19^{0}15’23” 73^{0}23’32”	Murbad	EW	200.00	traces	>50	-	56.00-57.00	Fractured Massive Basalt
10	Goveli Revati 19^{0}15’47” 73^{0}14’28”	Murbad	EW	200.00	0.431	26.50	>50	106.00-107.00	Vesicular Basalt
11	Bapgaon 19^{0}16’32” 73^{0}08’46”	Kalyan	EW	160.00	0.651	2.30	>50	30.00-31.00 150.00-151.00	Fracture and vesicular Basalt
12	Rahatoli 19^{0}10’22” 73^{0}16’49”	Ulhasnagar (Ambarnath)	EW	172.00	13.50	4.90	30.30	27.00-28.00 152.00-153.00	Fracture and vesicular Basalt
13	Rahatoli 19^{0}10’22” 73^{0}16’49”	Ulhasnagar (Ambarnath)	OW	200.00	1.37	7.55	25.05	27.00-28.00 147.00-148.00	Fracture and vesicular Basalt
14	Dhasai 19^{0}26’58” 73^{0}24’23”	Shahapur	EW	169.00	5.77	15.20	>50	52.00-53.00	DO
15	Dhasai 19^{0}26’58” 73^{0}24’23”	Shahapur	OW	200.00	nil	-	-	-	-
16	Shelouli 19^{0}25’21” 73^{0}27’13”	Shahapur	EW	200.00	0.38	>50	>50	194.00-195.00	Weathered Vesicular Basalt
17	Shelouli 19^{0}25’21” 73^{0}27’13”	Shahapur	Pz	80.60	0.38	25.00	>50	44.50-45.50	Weathered Vesicular Basalt
18	Khardi st. 19^{0}35’06” 73^{0}23’18”	Shahapur	EW	200.00	0.621	>50	>50	78.00-79.00 126.00-127.00	Fractured. Massive Basalt
19	Khardi st. 19^{0}35’06” 73^{0}23’18”	Shahapur	Pz	80.00	nil	-	-	-	-
20	Pendarghol 19^{0}31’00” 73^{0}21’18”	Shahapur	EW	200.00	nil	-	-	-	-
21	Aghai 19^{0}33’55” 73^{0}14’18”	Wada	EW	200.00	traces	>50	-	47.00-48.00	Weathered vesicular Basalt
22	Tuse 19^{0}38’05” 73^{0}10’20”	Wada	EW	200.00	1.37	23.90	4.81	16.50-17.50 28.7-30.80 144.60-147.80	Weathered, vesicular. Basalt And

									Fractured Basalt
23	Varath $19^0$27’15” $73^0$14’18” 47E/3	Bhivandi	EW	200.00	2.64	2.80	49.13	41-44,132-135,181-184	Fracture Basalt
24	Varath $19^0$27’15” $73^0$14’18” 47E/3	Bhivandi	OW	142.50	3.17	1.54	57.49	59-62,138-142	Fracture Basalt
25	Vihigoan $19^0$42’10” $73^0$29’50” 47/E/6	Shahapur	EW	202.60	Traces	2.33	-	16.50-19.60	Weathered, vesicular. Basalt
26	Washala $19^0$36’10” $73^0$30’05” 47E/10	Shahapur	EW	202.60	0.06	3.19	-	34.80-37.90	Fracture Basalt
27	Bhivandi $19^0$17’55” $73^0$05’50” 47E/3/A3	Bhivandi	EW	201.60	Negligible	6.84	-	118-121	Fracture and vesicular Basalt
28	Usgoan $19^0$29’46” $73^0$00’35” 47E/3/A	Bhivandi	EW	200.60	Traces	9.20	-	42-45	Fracture and vesicular Basalt
29	Shahapur $19^0$25’35” $73^0$19’42” 47E/7	Shahapur	EW	200.00	0.14	18.05	-	187-191	Fractured Basalt
30	Shahapur $19^0$25’46” $73^0$19’42” 47E/7	Shahapur	Pz	32.00	0.05	12.15	-	17.05-19.30 26.00-26.50	Weathered vesicular. and Fracture Basalt
31	Pivali (Vandre) $19^0$29’ $73^0$13’ 47E/3	Shahapur	Pz	101.90	Nil	15.00	-	86.00-86.25 95.50-95.80	Fracture and vesicular Basalt
32	Makhoda $19^0$55’ $73^0$22’ 47E/5	Makhoda	EW	200.00	0.78	5.67	-	65-66	Fracture and vesicular Basalt
33	Jawhar 19° 57’ 16” 73° 14’18" 56E/9/3B	Jawhar	EW	200.00	0.14	7.50	-	42-43 93-94 104-105	Do
34	Kasa 19° 50’ 46” 72° 50’46" 47A/13	Dahanu	EW	83.60	17.92	6.15	11.82	10.40 – 13.50: 0.09 25.70-28.70: 0.38 80.60-83.60:17.92	Fracture and vesicular Basalt
35	Do	Do	OW	68.40	17.92	6.50	26.45	19.60-22.60:0.14 40.90-44.00:0.38 59.20-62.30:2.16 62.30-65.30:17.92	Do

