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Technical Report Series

GROUND WATER BROCHURE AHMEDABAD DISTRICT GUJARAT

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Government of India
Central Ground Water Board
West Central Region
Ahmedabad

March 2014

AHMEDABAD DISTRICT AT A GLANCE

SL No.	Items		Statistics	
1.	**General Information**			
	i) Geographical Area (Sq. Km)		**8087**	
	ii) Administrative Divisions (2011) Number of Taluka Number of Villages		 **11** **512**	
	iii) Populations (As per 2011 census)		**72,08,200**	
	iv) Average Annual Rainfall (mm)		**612**	
2.	**GEOMORPHOLOGY**			
	Major Physiographic Units		**Alluvial plain**	
	Major Drainages		**Sabarmati**	
3.	**LAND USE (Sq. Km)**			
	a) Forest area b) Net area sown c) Cultivable area		**106.82** **5389** **5760**	
4.	**MAJOR SOIL TYPES**		**Sandy soil**	
5.	**AREA UNDER PRINCIPALFOODGRAIN CROPS (sq.km.)**			
	Rice-790, Jowar-20, Bajra-210, Wheat-1190, Total cereals 2220, Gram 110, other pulses-50, Total pulses-160, Total food crops-2380,Seasam -140, Rapes and Mustard-30, Total oil seeds-290.			
6.	**IRRIGATION BY DIFFERENT SOURCES**			
	(Areas and numbers of structures) 2011		**No.**	**Area (sq. km.)**
	Dugwells		**15024**	**1064**
	Tube wells & other wells		**3123**	**1424**
	Tanks/Ponds		**1425**	**45**
	Canals		**-**	**610**
	Other Sources		**-**	**16**
	Net Irrigated area (sq. km.)	Dug Wells	**694**	
		Tube Wells	**730**	
	Gross Irrigated area (sq. km.)	Dug Wells	**931**	
		Tube Wells	**1064**	
7.	**NUMBERS OF GROUND WATER MONITORING WELLS**			
	CGWB (As on 31-03-2012) No of Dug Wells No of Piezometers		**71** 17 54	
8.	**PREDOMINANT GEOLOGICAL FORMATIONS**			
	Alluvium (Major portion, 2785.10 Sq.km.) Limestone and Deccan traps (Few minor portion 562.33 Sq.km)			

9. HYDROGEOLOGY

Major Water Bearing Formation: Quaternary alluvium

Depth to water Level during 2011-12				
Period	**Phreatic Aquifer (DTW)**		**Semi-confined Aquifer (PZ head)**	
	Min	**Max**	**Min**	**Max**
Pre Monsoon	3.11 (Viramgam)	22.32 (Vastrapur Lake-II)	6.62 (Bagodara)	105.14 (Kankariya PZ-I)
Post Monsoon	1.34 (Paccham)	22.87 (Vastrapur-II)	5.27 (Bagodara)	107.35 (Vastrapur-I)

Long Term (10 Years) Water Level Trend (2001 to 2010)		
Trend	**Pre-Monsoon**	**Post- Monsoon**
Rise (m/Yr)	0.025 (Ranpur) to 0.58 (Barvala)	0.16 (Ranpur) to 1.08 (Barvala)
Fall (m/Yr)	0.016 (Viramgam) to 0.50 (Dholka)	0.30 (City Daskroi) to 0.95 (Dholka)

10. GROUND WATER EXPLORATION BY CGWB (As on 31 -03 -2012)

No of wells drilled (EW, OW, Pz, SH, Total)

EW	OW	SH	**Total**
29	10	01	**125**

	Depth Range(m)	**27- 565.4**
	Discharge (Litres per second)	**0.1 – 15 lps**
	Storativity (S)	
	Transmissivity (m^2/day)	**10- 3867**
11.	**GROUND WATER QUALITY**	
	Presence of chemical constituents more than permissible limit	**Fluoride - 161 villages** **EC - 101 villages** **Nitrate - 2 villages**
	Type of water	**Predominant bicarbonate-Chloride type**

<table>
<tr><td>12.</td><td>DYNAMIC GROUND WATER RESOURCES (2011)- in mcm</td><td></td></tr>
<tr><td></td><td>Annual Replenishable Ground Water Resources</td><td>616.86</td></tr>
<tr><td></td><td>Net Annual Ground Water Availability</td><td>583.09</td></tr>
<tr><td></td><td>Projected Demand for Domestic and industrial Uses up to 2025</td><td>95.97</td></tr>
<tr><td></td><td>Stage of Ground Water Development</td><td>78.36</td></tr>
<tr><td>13.</td><td colspan="2">AWARENESS/ TRAINING ACTIVITIES Etc. as on 31-03-2014</td></tr>
<tr><td></td><td colspan="2">Sl. No. Activity Nos.
1 Mass Awareness Programme 03
2 Water management Training Programme 05
3 Workshops 05
4 State Level painting Competition 04
5 World water Day 2007 01</td></tr>
<tr><td>14.</td><td colspan="2">EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING</td></tr>
<tr><td></td><td>Projects completed by CGWB (No & Amount spent)
<table><tr><td>Sr. No.</td><td>Project</td><td>Amount (Rs.)</td></tr><tr><td>1.</td><td>Sola High Court</td><td>10.25 lakhs</td></tr><tr><td>2.</td><td>PRL</td><td>3.00 lakhs</td></tr></table></td><td>Two (Sola High Court & PRL)</td></tr>
<tr><td></td><td>Projects under technical guidance of CGWB (Numbers)</td><td>Nil</td></tr>
<tr><td>15.</td><td>GROUND WATER CONTROL AND REGULATION</td><td></td></tr>
<tr><td></td><td>Number of OE Blocks</td><td>01
(City-Daskroi)</td></tr>
<tr><td></td><td>Number of Critical Blocks</td><td>01
(Dholka)</td></tr>
<tr><td></td><td>Number of Semi Critical Blocks</td><td>02
(Detroj- Rampura, Viramgam)</td></tr>
<tr><td></td><td>Number of Safe Blocks</td><td>05
(Barwala, Bavla, Mandal,Ranpur, Sanand)</td></tr>
<tr><td></td><td>Number of Saline Blocks</td><td>01
(Dhanduka)</td></tr>
<tr><td></td><td>No. of Blocks Notified by CGWA</td><td>Nil</td></tr>
<tr><td>16.</td><td colspan="2">MAJOR GROUND WATER PROBLEMS AND ISSUES</td></tr>
<tr><td></td><td colspan="2">a. Declining Groundwater levels/ Piezometric heads in user aquifers
b. Increasing depth of tubewells
c. Increasing instances of high fluoride
d. Groundwater contamination due to unplanned construction and poor technical design of tube wells
e. Awareness amongst villagers on water conservation techniques
f. Demand supply management</td></tr>
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DISTRICT GROUND WATER BROCHURE
AHMEDABAD

1. Introduction

Ahmedabad is an Industrial hub for textiles and is popularly known as the "Manchester of India". The district headquarter, Ahmedabad was also the State Capital from May 1960 to May 1970, before it was shifted to the new township at Gandhinagar. Ahmedabad district occupies 8087 sq. km. area between 21°58' and 23°30' north latitudes and 71°35' and 73°02' east longitudes in the central part of Gujarat state. It falls in the survey of India degree sheet numbers 41N, 41M, 46A and 46B. It is bounded by Mahesana and Gandhinagar in north, Sabarkantha in north east, Kheda in east Gulf of Cambay (Khambat), Bhavnagar in South and Surendranagar in west.

1.1 Administrative Details

Administratively, Ahmedabad is divided in ten talukas, viz. Barvala, Bavla, City-Dascroi, Detroj-Rampura, Dhandhuka, Dholka, Mandal, Ranpur, Sanand and Viramgam. The district comprises of 547 villages and 25 towns/cities. The geographical area is 8086.81 sq. kms. Taluka-wise geographical area is given in table 1 below.

Table: 1 -Taluka wise geographical area in Ahmedabad District

S.No.	Taluka		Area (sq. kms)
1.	**Barvala**		45436.41
2.	**Bavla**		75185.7
3.	**City- Dascroi**	**City**	5367.14
		Dascroi	62416.55
4.	**Detroj-Rampura**		35365.02
5.	**Dhandhuka**		170321.15
6.	**Dholka**		101195.95
7.	**Mandal**		41491.7
8.	**Ranpur**		4713.44
9.	**Sanand**		74410.43
10.	**Viramgam**		87646.89

The total population of the district as per 2011 census is 72,08,200 having 11,49,436 rural and 60,58,764 as urban population. The sex ratio is 903 females per 1000 males. The population density is 890 persons per sq. km. The literacy rate in the district is 86.65%.

1.2 Basin/ Sub-basin

Major portion of the district falls under Sabarmati basin. Rupen, Saraswati, Banas form the sub basins.

1.3 Drainage

River Sabarmati is the principal river of the district. It originates from Dhebar lake in Aravalli Range of Udaipur District, Rajasthan and finally debauches into Gulf of Khambat near Vataman village of Dholka taluka. Sabarmati forms the eastern boundary of the district flowing from NE to SW direction in Ahmedabad and Gandhinagar districts. The river Vatrak flows for a smaller length and joins Sabarmati near village Wauta of Dholka taluka. The Khari river and the Meshwo river drain Dascroi taluka. The river Bhogavo with its branches Chatori and Omkar drains Dholka and Dhandhuka talukas. The Bhadar river with its branch Goma, Lilka, Utavali and Ghela drains Dhandhuka taluka of the district. River Rodh drains Sanand and Dholka talukas. Rivers Shelwa and Andhli drain Dholka taluka. There is no river or rivulet in Viramgam taluka.

1.4 Irrigation Practices

Table: 3- Area irrigated under the major crops in Ahmedabad District

Area in '00 Hect.

Rice (Paddy)	Jowar	Bajra	Maize	Wheat
817	-	20	1	492

Table: 4- Major source of irrigation in Ahmedabad District

S.No.	Taluka	Ground Water				Surface Water			Total
		Dug Wells	Shallow Tube Wells	Deep Tube Wells	Total	Surface Flow	Surface Lift	Total	
1.	**Barvala**	477	0	68	545	17	0	17	562
2.	**Bavla**	1634	251	343	2228	195	0	195	2423
3.	**City-Dascroi**	3026	0	2219	5245	1043	0	1043	6288
4.	**Detroj-Rampura**	375	0	450	825	193	7	200	1025
5.	**Dhandhuka**	570	0	16	586	28	0	28	614
6.	**Dholka**	761	114	1539	2414	252	5	257	2671
7.	**Mandal**	333	1	368	702	11	0	11	713
8.	**Ranpur**	1532	0	517	2049	0	0	0	2049
9.	**Sanand**	2046	122	694	2862	259	5	264	3126
10.	**Viramgam**	2660	129	472	3261	496	0	496	3757
	Total	13414	617	6686	20717	2494	17	2511	23228

1.5 Studies /Activities carried out by CGWB

1.5.1 Systematic hydrogeological studies

Systematic hydrogeological studies carried out by Central Ground Water Board are as given in table 5 below.

Table: 5- Systematic hydrogeological studies

Name	Taluka	Year
R.C.Jain	Dhanduka, Dholka, Sanand, and part of Viramgam, Dascroi & City Talukas	1981-82, 1983-84 and 1986-87.
P.K.Parchure	Part of Viramgam Taluka	1986-87

1.5.2 Reappraisal hydrogeological survey

Reappraisal hydrogeological survey of the entire district was carried out by following officers of CGWB during 1989-90.

Table: 6- Reappraisal hydrogeological survey

Name	Area covered (Talukas)
P.K.Jain	Dhandhuka Taluka
P.R. Gupte	Viramgam, Sanand, City, and Dascroi (Part) Talukas
A.B.Kawde	Dholka, and Dascroi (Part) Talukas

1.5.3 Ground Water Exploration

Ground water exploration by test drilling commenced in the fifties by the erstwhile Exploratory Tubewell Organisation (ETO) and continued later by CGWB. Apart from the exploratory wells, Piezometer of various depths are also constructed in the district for periodic monitoring of the ground water regime in the district and is continued till date. Total 109 wells have been constructed in the district which includes 26 Exploratory wells, 09 Observation Wells, 73 Piezometers and one Slim Hole. Details of the wells drilled are given in table 7 below.