36	Sawa 19° 55’ 42” 73° 05’ 00” 47 E/01/A1	Vikramgarh	EW	172.10	2.16	44.48	4.38	13.50 - 16.50: 0.14 114.10 -117.20: 0.78 144.60 - 147.70: 3.17 162.90 - 166.00: 7.76	Fracture and vesicular Basalt
37	Do	Do	OW	163.00	14.88	50.00	>60.0	9.00 -10.00 :0.07 65.30 - 68.40 : 0.14 153.80 -156.80 : 5.94 162.90 -166.00: 14.88	Do

5.0. Hydrogeology

5.1. Deccan trap Basalt of Upper Cretaceous to Lower Eocene age is the major rock type covering about 80% of the district, coastal alluvium is other formation occurring only in western end of the district. A map depicting the hydrogeological features is presented as Figure 2.

5.1.1 Deccan Trap Basalt

Ground water in Deccan Traps mostly occurs in the weathered and fractured parts down to 10-15m depth. At places potential zones are encountered at deeper levels in the form of fractures and inter-flow zones which are generally confined down to 60-80m in the district. The weathered portions of both vesicular and massive units have better porosity and permeability. Intensity of weathering is less in hilly region as seen in the eastern part of the district while it is higher in plain area. The yield of dug wells tapping phreatic aquifer ranges between 18 to 152cum/day, which have 5-12m depth range. The bore wells are generally drilled down to 40 to 60m tapping weathered and fracture/vesicular zones, these wells have a discharge of 2 to 4lps. It is noticed and reported that the yields of the wells drastically get reduced in summer months beginning form March up June end.

5.1.2 Alluvium

These are developed in the western part of the area along the coast and river courses and are lacustrine in nature. Along the coast, alluvium consists of clayey and mud deposits. The quality of water is slightly brackish and pumping from this formation has to be restricted to prevent ingression of seawater. The alluvium constitutes the potential aquifer in the area. The yield of dug wells ranges between 122 to 252cum/day, which have 8-16m depth range. The bore wells are generally drilled down to 20 to 30m tapping weathered and fracture/vesicular zones, these wells have a discharge of 4 to 6lps.