Table: 7- Ground Water Exploration

Salient Features	Exploratory Wells	Observation Wells	Piezometers
Total Nos.	26	09	73
Drill Depth range (mbgl)	80.47- 565.4	156.17 to 337.76	27-201
Depth Constructed range (mbgl)	151.00 to 427	154	24- to 200
Static Water Level (mbgl)	3.46 to 67.90	7.03	1.99 to 67.90
Draw down (m)	7.13 to 14.85	-	0.56 to 14.00
Transmissivity (m^2 / day)	-	-	1.78 to 687

2. Rainfall and climate

The climate of the district is characterised by hot summer and general dryness except during the southwest monsoon seasons. The year can be divided into four seasons. The period from March to May is the hot season (summer) followed by southwest monsoon from June to September. October and November constitute the post-monsoon or retreating monsoon season. The cold season (winter) starts from December and ends in February.

The mean maximum temperature ranges between 28.4ºC during January to 41.8ºC during May and the mean minimum temperatures vary between 11.7ºC during January and 27ºC during June. The relative humidity varies between 32 % (March) and 79% (August). The wind velocity varies from 74 km/d (November) and 174.2 km/d (June). The potential Evapo-transpiration varies between 3.2 mm (December) and 7.8 mm/d (June). Long-term average annual rainfall recorded by IMD station at Ahmedabad is 799.6 mm. Most of the rainfall (about 766 mm) is received from south-west monsoon between June to September. Climatological data of Ahmedabad IMD station which is nearest is given in the table 8.

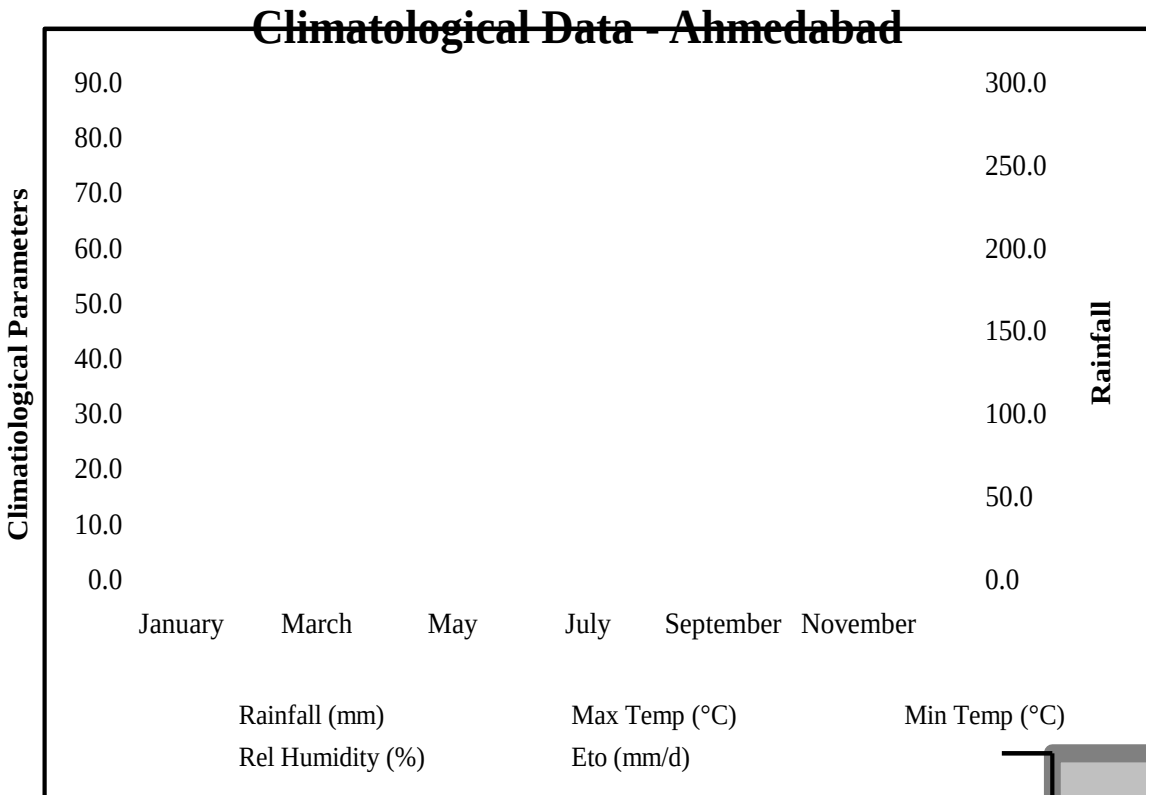


Table: 8- Climatological data of Ahmedabad IMD station

Month	Max Temp (°C)	Mini Temp (°C)	Humidity (%)	Wind Spd. Kmpd	Sunshine (Hours)	Solar Rad. (MJ/m2/d)	Evapotranspiration (mm/d)	Rainfall (mm)
January	28.4	11.7	43.0	100.1	9.6	17.5	3.4	2.6
February	31.3	13.8	36.0	101.8	10.2	20.5	4.2	1.1
March	36.0	18.8	32.0	108.7	9.3	21.7	5.3	1.0
April	39.9	23.4	34.5	120.8	10.0	24.5	6.6	0.9
May	41.8	26.2	42.5	158.7	10.6	25.9	7.8	6.0
June	38.4	27.0	59.5	174.2	8.8	23.2	6.7	108.7
July	33.3	25.7	76.0	150.1	4.6	16.8	4.4	265.3
August	31.9	24.8	79.0	124.2	4.3	16.0	3.9	219.8
September	33.4	24.1	71.0	103.5	6.7	18.5	4.4	171.9
October	35.8	20.9	50.5	74.2	9.5	20.3	4.4	10.8
November	33.2	16.5	43.0	79.4	9.7	18.1	3.6	8.9
December	29.8	13.0	45.0	91.4	9.5	16.7	3.2	2.6
Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**799.6**
Average	**34.4**	**20.5**	**51.0**	**115.6**	**8.6**	**20.0**	**4.8**	**-**

3. Geomorphology and Soil Type

3.1 Geomorphology

Geomorphologically the district can be divided into two zones, the major portion of it forms a flat planar topography except for a few rocky features in the extreme southern portion.

3.1.1 Flat Alluvial Peneplain

It includes the low-lying land of Dholka and Dhandhuka taluka (falling below 20 m) contour characterised by marshy land, which is believed to be under sea in the past. Water logging is common in these tracts at high tides during monsoon. This barren low land is termed as “The Bhal” area and characterised by high coastal salinity. The spreading of alluvial bed of Sabarmati river from end to end of the district is an important natural feature being observed. Below the city, on the left bank of the river and also midway between it and the Khari river are few small rises. But every where else, the surface of the ground is unbroken on every side, except the north, with groves of various trees. Along the Right Bank of Sabarmati river, the prominent characteristics of Dascroi pass into Dholka. However towards west and south-west they pass into fertile but absolutely flat and monotonous black soil of the Bhal. The area from Dholka to Bavliari creek along the coast is characterised by salty and marshy land. Along the western border, the land passes into a reddish form.

3.1.2 Low hills

A series of low hills are present few kilometres west of Rampur in the western Dhandhuka taluka. The hills around Ninana in the most westerly part of Dhandhuka are covered with fragments of quartz and limestone. Some hills are located around Vasai and Miroli in the southern section of the district, also near Thaltej and Gota of Dascroi taluka in the north, and Chandisar in Dholka and Vastrapur in the City Taluka.

3.2 Soils

The soils in the district can broadly be classified as:

Black Soils: Black soils cover the southern part of Dholka and eastern part of Dhandhuka taluka popularly known as 'Bhal' tract, where cotton is grown in the initial stage of monsoon. It is not very clayey and contains above 20% of clay and about 40 % of sand. Sub-soil invariably contains horizons of lime nodules. This type of soil is highly suitable for cultivation of rabi wheat, which is the main crop raised on this soil. If rains are sufficient in the late monsoon, rabi jowar and grams are sown. Medium Black Soils are found in Viramgam, Sanand and Dholka talukas. This soil is suitable for growing bajri, jowar and cotton.

Goradu Soils: Goradu soils vary from fertile brown to sandy loam and is found in City, Dascroi and parts of Sanand, Dholka and Viramgam talukas. This soil is mostly fertile and responds very well to irrigation and manuring. Practically all kinds of crops can grow on this soil.

Kyari: Kyari soils are found in several parts of City, Dascroi, Sanand, Dholka and Viramgam talukas. It is the most fertile soil with very good moisture and retentive capacity. Well known varieties of paddy such as Pankali, kamod, Jirasar, Sukhvel, Sutarsal and Basumati are grown on this soil.

Rocky soils: Rocky soils are found in Dhandhuka taluka and is known as Kaner tract. It is shallow, light in texture and fit for early maturing crops like cotton, Bajri, Jowar and Math.

4. Ground Water Scenario

4.1 Hydrogeology

The district forms a part of the CAMBAY BASIN. The stratigraphic succession of the formations encountered within the drilled depth of the wells in the district along with its thickness and generalised lithology are presented below.

Table: 9- Strategraphic succession of geological formations

Age	Formation	Thickness	Lithology
Holocene	Gujarat Alluvium,	100	Unconsolidated coarse sand, pebbly with kankar and minor clays.
Pleistocene	Jambusar	100	Sand, coarse grained with occ. Gravel
Pliocene	Broach	125	Greenish brown clays and sand clay alteration with variegated claystone.
Unconformity			
Upper to middle Miocene	Jhagadia	300	Greenish grey to variegated claystone with coarse to medium grained sand and minor coal.
Middle to lower Miocene	Kand	200	Greenish grey clay-stone with occasional bands of med to fine grained sands
Lower Miocene	Babaguru	125	Alternate bands of claystone and shale with minor sandstone beds.
Lower Miocene, to upper Oligocene	Tarakeshwar	125	Shale with minor clays and claystone with coarse to medium grained sands towards bottom.
Unconformity			
Lower Oligocene to upper Eocene	Tarapur shale.	175	Grey to greenish grey shale with argillaceous sandstone in the basal part.
Upper Eocene to middle Eocene	Kalol	250	Grey to dark grey shale with silty sandstone, siltstone and coal beds with minor sideritic claystones and oolite with sideritic matrix in Bavla and Ambaliyara areas.
Unconformity			
Lower Eocene	Cambay shale vagadkhol	>1500	Dark grey to black fissile, pyritic, carbonaceous shale with occasional siltstone bands towards bottom and reddish brown shale. The cambay shale Facies changes towards the basin margin to Vagadkhol formation with the lithology of trapo conglomerate, trap wash and brown clay / clay stone.
Unconformity			
Lower Eocene to upper Cretaceous	Deacon traps with intertrappean beds.	-	-

4.1.1 Ground water in the fissured formations (Hard rocks)

The Deccan trap and the limestone formations occupying the western part of the Dandhuka taluka forms the only hard rock aquifers in the district. It occupies the south western extremity of the district and can be termed as fissured formation. Occurrence and movement of ground water is governed by the extent and thickness of weathered zone, presence and interconnections of joint and fracture systems, which provides secondary porosity. The thickness of the weathered zone of the basalt ranges from less than one meter to more than 6 m and the joints and fracture system is prevalent down to a maximum depth of 80 to 90 mbgl in the basaltic terrain. The occurrence of vesicles and amygdales in the flows of the trap rocks and solution cavities in the limestone formations and the geological contact between limestone and basalt are other factors favourable for ground water storage and movement. Ground water

occurs in the weathered and fissured zones mainly under water table conditions. It occasionally occurs under semi-confined conditions in the event of comparatively deeper fracture system in these formations. These fissured formations do not form good repository of groundwater, compared to porous unconsolidated sedimentary formations. Groundwater is being developed in these formations by means of dug and dug-cum-bored wells. Depth of dugwells ranges between 5 and 38.5 mbgl whereas depth of dug-cum-bored wells varies between 15 and 78 mbgl in the case of fissured basaltic formations. Depth of dugwells in the limestone formations varies between 12 and 38 mbgl. Deeper wells are constructed in the western part in these formations. Depth to water levels in basaltic formation varies between 4 and 25 mbgl. In the limestone formation it varies between 12 and 33 mbgl. The deeper water levels are recorded towards western part of the area. The average yield of the wells in the trap formations varies between 50 and 1000 cu.m/day and of the wells in the limestone varies between 50 and 200 cu.m/day.

The general range of aquifer parameters, based on pumping tests conducted at select dug well in these formations are given as under**.**

Table: 10- The general range of aquifer and well parameters

FORMATION		Specific capacity m^3/day/m of d.d		Permeability m/day		Transmissivity m^2/day	
		From	To	From	To	From	To
Soft rock	Unconfined	0.12	38.48	0.49	105	10.58	3867.29
	Confined	0.12	38.48	0.49	472	10.58	13316
Hard	Deccan trap	7.44	234.6	3.18	17.00	3.54	114
	Lime stone	42.77	70.73	19.58	33.95	4.85	21.33

4.1.2 Ground water in Porous Formations (Sedimentaries)

It occupies the major part (93.5%) of the district. It includes the post-Miocene alluvial deposits at the top underlained by older Miocene formations. The sedimentary formations mainly consist of fine to coarse-grained sand, gravel, silt, clay, clay stone, siltstone and kankar. The thickness of the post-Miocene alluvial formations exceeds 419m near Dholka at Rampur Ground water occurs under phreatic as well as confined conditions in the granular horizons with in the sedimentaries.

Unconfined aquifer (phreatic)

The unconfined aquifer occurs in the upper horizons down to a maximum depth of 60-75 mbg consisting of medium to fine grained sand, silt with local lenses of sandy clay and clay. Medium to fine grained sands are found in the north-eastern part of the district. In this area where only phreatic aquifer is present, base of the alluvium is marked by gravel. Fine grained sands with silt are found further south and south-west at Dholka and Sanand taluka. The thickness of aquifer varies between 20 and 45 m in general, met with in the depth range of 3 and 75 mbgl and can be considered as aquifer 'A'.Ground water occurs under phreatic conditions in the north eastern part of the district. However, the intercalations of silt, at places, induces semi-confined conditions in the south and south western directions of Sanand and Dholka taluka. It bears potable and good quality water in the north eastern part of the district and eastern part of Dascroi taluka (east of Khari river). It is being developed by dug, dug-cum-bored wells and tube wells. The depth of the dug wells and dug-cum-bored wells usually varies between 10 and 60 mbgl. The tube wells range between 42 and 167 mbgl. In the rest part of the area it bears brackish to saline ground water. Hence ground water development is meagre and dug wells are constructed in or vicinity of ponds to meet the local demands. Hydraulic characters of this aquifer are not separately estimated. Tube wells, tapping this aquifer invariably tap one or more aquifers occurring underneath. Yields of such tube wells varies between 225 and 3032 m3/day. Specific capacity of tube wells varies between 0.12 and 38.48 lpm/m, permeability varies between 0.49 and 105 m/day and transmissivity varies between 10.58 and 3867.29 m^2/day.

Confined aquifers

The upper unconfined aquifer is underlained by persistent clay formations of considerable thickness in the entire area of porous sedimentary formations. This separates the lower unit consisting of a few hundred meters of alternating sandy and argillaceous beds forming the confined aquifer system. The arenaceous horizons of the confined aquifer, consists of medium to coarse-grained sand with gravel interstratified locally with silty or clayey sand and clay lenses. As mentioned earlier, the confined aquifers are grouped and designated as B, C & D with in the post Miocene alluvial sediments and G and F aquifers in Miocene sediments with in the drilled depth of 565 m in the district. The distribution of the confined aquifers varies considerably in the district. The sand content of the aquifer decreases considerably both in depth and space. It resulted in the pinching out of certain aquifers occurring below 150 mbgl in the south and south western directions, as seen, in Kalyangarh and Bagodra bore holes. The development of these aquifers hence depends upon the aquifer geometry, yield characters of the individual aquifers and / or salinity of formation waters.

Confined aquifers with potable water occurs down to 300 to 350 m in the area towards north and north east of the low lying 'Bhal' land in the district. The aquifers that are developed include B and C and to some extent the upper part of the D aquifers of the post Miocene alluvial aquifer and can be termed as user confined aquifers (UCA).

4.1.3 Ground Water Regime Monitoring

Ground Water Regime monitoring is being carried out four times in a year during May, August, November and January. In all 71 Hydrograph stations (17 Open Wells and 54 Purpose built Piezometers)spread over the entire district are being monitored during 2012-13.

Premonsoon (May 2012)

The ground water level during the premonsoon period (May 2012) ranged from 2.28 to 22.58 mbgl. The shallowest Water level of 2.28 mbgl was recorded at Gamph and the deepest water level of 22.28 m was recorded at Vastrapur lake Pz-II. The range of ground water level in the district is given as below.

Table: 11- Range of Ground Water Level during Pre Monsoon (May 2012)

No of well analysed	DTWL mbgl		No of well in different Depth Ranges					
	Min	Max	0 to 2 (m)	2 to 5 (m)	5 to 10 (m)	10 to 20 (m)	20 to 40 (m)	>40(m)
26	2.28	22.58	0 0.00%	8 30.77 %	6 23.08%	9 34.62%	3 11.54%	0 0.00%

Postmonsoon (November 2012)

The ground water level during the postmonsoon period (November 2012) ranged from 1.06 to 16.52 mbgl. The shallowest Water level of 1.06 mbgl was recorded at Fedra and the deepest water level of 16.52 m was recorded at Jholapur. The range of ground water level in the district is given as below.

Table: 12-Range of Ground Water Level during Post Monsoon (Nov-2012)

No of well analysed	DTWL mbgl		No of well in different Depth Ranges					
	Min	Max	0 to 2 (m)	2 to 5 (m)	5 to 10 (m)	10 to 20 (m)	20 to 40 (m)	>40(m)
25	1.06	16.52	3 12.00%	8 32.00%	8 32.00%	4 16.00%	2 8.00%	0 0.00%

73.91 % of the wells in the district showed rise in the ground water level between May to November 2012. Rise in the district ranged form 0.04 to 7.58m. 43.48% of the wells showed rise between 0 to 2 m , 8.70 % of the wells showed rise between 2 to 4 m. and 21.74 % of the wells showed rise > 4 m.

26.08 % of the wells in the district showed fall in the ground water level between May to November 2012. Fall in the district ranged form 0.07 to 0.93 m. 26.09 % of the wells showed fall between 0 to 2 m.

Table: 13- Range of Fluctuation

No of well analysed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation						Total No. of Wells	
	Rise		Fall		Rise			Fall				
	Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4	Rise	Fall
23	0.04	7.58	0.07	0.93	10 43.48 %	2 8.70 %	5 21.74 %	6 26.09 %	0 0 %	0 0 %	17	6

4.1.3.1 Long Term Fluctuations

Long Term Fluctuations- May (2002 to 2011)

A comparison of the water level observed in May 2011 with the average water level observed in the month of May during last one decade (2002-2011) reveals that rise in water level ranged from 0.75 to 3.33 mbgl and fall ranged from 0.75 to 7.88 mbgl. 64% of the wells had shown rise in the ground water level whereas only 36 of the wells have shown fall in the water level.

Table: 14- Categorisation of Changes In Water Level During May 2012 with respect to Decadal Average of May (2002 to 2011)

No of well analysed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation						Total No. of Wells	
	Rise		Fall		Rise			Fall				
	Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4	Rise	Fall
25	0.75	3.33	0.75	7.88	11 44.0%	5 20.00%	0 0%	2 8%	5 20%	2 8%	16	9

Long Term Fluctuations- November (2002 to 2011)

A comparison of the water level observed in November 2012 with the average water level observed in the month of November during last one decade (2002-2011) reveals that rise in water level ranged from 0.01 to 5.89 mbgl and fall ranged from 0.15 to 9.77 mbgl. 44% of the wells had shown rise in the ground water level whereas 56 % of the wells have shown fall in the water level.

Table: 15- Categorisation of Changes In Water Level During November 2012 with respect to Decadal Average of November (2002 to 2011)

No of well analysed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation						Total No. of Wells	
	Rise		Fall		Rise			Fall				
	Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4	Rise	Fall
25	0.01	5.89	0.15	9.77	8 32 %	2 8 %	1 4 %	10 40%	1 4%	3 12 %	11	14

4.2 Ground Water Resources

The ground water resources of the district were calculated as on March 2011 in collaboration with the Government of Gujarat using the methodlogy suggested by Ground Water Resource Estimation Committee (GEC-97). These resources were computed after reorganisation of the districts.

4.2.1 Ground Water Recharge

The Annual Ground Water Recharge varies form 1601.62 ha.m (Barwala taluka) to 20271.87 ha.m (City-Dascroi Taluka). The Gross Annual Ground Water Recharge in the district is 61686.37 ha.m. The net available recharge after leaving natural discharge from monsoon period varies from1521.54 ha.m (Barvala Taluka) to 19258.28 ha.m (City-Dascroi Taluka). The net available recharge in the district is 58309.42 ha.m.

4.2.2 Ground Water Draft

The ground water draft from irrigation and Domestic /Industrial sources is presented in Table:16. The Existing Gross Ground Water Draft for all uses varies form 942.90 ha.m (Barwala taluka) to 19977.50 ha.m (City-Dascroi Taluka). The Gross Ground Water Draft for All uses in the district is 45693.67ha.m.

4.2.3 Ground Water Balance for Irrigation

The irrigation potential available for future use of ground water has been computed leaving the ground water projected for allocation for the domestic and industrial requirements (for Next 25 Years) for all the talukas. It varies from -14341 ha.m (City-Dascroi Taluka) to 576 ha.m (Ranpur taluka). The total irrigation potential available for future use of ground water in the district is -13247 ha.m.

Table: 16- Ground Water Resource Potential (in ha m)

Sr. No.	Assessment Unit/ District	Total Annual Ground Water Recharge	Natural Discharge during non-monsoon season	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for domestic & industrial water supply	Existing Gross Ground Water Draft for All uses
1	Barvala	1601.62	80.08	1521.54	816.40	126.50	942.90
2	Bavla	4573.27	228.66	4344.61	1341.40	255.00	1596.40
3	City-Dascroi	20271.87	1013.59	19258.28	14685.50	5292.00	19977.50
4	Detroj-Rampura	5852.75	585.28	5267.48	3851.60	147.00	3998.60
5	Dhandhuka	**SALINE**					
6	Dholka	4624.67	231.23	4393.43	3641.60	406.77	4048.37
7	Mandal	3599.21	179.96	3419.24	1555.00	99.00	1654.00
8	Ranpur	4372.32	218.62	4153.71	2689.60	144.30	2833.90
9	Sanand	11668.25	583.41	11084.83	6316.00	366.00	6682.00
10	Viramgam	5122.41	256.12	4866.29	3594.00	366.00	3960.00
TOTAL		**61686.37**	**3376.96**	**58309.42**	**38491.10**	**7202.57**	**45693.67**

4.2.4 Level of Ground Water Development & Stage

The level of Ground Water Development varies between 36.74 % (Bavla Taluka) and 103.73 % (City-Dascroi Taluka). The overall development in the district is 78.36 %. One taluka is categorised as Over Exploited and one taluka as Critical. Two talukas are categorised as Semi Critical and Five Talukas are Safe. One taluka is Saline.