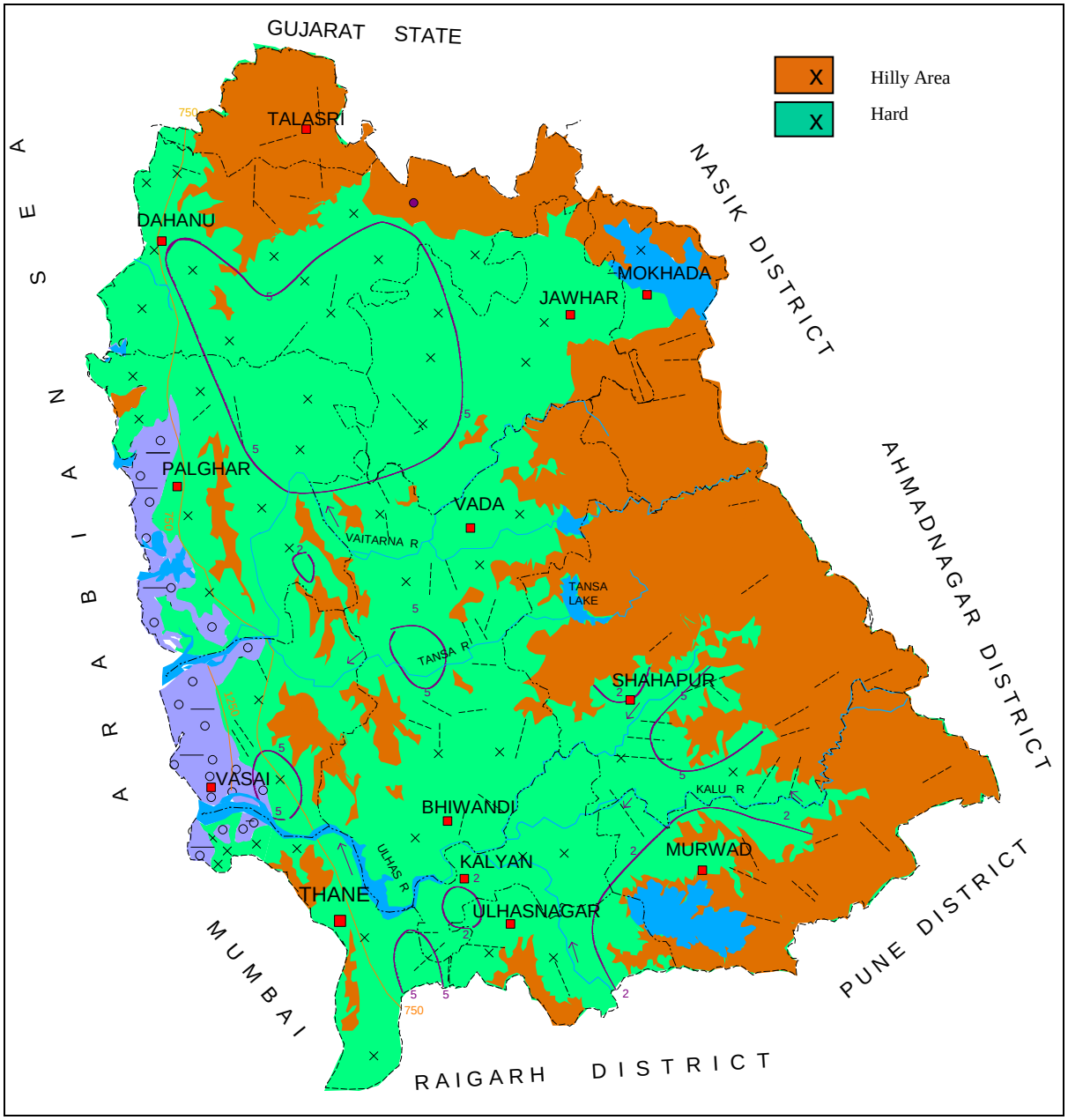

Figure 2: Hydrogeology

5.1.3 Water Level Scenario

Central Ground Water Board periodically monitors 42 National Hydrograph Network Stations (NHNS) stations in the 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 discussed below.

5.1.3.1 Pre monsoon Depth to Water Level (May-2012)

The pre-monsoon depth to water level ranges from 0.50 to 14.60 m bgl. The depth to water level ranging between 2 to 5 m bgl and 5 to 10 mbgl are observed in major part of the district, whereas water level more than 10 mbgl are observed as patches. Spatial distribution of pre monsoon water level is depicted in fig 3.

5.1.3.2 Post-monsoon Depth to Water Level (Nov- 2012)

The post monsoon water level ranges from 1.20 to 6.90 m bgl. The water levels of 2-5 m bgl are observed in major part of the district. Less than 2 mbgl water level is observed in the eastern part of the district and water level of more than 5 m bgl occurs as isolated patches in the central and northern part of the district. Spatial distribution of water level is depicted in fig 4.