Table: 17- Stage of Ground Water Development

(in ha m)

Sr. No.	Assessment Unit/ Taluka	Net Annual Ground Water Avail-ability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for All uses (4+5)	Allocation for domestic and industrial require-ment supply upto next 25 years	Net Ground Water Availability for future irrigation developme nt (3-4-7)	Stage of Ground Water Development {(6/3)*100} (%)	Categorizat ion for future ground water develop-ment
1	2	3	4	6	7	8	9	
1	**Barvala**	1521.54	816.40	942.90	169.00	536.14	61.97	Safe
2	**Bavla**	4344.61	1341.40	1596.40	342.00	2661.21	36.74	Safe
3	**City-Dascroi**	19258.28	14685.50	19977.50	7091.00	0.00	103.73	Over Exploited
4	**Detroj-Rampura**	5267.48	3851.60	3998.60	197.00	1218.88	75.91	Semi critical
5	**Dhandhuka**	**SALINE**						
6	**Dholka**	4393.43	3641.60	4048.37	545.00	206.83	92.15	Critical
7	**Mandal**	3419.24	1555.00	1654.00	133.00	1731.24	48.37	Safe
8	**Ranpur**	4153.71	2689.60	2833.90	193.00	1271.11	68.23	Safe
9	**Sanand**	11084.83	6316.00	6682.00	490.00	4278.83	60.28	Safe
10	**Viramgam**	4866.29	3594.00	3960.00	437.00	835.29	81.38	Semi critical
TOTAL		58309.42	38491.10	4569.67	9597.00	12739.54	78.36	Semi critical

4.3 Ground Water quality

4.3.1 Unconfined aquifer (Phreatic)

The chemical quality of ground water in the phreatic aquifer shows considerable variation. Highly saline nature of formation water, akin to brine occurs in the 'Bhal' area. It is fresh a) in the north eastern part of the district at taluka, b) in the north eastern of the district, covering upper eastern half of Viramgam taluka and in the south western part of the district covering western part of Dhandhuka Taluka.

4.3.2 Confined aquifers

The ground Water quality in the deeper aquifers (with-in about 300m depth) which may also be called as user confined aquifer is generally fresh (TDS< 2000 ppm) in the north eastern and central parts and is good for drinking as wells as Irrigation purpose. Deterioration of ground water quality is observed

from recharge area in the north-east to discharge area in south west. chemical quality of ground water down to 300 to 350 m is generally good with TDS less than 2000 ppm in the area north covering part of Sanand taluka and further north-east covering Dascroi taluka. Gradual increase in salinity toward 'Bhal' area in south and south-western direction and towards west in the northern half of Viramgam taluka is recorded. The tube wells tapping the deeper aquifer (i.e. below 250 meters) at the 'Bhal' area in Dholka taluka (Kalyangadh, Bagodara) etc recorded better quality of ground water (EC around 3000 µs/cm) under artesian conditions during early sixties and seventies.

The fluoride concentration in the ground water of both phreatic and confined aquifer exceeds permissible limit (1.5 ppm) at many places in the district.

Ground water Quality is monitored through Ground water Monitoring stations in the district. Analysis of ground water quality data for May 2012 is presented as below.

Table: 18-Range of Different Chemical Constituents in Ground Water

Chemical constituents	Unit	Minimum	Maximum
TDS		541 - Kundali	8435- Dalod
pH		8.10- Davalia	8.80- Mandal
Sp. Conductance	**µS/cm at 25^0C**	808- Kundali	12590- Dalod
HCO_3	**mg/l**	232-Rajpada	1074- Dalod
Cl^-	**mg/l**	71-Kundali	3302- Dalod
NO_3	**mg/l**	6-Viramgam	70 -Kumarkhan
SO_4^-	**mg/l**	36-Kundali	1300-Kumarkhan
F^-	**mg/l**	0.45- Endla, Rajpada	6.25-Kumarkhan
Ca^{++}	**mg/l**	16-Barwala	220-Kumarkhan
Mg^{++}	**mg/l**	22-Dealia	207- Dalod
Fe	**mg/l**	0.00 – Barwala, Endla, Ghuma, Kumarkhan, Viramgam	0.6 -Rajpada
TH	**mg/l**	150- Devalia	1300- Dalod
Na^+	**mg/l**	74- Kundali	2246-Kumarkhan
K^+	**mg/l**	0.0- Barwala	193- Ghuma

Status of Ground Water Development (Taluka wise)

4.3.3 Feasibility, Yield potential, Depth and Dia of ground water abstraction structures.

Taluka wise Feasibility, Yield potential, Depth and Diameter of ground water abstraction structuresis presented in Table 19.

Table: 19- Feasibility, Yield potential, Depth and Dia of ground water abstraction structures

Taluka	Area Type	Wells feasible	Suitable drilling technique	Depth of well (m)	Diameter	Discharge (lpm)
Barvala	Soft Rock Area	Dug well	Manual	10-25	1-3 m	200-300
				15-30	1-3 m	200-300
		Tubewells	Direct/ Reverse Rotary	50-100	200-250 mm	200-400
				100-200	200-250 mm	600-1000
	Hard Rock Area	Dug well	Manual	10-25	1-3 m	60-150
		Shallow Tube Wells	Down to the Hole Hammer (DTH)	100-200	200-250 mm	100-300
Bavla, Dholka, Mandal, Sanand & Viramgam	Soft Rock Area	Dug Well	Manual	15-30	1-3 m	200-300
		Tube Wells	Direct/ Reverse Rotary	100-200	200-250 mm	600-1000
				100-300	200-250 mm	1000-1200
City-Dascroi	Soft Rock Area	Dug Well	Manual	10-25	1-3 m	200-300
				15-30	1-3 m	200-300
		Tube Wells	Direct/ Reverse Rotary	50-100	200-250 mm	200-400
				100-300	200-250 mm	1000-1200
Detroj-Rampura	Soft Rock Area	Dug Well	Manual	15-30	1-3 m	200-300
		Tube Well	Direct/ Reverse Rotary	100-300	200-250 mm	1000-1200
Dhandhuka	Soft Rock Area	Dug well	Manual	10-25	1-3 m	200-300
				15-30	1-3 m	200-300
		Tube Wells	Direct/ Reverse Rotary	50-100	200-250 mm	200-400
				100-200	200-250 mm	600-1000
Ranpur	Soft Rock Area	Dug well	Manual	10-25	1-3 m	200-300
		Tube Wells	Direct/ Reverse Rotary	50-100	200-250 mm	200-400
	Hard Rock Area	Dug well	Manual	10-25	1-3 m	60-150
		Shallow Tube Wells	Down to the Hole Hammer (DTH)	100-200	200-250 mm	100-300

4.3.4 Drinking water wells and water supply based on groundwater sources

Table: 20- Drinking water wells and water supply

Taluka	No. of Dugwell	No. of Tube Wells	No. of Hand Pumps	Depth Range (m)	Discharge range (LPM)
Barvala	16	1	11	16-90	10
Bavla	-	48	-	150-300	400-800
City-Dascroi	-	93	-	120-300	400-800
Detroj-Rampura	-	55	-	230-400	400-800
Dhandhuka	67	-	1	8-35	10
Dholka	5	66	-	12-280	400-800
Mandal	-	37	-	230-350	400-800
Ranpur	-	-	34	60-90	-
Sanand	-	67	-	200-300	400-800
Viramgam	-	69	-	180-400	400-800

Source: GWS&SB

4.3.5 Type of pumps and water lifting devices for Irrigation dugwells, shallow tubewells and deep tubewells.

Table: 21-Dugwells

Taluka	Electric pumps	Diesel pumps	Wind mills	Solar pumps	Man/Ani. Operated	Others	Total
Barvala	242	231	4	0	0	0	477
Bavla	443	1114	26	1	41	9	1634
City-Dascroi	1554	1354	3	0	67	48	3026
Detroj-Rampura	118	146	41	16	54	0	375
Dhandhuka	277	289	4	0	0	0	570
Dholka	333	423	5	0	0	0	761
Mandal	247	55	3	0	28	0	333
Ranpur	265	1256	4	2	5	0	1532
Sanand	1495	545	3	0	1	2	2046
Viramgam	3	859	7	0	1	1790	2660

Table: 22- Shallow Tubewells

Taluka	Electric pumps	Diesel pumps	Wind mills	Solar pumps	Man/Ani. Operated	Others	Total
Bavla	79	168	0	0	1	3	251
Dholka	63	50	1	0	0	0	114
Mandal	1	0	0	0	0	0	1
Sanand	50	71	1	0	0	0	122
Viramgam	34	93	0	0	2	0	129

Table: 23- Deep Tubewells

Taluka	Submersible pumps	Turbine pumps	Others	Total
Barvala	68	0	0	68
Bavla	342	0	1	343
City-Dascroi	2218	0	1	2219
Detroj-Rampura	444	0	6	450
Dhandhuka	16	0	0	16
Dholka	1525	5	9	1539
Mandal	368	0	0	368
Ranpur	497	12	8	517
Sanand	655	5	34	694
Viramgam	428	24	20	472

4.3.6 Irrigation scenario from ground water sources

4.3.6.1.1 Dugwells

As per MI census 2000-01 there are 13414 dugwells out of which 2406 are in use. Irrigation potential created through these dugwells is 77251 sq. km and potential utilized is 62349 sq. km. area.

4.3.6.1.2 Shallow tubewells

As per MI Census 2000-01 there are 617 shallow tubewells out which 564 are in use. The irrigation potential created is 6550 sq. km and utilized is 5186 sq. km. area.

4.3.6.1.3 Deep Tubewells

As per MI census 2000-01 there are 6686 deep tubewells in the district out of which 5254 are in use. The irrigation potential created is 109303 sq. km. are and potential utilized is 77748 sq. km. area.

Following is the talukawise detail of irrigation potential for ground water sources

Table: 24- Talukawise detail of irrigation potential for ground water sources

Taluka	Dugwells		Shallow tubewells		Deep tubewells	
	Potential created	Potential utilized	Potential created	Potential utilized	Potential created	Potential utilized
Barvala	61592	51143	0	0	14025	11595
Bavla	4829	3090	2816	2333	5670	3608
City-Dascroi	280	224	0	0	15685	11040
Detroj-Rampura	0	0	0	0	10307	7913
Dhandhuka	3159	2411	0	0	59	44
Dholka	2041	1711	1274	995	20936	15959
Mandal	12	8	0	0	7118	6957
Ranpur	1209	974	0	0	2381	1670
Sanand	766	497	836	664	20359	10353
Viramgam	3327	2291	1624	1194	12763	8609

5. Ground Water Management Strategy

5.1 Ground Water Development

As per the GWRE, 2011 report, out of Ten Talukas of the district, One Taluka is Over Exploited and One Taluka is Critical, Three talukas are categorised as Semi Critical, Five Talukas are Safe and One Taluka as Saline. The level of Ground Water Development varies from 36.74 % (Bavla Taluka) to 103.73 % (City-Dascroi Taluka). The overall development in the district is 78.36 %, and as a whole the Ahmedabad district is Semi Critical. Improvement in Groundwater development is observed as a perusal of GWRE 2004, 2009 and 2011. The district was categorized as Over Exploited during GWRE 2004 and 2009 and now as per GWRE 2011 it falls in Semi Critical Category, leaving some scope for development of the ground water resources. Dhandhuka taluka has potential but the phreatic aquifer being saline, further development is not possible. In the semi critical blocks the ground water may be developed along with rain water harvesting measures.

5.2 Water Conservation and Artificial Recharge

The suitable recharge structures feasible in the district are Percolation tanks/ponds, Recharge wells, recharge shaft, check dams, nalla bunds etc depending on the terrain conditions.

In the phreatic aquifers with deep water levels and desaturation, spreading channels, recharge pits, recharge ponds etc are suitable to utilize surplus runoff and tail end releases from the canals.