5.1.3.3 Seasonal Water Level Fluctuation (May-Nov 2012)

The seasonal water level fluctuation (May-Nov 2004) ranges from -0.70 to 7.70 m. The fluctuation 0-2 m and 2-4 m has been observed in major part of the area. The higher fluctuation of 4-6 m and 6-8 m are observed in the eastern part of the district being the recharge area. Negative fluctuation is observed in very few wells in isolated patches.

5.1.4 Decadal Pre-Monsoon Depth to Water Level Trend (2002-2012)

Decadal mean pre-monsoon depth to water level very between 0.89 and 6.26 m bgl. In major part of the district, the depth to water level ranges from 2 to 5 m.bgl, while the next major range of water level i.e more than 5 m bgl, is observed in the eastern part of the district. In remaining part, the water level is less than 2 m bgl. The decadal water level trend is showing raise in many wells and fall in few wells (10) which vary from +0.010 to 0.57m/yr. Falling trend is recorded in the range of 0.01 to 0.82 m/yr. In general pre-monsoon water levels are stable with marginal rising trend.

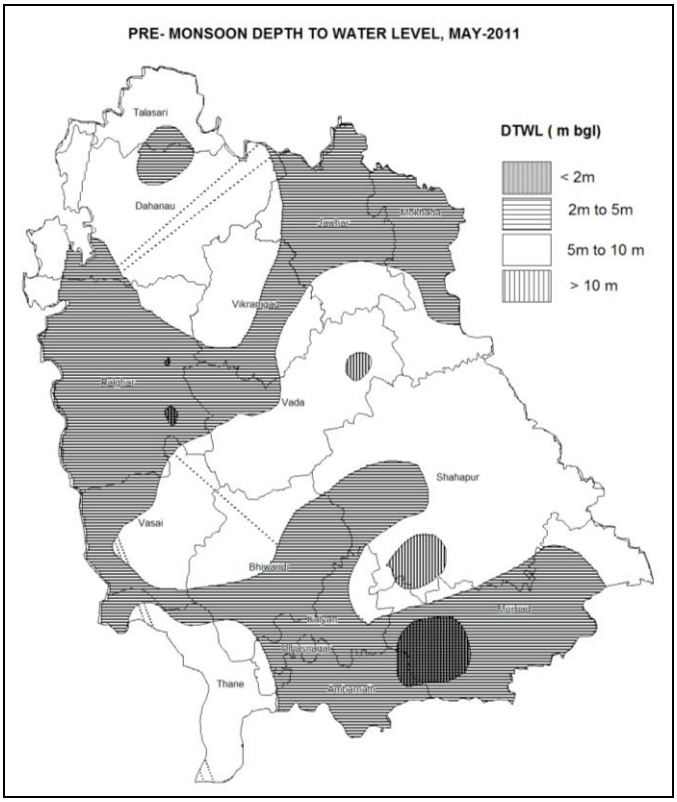

Figure 3: Premonsoon Depth to Water Level (May 2011)