In the confined aquifers artificial recharge by indirect injection technique is suitable that is dual purpose connector wells. These recharge wells should have screens against upper saturated aquifer and also against the targeted confined aquifer. it would function under gravity since the piezometric level of confined aquifer is much below phreatic water level.

Various rainwater harvesting schemes depending on the suitable hydrogeological conditions have been constructed in the district viz. Check dams, Recharge tube wells , deepening the of the village ponds etc and have shown good impact on the groundwater scenario.

In the South- western parts of the district in regions of hard rock formations suitable recharge structures are percolation tanks/ Ponds, Recharge wells, Check Dams, Nalla bunds etc.

Table: 25- Taluka wise Suitable Artificial Recharge Structures

Taluka	Formation /Aquifer	Suitable Artificial Recharge Structures
Barvala	Soft Rock	Percoaltion Tanks/ Ponds, Recharge Wells, Recharge Shafts
Bavla		
City-Dascroi		
Detroj-Rampura		
Dhandhuka		
Dholka		
Mandal		
Sanand		
Viramgam		
Ranpur	Hard Rock	Percolation Tanks/ Ponds, Recharge Wells, Check Dams, Nalla bunds

6. Ground Water Related Issues and Problems

- Over exploitation of ground water is a major issue in some parts of the district resulting in the fast depletion of this resource. Piezometric heads of deep confined aquifer has also declined sharply owing to the huge withdrawal. In some parts of the district phreatic aquifers are desaturated needing urgent attention.
- Replacement wells, increase in well depth, prime mover, declining well yields are also the major issues.
- Flood irrigation technique which is practised in the area is also the major cause of wastage of ground water as there is no control on the watering depth.
- Control on the area under fodder crops like alfalfa is also to be done asthis is water intensive crop and consumes much more water compared to other crops like wheat, bajra, castor, mustard etc.
- Although ground water quality for irrigation practice is within the limit in most parts of the district but many parts of the district are having high fluoride (>1.5 ppm) content (more than 161 villages) (Source: GWSSB)
- Awareness among the people regarding rainwater harvesting and artificial recharge.

7. Mass awareness and Training Activity

7.1 Masawareness Programmes

Till now three mass awareness programme have been conducted in the district at Village Vatva, Bhawda and Ahmedabad.

Table: 26 Mass Awareness Programmes

S.No	Taluka	Place	Date	No. of Participants
1.	City	SDA School	10th Feb. 2005	200
2.	Dascroi	Primary School Bhawda	29th March 2005	200 (Including Students and Teachers)
3.	City	Kendryia Vidhalaya	25th July 2003	200

7.2 Water Management Training Programmes

Till now three Water management training programme have been conducted in the district by CGWB.

Table: 27 Water Management Training Programmes

S.No	Taluka	Place	Date	No. of Participants (App.)
1.	City	MGL Institute	01-3rd Dec. 2005	20
2.	City	AMA Seminar Room	07th March 2008	20
3.	City	Hotel Inder Residency	5th March 2011	30

8. Areas Notified by CGWA/SGWA

None of the talukas have been notified by CGWA.

9. Recommendations

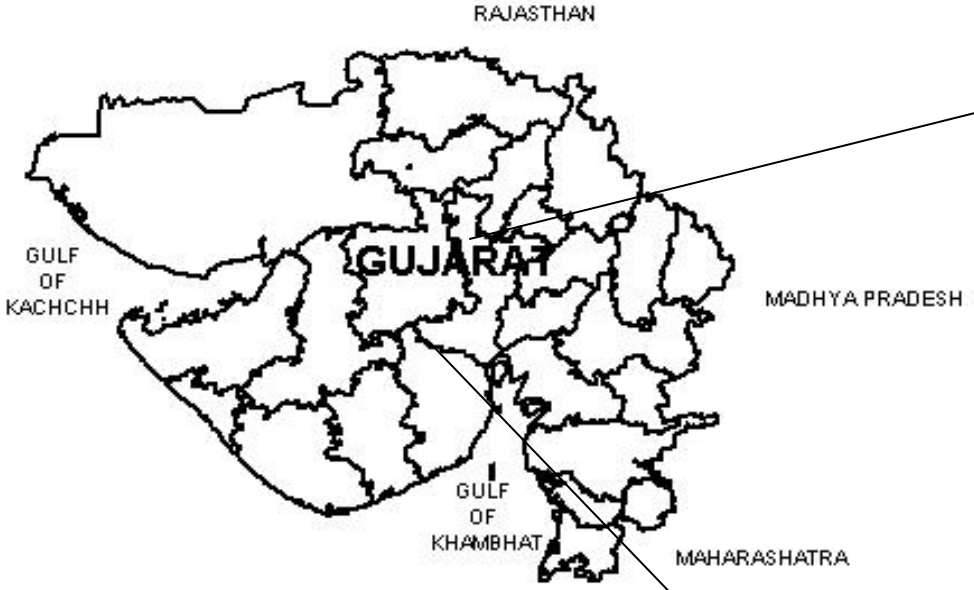
- There is a great need for management of resources for sustainable development. The north-eastern part of the district comprising Dascroi - City taluka and Dholka taluka needs immediate attention of the authorities to safeguard the groundwater scenario. These areas need conservation and augmentation measures of the groundwater resources. The declining trend of the groundwater level over the years has resulted to near complete desaturation of the aquifers in certain parts of the region.
- Suitable ground water legislation may be enforced and all future ground water exploitation by deep tube wells be completely banned
- As a conservation measure, farmers should be encouraged and educated to adopt modern irrigation techniques like drip, sprinkler irrigation etc. to effect minimum withdrawal and maximum utilisation of groundwater. Suitable cropping pattern can also be conceived and implemented that require lesser water-consumption.
- The augmentation measures like diverting of excess flow to artificial recharge ponds and other suitable structures, designing and construction of rainwater harvesting structures in the city area are to be planned and implemented. Liberal institutional finance with some attractive subsidy can be made available for those who come forward to implement the above schemes.
- The land holding of the group of farmers under public tubewell irrigation should be brought under the provision of the change in crops, irrigation practices and installation of drip/sprinkler irrigation technique, soft term institutional finances to the farmers and liberal subsidies in equipments are suggested.

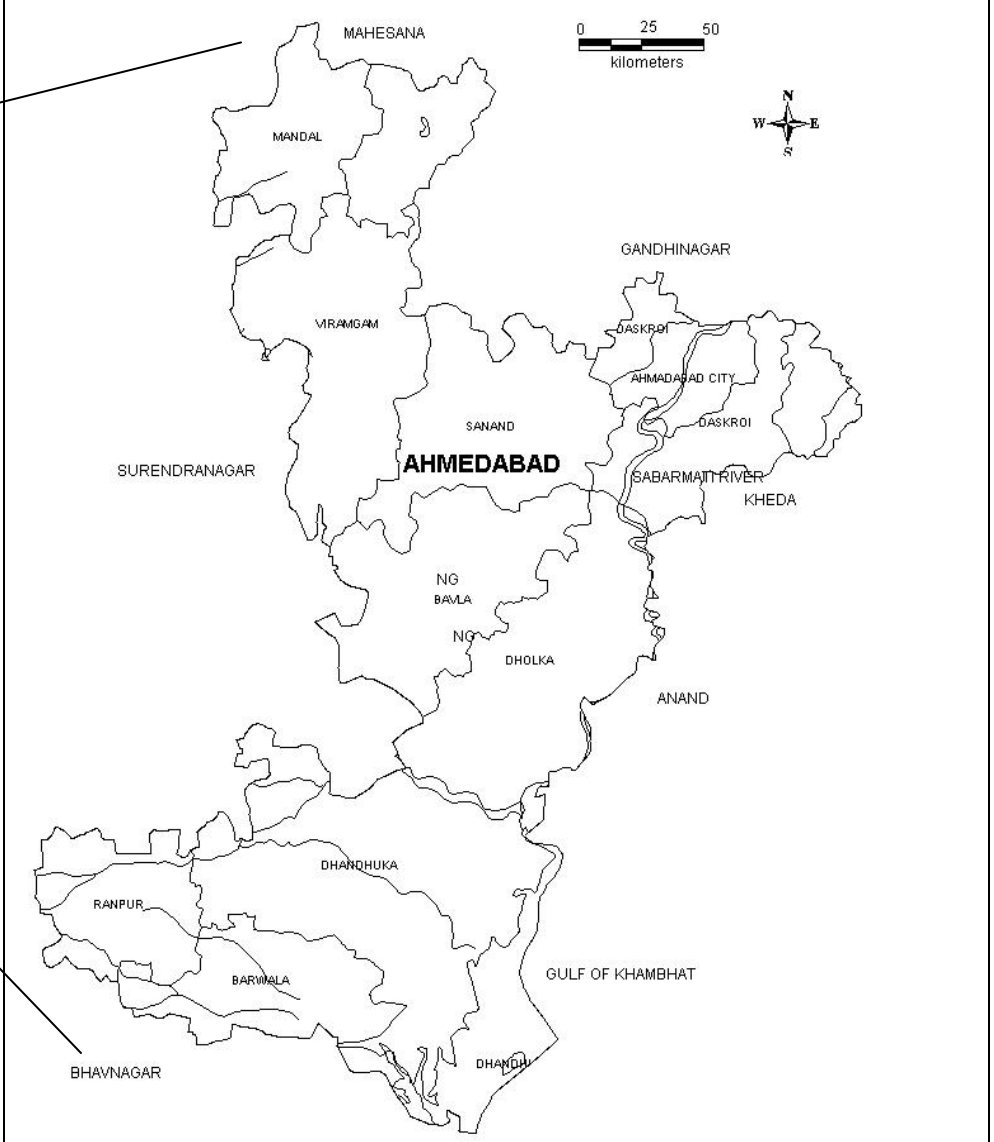
- The district bears a multi-layered aquifer systems. Development is taking place at considerable rate without proper assessment of parameters of individual aquifer systems. Precise data of individual aquifer groups are to be collected for proper assessment and management of the same.
- The potable water bearing deeper aquifers encountered in wells with artesian flow in the border area of 'Bhal' in Dholka taluka are to be studied properly. Its aquifer geometry towards further south and south-west are to be ascertained along with its parameters by taking a few more exploratory drilling at suitable locations in the district.
- The aquifers of the deeper Miocene formations identified at some deep exploratory boreholes, needs further detailed study in the area. Its aquifer geometry is to be delineated and parameters are to be collected properly by planning and implementing suitable exploratory drilling programmes in the district.
- Since considerable areas are characterised by saline water bearing aquifers, research can be taken up to find suitable salt resistant crops for the area for effective use of saline waters.
- In the areas where poor quality water overlies potable water bearing aquifers, the poor quality water can be used for washing and the non-drinking uses. The potable water can be tapped for drinking and other kitchen uses only where domestic water supply depends on groundwater.
- The fluoride occurrence in the ground water in the district is of considerable amount at many places. A detailed study has to be made so that necessary measures can be taken up in the proposed water supply scheme.