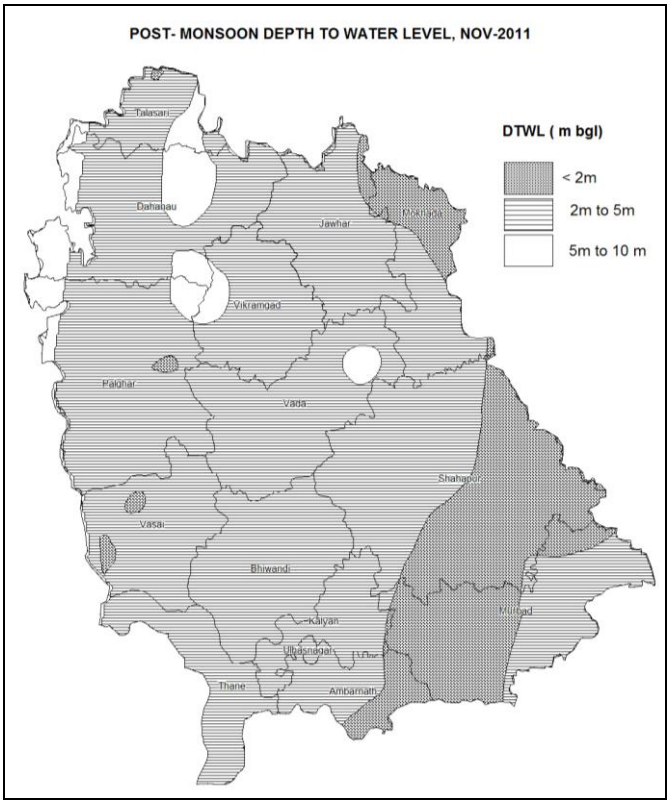

Figure 4: Postmonsoon Depth to Water Level (May 2011)

5.1.5 Decadal Post Monsoon Depth to Water Level (2002-2012)

Decadal mean post-monsoon depth to water level varies between 0.32 and 5.25 m bgl. In major part of the district mean water level is in the range of less than 2 m bgl. Mean water level range of 2 to 5 m bgl is observed in the north western part around Palghar, Dahanu, Talasari and Pansipada and also in the form of isolated patches in the, central part of the district. The deeper, mean water level of more than 5 m bgl is observed as isolated patches in northern part. The decadal water level trend vary from +0.0615 to -0.10m/yr. In post-monsoon 24 wells out of 53 monitored show fall in water levels indicating draining of aquifer due to steep gradient and natural base flow.

5.1.6 Aquifer Parameters

The Groundwater Surveys and Development Agency (GSDA), Govt of Maharashtra has drilled a large number of bore/tube wells. The aquifer performance test conducted on some these wells indicate that the Specific Capacity ranges from 1.23 to 62.05, Transmissivity ranges from 7.28 to 177.60 m^2/day whereas Storativity varies between 0.0082 and 0.0986.

5.2 Ground water Resource

Ground water resource estimation has been done jointly be CGWB and GSDA, Government of Maharashtra based on GEC-1997 methodology for the base year 2009. The ground water resources of 15 talukas of the district as per with assessment is summarized in Table 3. The net annual ground water availability is estimated to be 67314.56 ham and gross draft is estimated to be 7595.79 ham in the district. The stage of ground water development of the district is 11.28%. All the talukas fall under safe category.

5.3 Ground water Quality

CGWB is monitoring the ground water quality of the Thane 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 27 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 to 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.

Table 3: Ground water Resources of Thane District (As on March 2009)

Taluk	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	Provision for domestic and industrial requirement supply to 2025	Net Ground Water Availability for future irrigation development	Stage of Ground Water Development (%)	Category
Ambarnath	2751.18	153.03	36.93	189.96	73.54	2499.11	6.90	SAFE
Bhivandi	4864.30	917.28	107.43	1024.71	209.59	3549.18	21.07	SAFE
Dahanu	4296.61	1225.38	194.44	1419.82	389.10	2683.99	33.05	SAFE
Jawhar	3354.11	103.34	63.99	167.34	130.55	3386.30	4.99	SAFE
Kalyan	1236.11	68.95	26.57	95.52	56.34	1414.62	7.73	SAFE
Mokhada	1629.60	47.63	59.07	106.70	117.44	1464.21	6.55	SAFE
Murbad	5663.35	162.76	118.92	281.68	235.42	5230.09	4.97	SAFE
Palghar	16002.60	1665.73	158.04	1823.77	305.07	13581.06	11.40	SAFE
Shahapur	9655.56	218.81	159.52	378.33	318.59	8874.99	3.92	SAFE
Talasari	1691.75	273.75	58.01	331.76	116.89	1308.23	19.61	SAFE
Thane	2450.00	152.62	15.86	168.48	31.72	2265.66	6.88	SAFE
Ulhasnagar	89.24	16.77	2.08	18.85	4.16	68.31	21.12	SAFE
Vasai	3661.47	981.96	83.78	1065.74	173.85	3100.85	29.11	SAFE
Vikramgad	5016.53	170.45	63.69	234.14	127.04	4639.83	4.67	SAFE
Wada	4952.15	182.11	106.90	289.01	221.16	4397.11	5.84	SAFE
TOTAL	67314.56	6340.57	1255.22	7595.79	2510.45	58463.54	11.28	

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., TH, NO_3 and F prescribed in the standards and is given in Table-4.

Table-4: 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**
TH (mg/L)	300	600	22	4	1
NO_3 (mg/L)	45	No relaxation	25	-	2
F (mg/L)	1.0	1.5	27	-	-

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

The perusal of Table-4 shows that the concentrations of all the parameters are within the desirable limit of BIS standards except Nitrate in two samples Overall, it can be concluded that the ground water quality in the wells monitored in the district is not much affected and ground water in general potable.

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 was carried out irrigation purpose and given below in Table-5.

It is observed from the Table-5 that maximum number of samples (66%) falls under the category of Medium salinity water while nearly 26% of samples fall in 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-5: Classification of Ground Water for Irrigation based on EC.

Type	**EC (µS/cm)**	**No. of Samples**	**% of Samples**
Low Salinity Water	<250	1	4
Medium Salinity Water	250-750	18	66
High Salinity Water	750-2250	7	26
Very High Salinity Water	>2250	1	4
Total		**27**	**100**

5.4 Status of Ground water Development

5.4.1. Irrigation by Different Sources

Development of ground water for irrigation has taken place on a limited scale in trap area. However, ground water development for irrigation purpose has taken place on a good scale in the alluvial area in coastal tract. Thane district is predominantly irrigated by ground water, which accounts for 98% of total

irrigation. The area irrigated by surface water is 5381 ha while through ground water it is 13845 ha. Gross irrigated area is 21346 ha, while gross cropped area 400582 ha i.e. only 5.33% of the area is under irrigation in the district. The taluka wise area under irrigation is presented in Table 6.

Table 6. Taluka wise Irrigation by Different Sources in Thane District (Year 2000-01) (Area in Ha)

Taluka	Irrigated Area		Net Irrigated Area	Gross Irrigated Area	Gross Cropped Area	% of Irrigated Area
	S.W	G.W				
Talasari	424	989	1413	1498	15515	9.66
Dahanu	1925	4662	6587	7161	41163	17.40
Vikramgarh	23	143	166	179	2058	8.70
Jawahar	489	936	1425	1510	36165	4.18
Mokhada	428	852	1280	1372	26317	5.21
Vada	59	562	621	621	31991	1.94
Palghar	783	1984	2767	2951	43764	6.74
Vasai	468	1465	1933	2601	20365	12.77
Thane	23	52	75	75	8309	0.90
Bhiwandi	31	145	176	176	24281	0.72
Shahapur	158	544	702	747	70869	1.05
Kalyan	79	146	225	225	19232	1.17
Ulhasnagar	64	133	197	197	13492	1.46
Ambarnath		-	-	-	-	-
Murbad	427	1232	1659	2033	47061	4.32
Total	5381	13845	19226	21346	400582	5.33

Here SW- Surface Water, GW- Ground Water.

(Source District social and economic statistics - Thane District March 2009 of Maharashtra Sate)

5.4.2. Rural Water Supply

There are total 555 pipe water supply schemes covering 530 villages, 20 PWSS covering 196 villages. In addition to these, there are 5,498 dug wells in 1,469 villages, 5,930 hand pumps in 1156 villages, and 155 electric motor fitted bore wells in 102 villages being utilized for water supply in rural areas of the district. Taluka wise details are given in Table 7.

Table 7. Rural Water Supply Schemes in Thane District (March-2004)

Taluka	Joint Pipe Water Supply	Independent Pipe Water Supply	Dug Wells	Bore Wells	Electric Pump fitted Bore wells
Shahpur	5	80	669	615	12
Wada	-	47	332	607	20
Jawahar	-	23	259	56	0
Mokhada	01	30	233	59	0
Vikramgarh	-	18	383	283	03

Dahanu	01	30	669	911	18
Talasari	-	07	159	465	07
Palghar	05	77	830	1032	22
Vasai	-	20	545	359	16
Bhiwandi	03	45	391	706	29
Murbad	-	104	716	474	17
Kalyan	03	30	122	163	07
Ambernath	02	44	190	200	04
Total	20	555	5498	5930	155