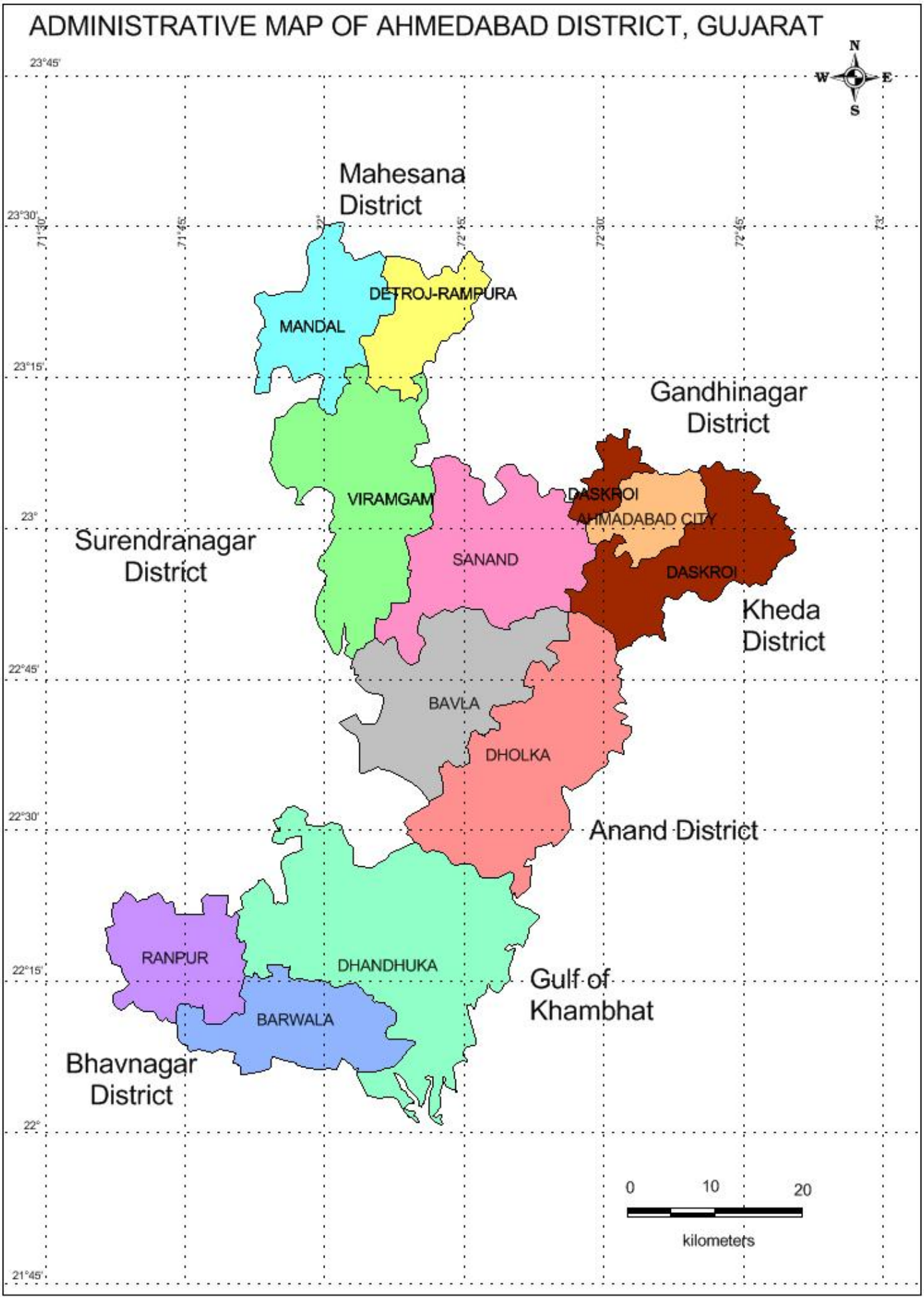
Annexure 1 Taluka wise Hydrogeological Parameters

	Min. / Max. / Avg.	Depth drill ed (m)	Depth constru - cted(m)	zones From (m)	zones To (m)	Cement seal Between (m)	(m)	Swl mbgl	PWL mbgl	Draw- down	Dis-char-ge	Transmis-sivity	Pf	Speci-fic ca- pacity	Elect. Condu-ctivity	Total disolv-ed soli-ds.	Ph	SAR	ADJ-SAR	SSP	RSC	Cl CO
Dascroi	**Min.**	**133.24**	**115.66**	**40.25**	**112.41**	**66**	**60**	**14.10**	**20.85**	**1.10**	**420**	**75.00**	**1.25**	**0.89**	**1060**	**690**	**7.4**	**3.94**	**10.60**	**52.44**	**0.10**	**0.23**
	Max.	**700.00**	**269.73**	**164.89**	**266.67**	**191**	**188**	**88.35**	**92.40**	**21.20**	**3420**	**13316.73**	**472.74**	**15.99**	**3900**	**2350**	**8.20**	**19.33**	**45.28**	**88.82**	**10.15**	**7.51**
	Avg.	**212.4**	**195.66**	**99.18**	**191.22**	**105**	**104**	**49.69**	**55.33**	**5.68**	**1588**	**1072.47**	**22.47**	**6.44**	**2083**	**1301**	**9.97**	**11.08**	**25.73**	**78.17**	**5.34**	**1.15**
Dholka	**Min.**	**165.00**	**159.65**	**84.93**	**156.01**	**74**	**69**	**10.20**	**12.50**	**1.60**	**699**	**184.64**	**3.28**	**1.35**	**2000**	**1220**	**7.60**	**0.29**	**14.99**	**57.49**	**0.65**	**1.28**
	Max.	**242.00**	**206.70**	**132.00**	**203.50**	**125**	**120**	**50.10**	**60.85**	**14.00**	**3032**	**2844.00**	**59.68**	**15.79**	**3770**	**2430**	**8.00**	**22.13**	**42.04**	**91.71**	**5.4**	**6.25**
	Avg.	**209.15**	**187.13**	**101.29**	**183.64**	**91**	**87**	**26.40**	**31.95**	**5.52**	**1636**	**787.67**	**15.20**	**6.36**	**2738**	**1667**	**7.77**	**10.25**	**23.91**	**72.14**	**2.45**	**3.19**
Sanand	**Min.**	**161.53**	**156.25**	**82.00**	**153.00**	**63**	**58**	**8.60**	**14.40**	**3.80**	**757**	**57.55**	**0.99**	**0.57**	**1610**	**980**	**7.60**	**6.20**	**13.65**	**63.21**	**0.20**	**1.05**
	Max.	**347.87**	**336.00**	**152.00**	**332.00**	**143**	**138**	**56.40**	**77.09**	**33.00**	**2274**	**1035.02**	**22.16**	**9.35**	**2700**	**1670**	**8.00**	**28.34**	**44.74**	**94.71**	**3.60**	**3.28**
	Avg.	**231.38**	**220.70**	**114.93**	**217.28**	**104**	**99**	**33.62**	**44.83**	**12.27**	**1376**	**330.79**	**6.54**	**2.96**	**1968**	**1229**	**7.76**	**12.79**	**23.73**	**78.23**	**1.87**	**2.08**
Viramam	**Min.**	**181.36**	**163.10**	**89.00**	**159.47**	**70**	**65**	**15.10**	**25.73**	**2.05**	**757**	**52.30**	**1.03**	**0.39**	**1800**	**1090**	**7.6**	**6.79**	**15.61**	**59.19**	**0.50**	**1.09**
	Max.	**270.00**	**260.52**	**156.56**	**258.08**	**225**	**220**	**80.56**	**94.35**	**33.70**	**2274**	**1798.22**	**21.55**	**9.59**	**5780**	**3470**	**8.00**	**30.92**	**57.69**	**95.13**	**4.20**	**9.18**
	Avg.	**228.17**	**217.75**	**119.87**	**212.88**	**109**	**105**	**46.56**	**56.82**	**10.14**	**1377**	**398.96**	**6.65**	**3.10**	**2707**	**1650**	**7.75**	**15.44**	**29.82**	**80.53**	**2.27**	**4.41**

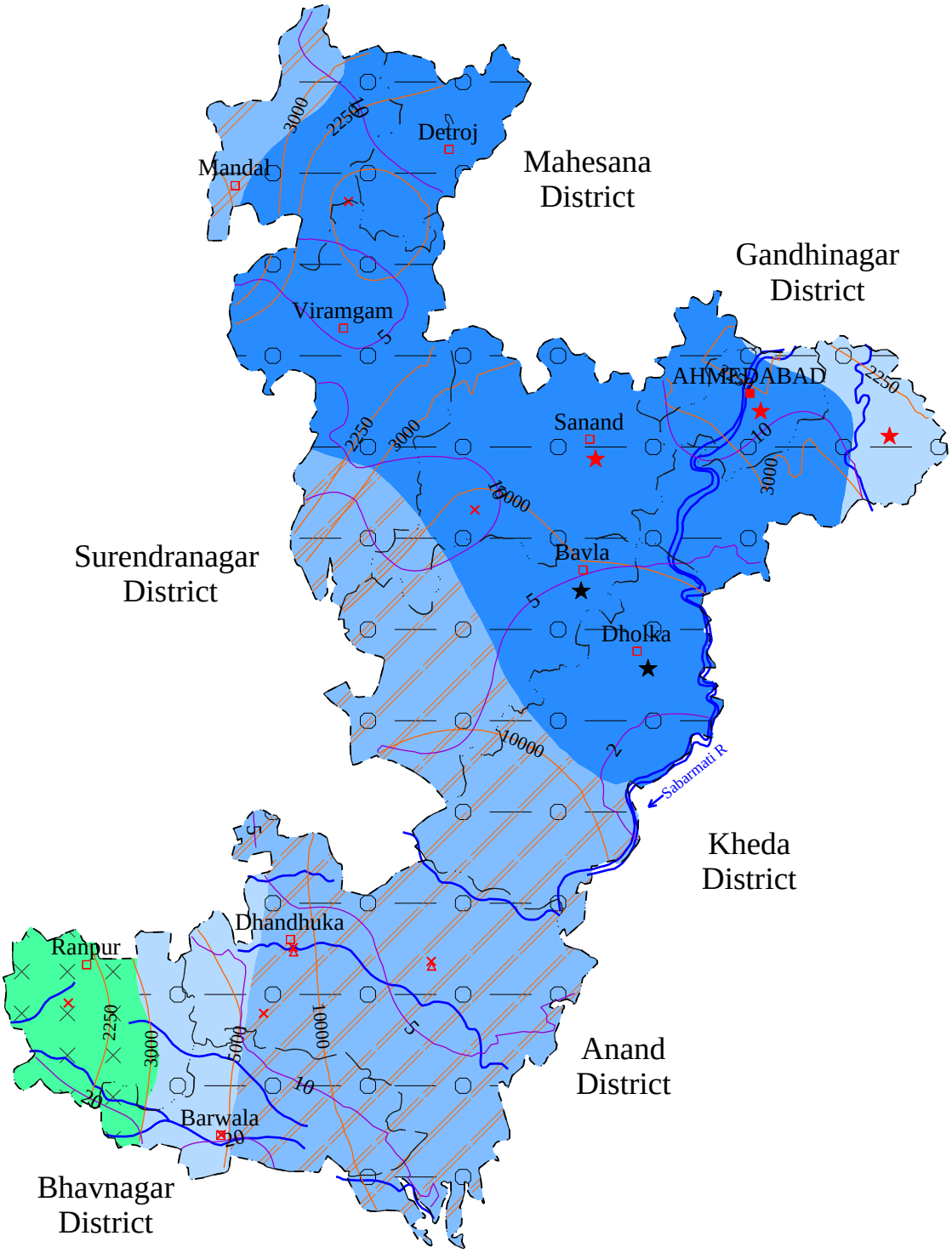
AHMEDABAD DISTRICT LOCATION MAP






ADMINISTRATIVE MAP OF AHMEDABAD DISTRICT, GUJARAT
N
W
E
S
Mahesana District
DETROJ-RAMPURA
MANDAL
Gandhinagar District
VIRAMGAM
DASKROI
AHMADABAD CITY
SANAND
DASKROI
Surendranagar District
Kheda District
BAVLA
DHOLKA
Anand District
RANPUR
DHANDHUKA
Gulf of Khambhat
BARWALA
Bhavnagar District
0
10
20
kilometers
23°45'
23°30'
23°15'
23°
22°45'
22°30'
22°15'
22°
21°45'
71°30'
71°45'
72°
72°15'
72°30'
72°45'
73°