5.4.3. Urban Water Supply

The urban water supply is mainly through surface water sources with 100 MLD of water being supplied through Suryadam to Nalsopara, Nawghar-Manikpur and Vasai-Virar towns. About 14.2 MLD water from Pelhar Dam is being supplied to Nawghar Manikpur towns, 20 MLD water is being supplied from Urgaon Dam to Virar, Nalasopra, Nawghar-Manikpur and Vasai towns. About 117 MLD water is being supplied from Ulhas River to Kalyan-Dombivalli, 160 MLD water is being supplied to Thane town from Ulhas, Bhatsa and Tansa River. About 150 MLD water is being supplied from Ulhas River to Meera Bhayender, Bhiwandi-Nizampur, Thane town. About 38 MLD water is being supplied from Tansa River to Bhiwandi-Nizampur Corporation. About 2,436 hand pumps and 676 bore wells are also supplying water to urban areas under various municipal corporations.

6.0. Ground water Management Strategies

The district has a stage of ground water development of 11.28% as per the ground water resource assessment (2009), thus there is scope for further ground water development at feasible locations so as to bring more cultivable land under irrigation. The prime objective should be to achieve the development in planned and scientific manner by adopting latest ground water management techniques.

6.1. Ground water Development

The major part of the area constitutes hilly and rugged terrain where ground water conditions are highly localized, any further ground water development to meet drinking water requirement can be implemented on village to village basis. There exists scope for tapping the deep aquifer through bore wells in the depth range of 45-100 m bgl for drinking water supply. Dugwells may

be constructed down to the depth of 15 m, so as to tap the weathered, vesicular/ fractured and jointed basalt, normally available down the depth of 15 m bgl. The diameter of the well can be 3.5 to 6.5 m, so that the storage in the well can also be made use of in addition to the ground water seeping in. Dry dug wells existing in the trap area are shallow and these can be revitalized by converting them to dug-cum-bore wells.

6.2 Water Conservation and Artificial Recharge

Thane district receives normal rainfall of 1900-2600mm, however major part of the district is occupied by hard rock formations having low sub surface storage potentials and steep gradient along hill ranges and hillocks thus the availability of surface water is limited to monsoon period. In order to overcome the problem, small schemes of water conservation and artificial recharge may be undertaken at suitable locations. Social Forestry Department and Agriculture Department of Govt. of Maharashtra have therefore undertaken small schemes of water conservation and artificial recharge. Social Forestry department has selected 2 water sheds under Ministry of Rural Development, Government of India scheme and has sanctioned Rs.409.68 lakh for development of 10246.90 ha of fallow land in watershed no. WF-7 and 8 covering 15 villages of Jawahar taluka in Thane district.

Social forestry has implemented water conservation measures in 5513.56 ha of land, covering 8 villages of Watersheds WF-7 and WF-8. They have carried out aforestation by planting fruit plants, medicinal plants, agricultural plants, re-forestation etc in addition to water conservation measures by constructing various structures. Water conservation structures include 2427 nala widening, 95 stone nala bunds, 104 loose boulder bunds, 277 masonry bunds, 3 gabbion structure, 6 brick gabbion structure, 2 cement bandhara, 1 check dam and 4 percolation tanks. Department of Agriculture, Thane has also carried out watershed development programme in the district. The department has carried out this work under various schemes from the year 1992 to 2005. This water shed development efforts are aimed at soil and water conservation by leveling 2150.32 ha of and, development of 49,195 ha biological belt, 3,126 ha grass land. In addition to this, 83,975 trees, 1,07,489 bushes were planted and 5,206 bio-bunds, 3,589 live check dam, 4,349 brush wood dam, 1,39,621 loose boulder structures, 5,322 earthen structures, 28 gabbion structure, 39 diversion dam, 961

farm ponds, 482 cement nala plugs, 1,890 earthen nala bunds, 1,943 nala channeling were constructed.

7.0. Ground water Related Issues and Problems

7.1. Ground Water Pollution from Industries

Since Thane is one of the most industrially developed district in the State, the pollution by industries is an important threat to the ground water regime, hence the special studies were carried out in the district to ascertain the pollution threat. In view of the ground water quality problems in the resulting from Industrial activity, the studies were undertaken by C.G.W.B, CR in year 1990 to evaluate the impact of industrialization on ground water in Thane-Belapur industrial belt, Kairna, Khadi Pada and Ghansoli areas. It is observed that the ground water is of Magnesium Chloride (Mg-Cl) type, whereas in affected area it is of Sodium Chloride (Na-Cl) type. The chloride anion is predominant in both the areas, and among cations, magnesium is predominant in unaffected areas and sodium is predominant in affected area. This indicates possibility of ground water pollution by addition of sodium cations in the affected area due to hectic industrial activity. Further, the average value of TDS in unaffected area is 760 mg/l where as in the affected area it is 975 mg/l. Also change in pH from 7.71 to 8.18 indicates deterioration of ground water quality in the area and percolation of industrial effluents to ground water.

Tarapur MIDC area is located at Boiser (Toposheet No 47A/9) about 10 Km southwest of Tarapur, which is famous for two Atomic Power installations that is the Tarapur Atomic Power Station (TAPS) and Bhabha Atomic Research Center (BARC). Chemical analyses of samples include determination of the major ionic concentration and heavy metal. The analyses of Ca/Mg ratio show that the concentration of Ca exceeds the concentration of Mg in about 50% of the samples in both dugwells and Borewells. In the rest 50%, Mg is dominant cation especially in the southwestern part of Mumbra Creek. The higher concentration of Mg than Ca indicates contamination by some external source. The Mumbra creek water is highly polluted. The pH, TDS, Na and Cl value increase seaward while concentration of SO_4, Fe, Mn, Pb and Zn decrease. Low pH value and high concentration of heavy metals in the creek water may be attributed to indiscriminate disposal of industrial effluents.

7.2. Sea Water Ingress in the Coastal Tract

Thane district has a coastal line of 110 km along the west coast in the western part of Thane district, with number of creeks. In the last decade, due to rapid urbanization, there has been phenomenal growth in the residential colonies and commercial complexes and small-scale industries. To meet the growing demand of water, the ground water is exploited. The excessive ground water withdrawal is responsible for deterioration of quality in the area bounded by Vaitarna, Vasai and Dahanu creeks comprising of about 67 villages are located in the area. A study carried by CGWB indicate that only 14 samples in saline area are within desirable limit of Bureau of Indian Standards specification for drinking water, another 42 samples are within permissible limits, 7 samples are beyond permissible limits.

8.0 Mass Awareness and Training Activities

In Thane district till the end of 2012 one mass awareness programme was organized.

9.0 Area Notified by CGWA/SGWA

The stage of ground water development in entire Thane district is only 11.28% and all talukas are in safe category. Hence there are no areas notified the district either by CGWB or SGWA.

10.0. Recommendations

Since the groundwater development is marginal (11.28%) there is ample scope for further ground water development at feasible locations so as to bring more cultivable land under irrigation. Some of the feasible recommendations for further improvement and development of available resources are listed below….

1. Large diameter (3-6m) dug wells may be constructed down to the depth of 15 m in valley portions and other feasible locations to exploit shallow and potential aquifer.
2. Over draft of ground water should be avoided to keep the aquifer safe from quality deterioration due to sea water ingress. The spacing of 200 m between the dug well is recommended in this area.

3. Small schemes of surface water conservation should be undertaken to conserve monsoon water and runoff generated there upon. Storage tanks on hilltops, Nalabunds, Check dam/ Stop dam etc., should be constructed on second order streams after feasibility study, to conserve the surface water runoff and augment the ground water recharge by impounding the water for longer duration. Under ground Bandharas are also feasible to check the base flow which flows out as surface runoff during the winter months.
4. Excessive pumping in the wells close to the vicinity of sea creeks which causes sea water ingress into the main land may be stopped and ban may be imposed on construction of new wells in the areas affected by this ingression.
5. To control the industrial pollution, effluent treatment should be practiced before transporting them to effluent sumps. Disposal of waste etc., should be done at proper place after taking proper measures.

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