HYDROGEOLOGICAL MAP
AHMEDABAD DISTRICT



HYDROEOLOGICAL MAP
AHMEDABAD DISTRICT

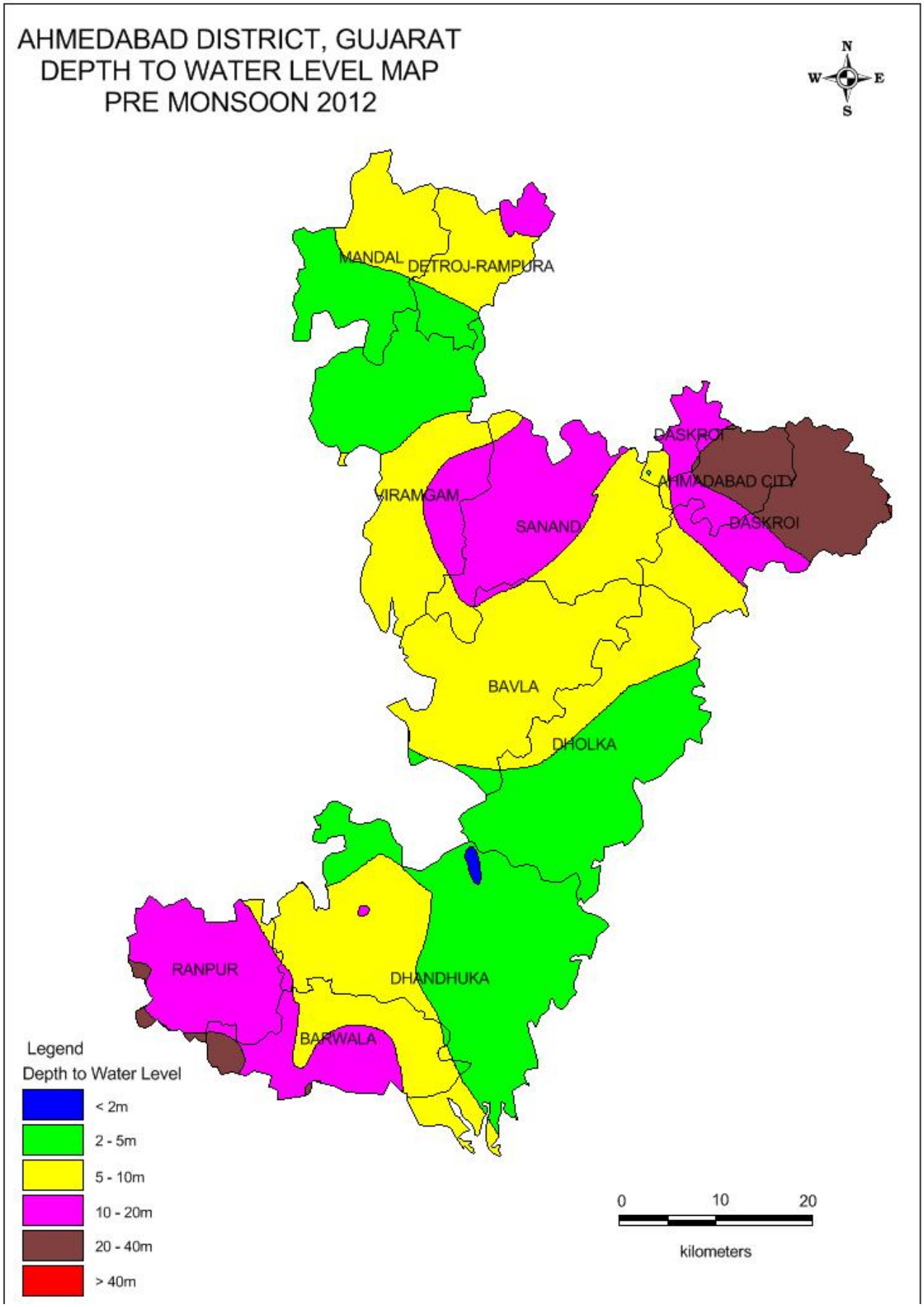
Legend

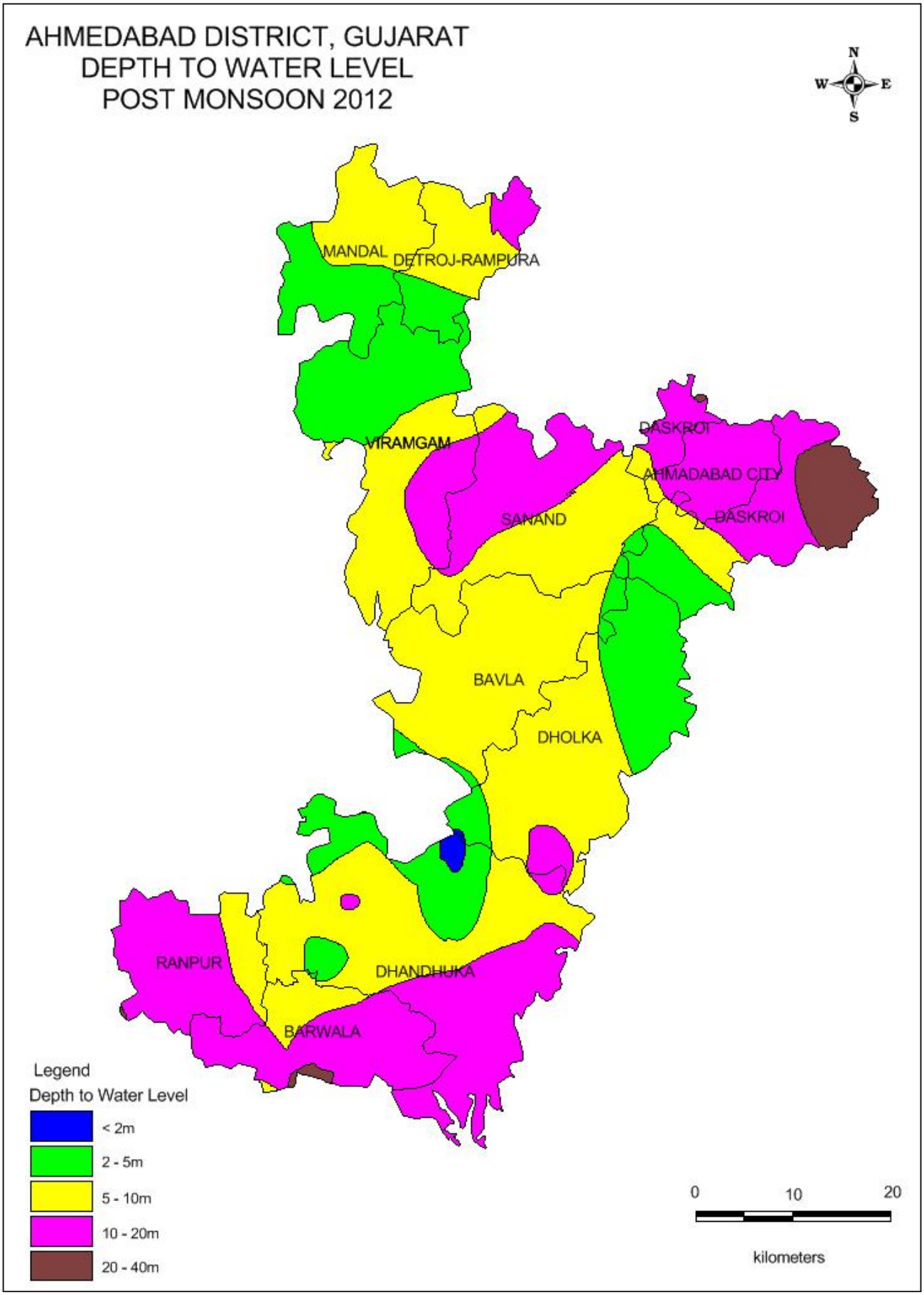
	Wells Feasible	Rigs Suitable	Depth of Well (m)	Discharge (lpm)	Artificial Recharge Structure Suitable
Soft Rock Aquifer	Dug Well Tubewell	Manual Direct Rotary, Reverse Rotary	10-25 50-100	200-300 200-400	Percolation Tanks/ Ponds, Recharge Wells,
Soft Rock Aquifer	Dug Well Tubewell	Manual Direct Rotary Reverse Rotary	15-30 100-200	200-300 600-1000	Percolation Tanks/ Ponds, Recharge Wells, Recharge Shaft
Soft Rock Aqyufer	Dug Well Tubewell	Manual Direct Rotary Reverse Rotary	15- 30 100-300	200-300 1000-1200	Percolation Tanks/ Ponds, Recharge Wells, Recharge Shaft
Hard Rock Aquifer	Dug Well Shallow Tubewell	Manual Down the Hole Hammer (DTH)	10-25 100-200	60-150 100-300	Percolation Tanks/ Ponds, Recharge Wells, Check Dams, Nalla Bunds.
Saline Area	Not Suitable except localised fresh water pockets				

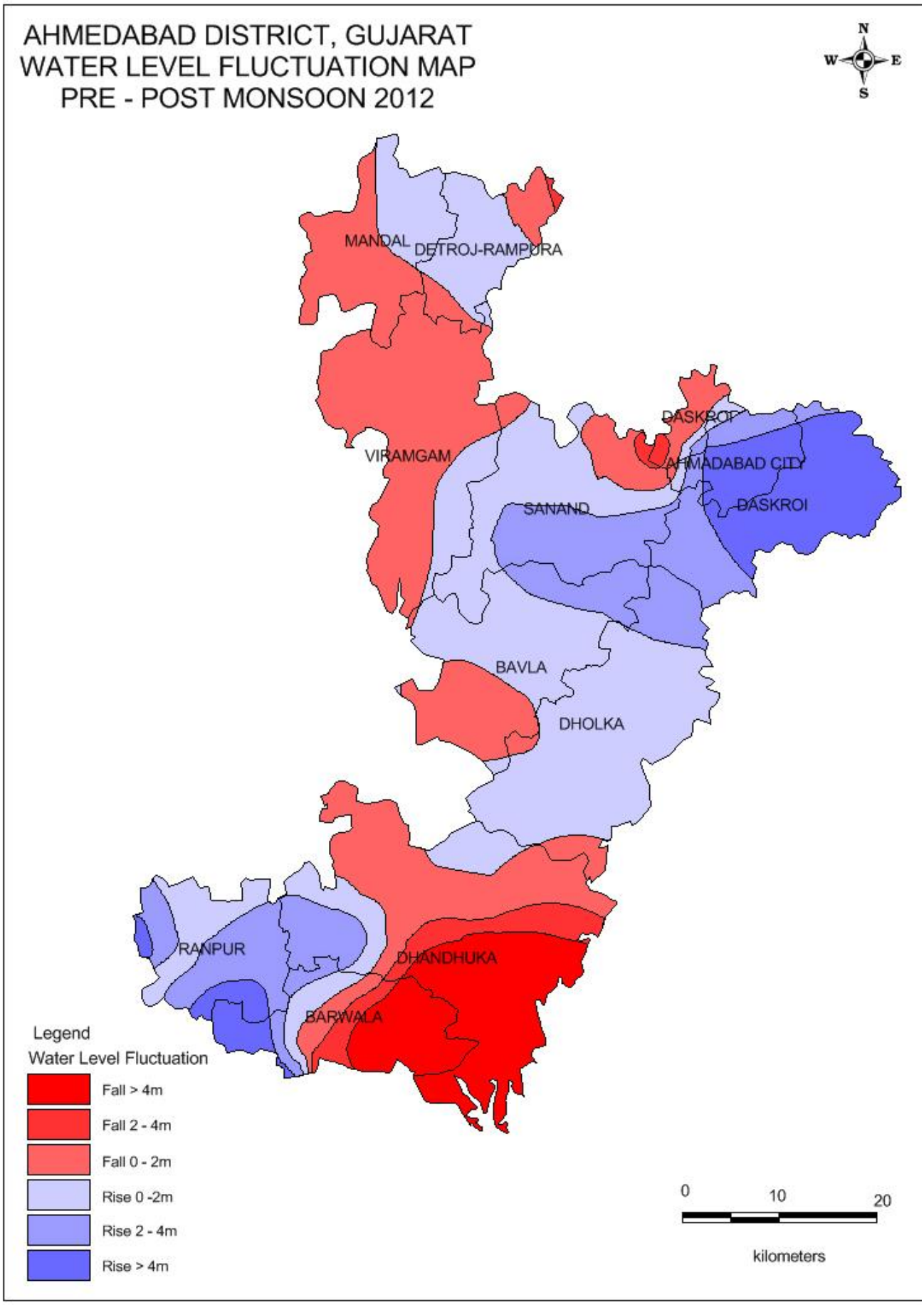
20	Pre-monsoon Decadal mean (1993-2000) Depth to Water Level (mbgl)	2000	Electrical Conductivity (µS/cm at 25° C)
	Fluoride > Maximum Permissible Limit (1.5 mg/l)		Nitrate > Maximum Permissible Limit (100 mg/l)
	Over Exploited Taluka		Dark Taluka
	Drainage		District/Taluka HQ

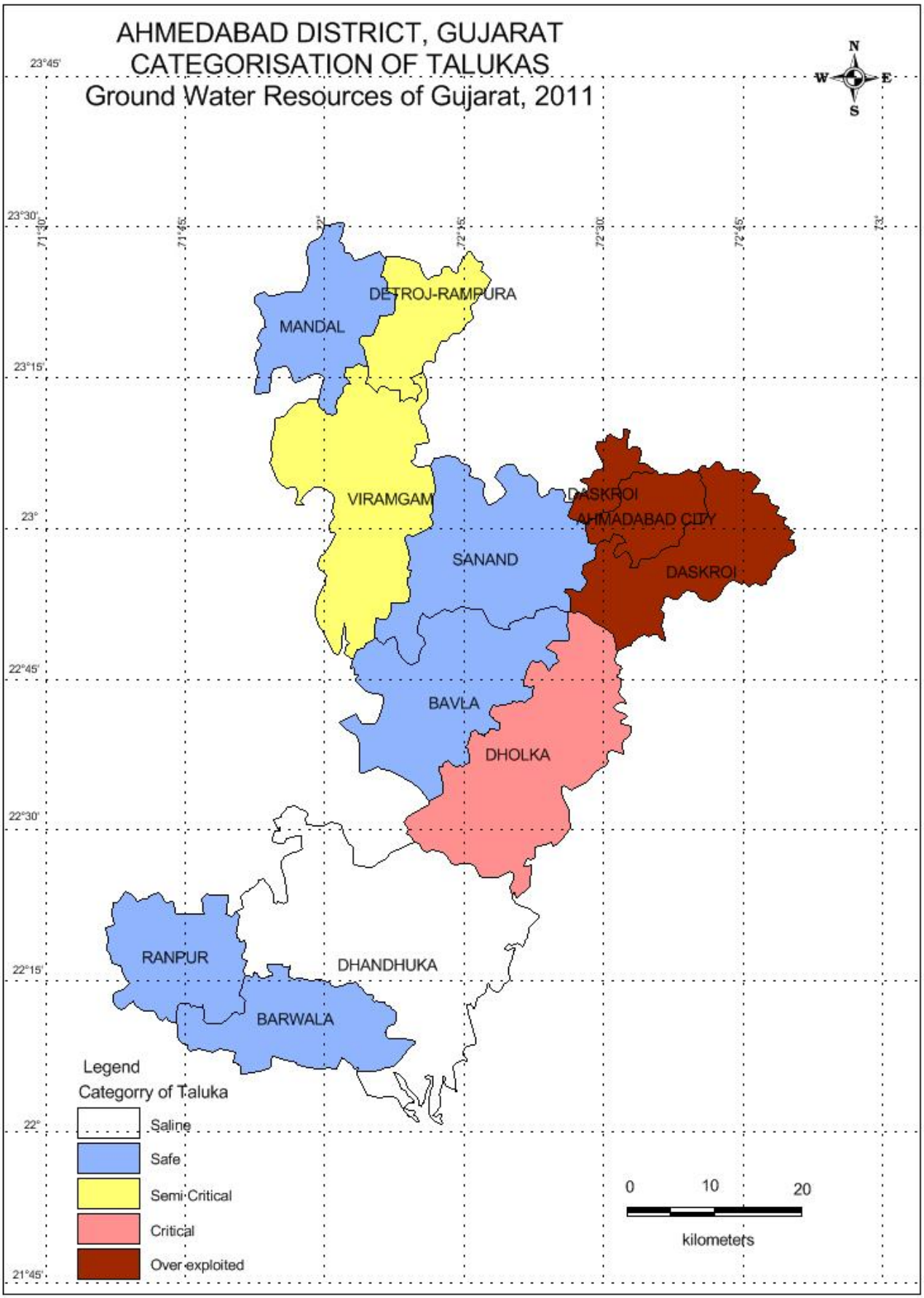
Other Information

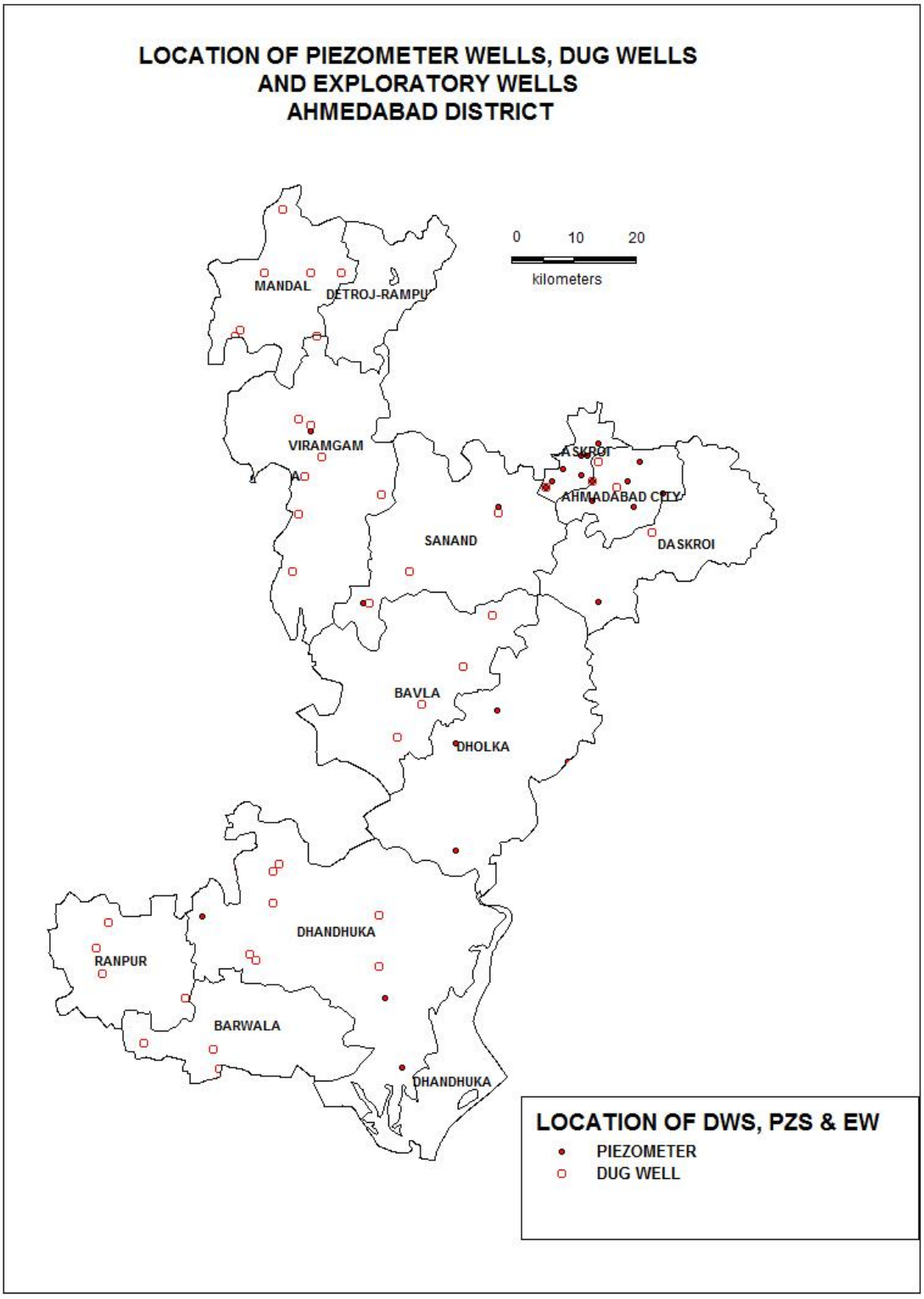
Geographical Area	7,396 sq. km
No of Blocks/ Talukas	11
Population (2001 Census)	58,08,378
Average Annual Rainfall	827 mm
Range of Average Temperature	20-31 °C
Major Drainage System	Sabarmati
Major/ Medium Irrigation Scheme	Fatehwadi
Major Geological Formation	Soft Rock: Alluvium Hard Rock: Deccan Trap
Utilizable Ground Water Resources	642 MCM/Yr
Net Ground Water Draft	469 MCM/Yr
Stage of Ground Water Development	73 %
Blocks Showing Intensive Ground Water Development	Ahmedabad City, Bavla, Daskroi, Dholka, Sanand


AHMEDABAD DISTRICT, GUJARAT
DEPTH TO WATER LEVEL MAP
PRE MONSOON 2012
N
W
E
S
MANDAL
DETROJ-RAMPURA
DASKROI
AHMADABAD CITY
VIRAMGAM
SANAND
DASKROI
BAVLA
DHOLKA
RANPUR
DHANDHUKA
BARWALA
Legend
Depth to Water Level
< 2m
2 - 5m
5 - 10m
10 - 20m
20 - 40m
> 40m
0
10
20
kilometers


AHMEDABAD DISTRICT, GUJARAT
DEPTH TO WATER LEVEL
POST MONSOON 2012
N
W
E
S
MANDAL
DETROJ-RAMPURA
VIRAMGAM
DASKROI
AHMADABAD CITY
SANAND
DASKROI
BAVLA
DHOLKA
RANPUR
DHANDHUKA
BARWALA
Legend
Depth to Water Level
< 2m
2 - 5m
5 - 10m
10 - 20m
20 - 40m
0
10
20
kilometers


AHMEDABAD DISTRICT, GUJARAT
WATER LEVEL FLUCTUATION MAP
PRE - POST MONSOON 2012
N
W
E
S
MANDAL
DETROJ-RAMPURA
VIRAMGAM
DASKROI
AHMADABAD CITY
SANAND
DASKROI
BAVLA
DHOLKA
RANPUR
DHANDHUKA
BARWALA
Legend
Water Level Fluctuation
Fall > 4m
Fall 2 - 4m
Fall 0 - 2m
Rise 0 -2m
Rise 2 - 4m
Rise > 4m
0
10
20
kilometers


AHMEDABAD DISTRICT, GUJARAT
CATEGORISATION OF TALUKAS
Ground Water Resources of Gujarat, 2011
N
W
E
S
23°45'
23°30'
23°15'
23°
22°45'
22°30'
22°15'
22°
21°45'
71°30'
71°45'
72°
72°15'
72°30'
72°45'
73°
DETROJ-RAMPURA
MANDAL
VIRAMGAM
SANAND
DASKROI
AHMADABAD CITY
DASKROI
BAVLA
DHOLKA
RANPUR
DHANDHUKA
BARWALA
Legend
Categorry of Taluka
Saline
Safe
Semi Critical
Critical
Over exploited
0
10
20
kilometers


LOCATION OF PIEZOMETER WELLS, DUG WELLS
AND EXPLORATORY WELLS
AHMEDABAD DISTRICT
0
10
20
kilometers
MANDAL
DETROJ-RAMPU
VIRAMGAM
A
SANAND
ASKROI
AHMADABAD CITY
DASKROI
BAVLA
DHOLKA
DHANDHUKA
RANPUR
BARWALA
DHANDHUKA
LOCATION OF DWS, PZS & EW
PIEZOMETER
DUG WELL

State Govt. Data

Monitoring Network carried out by

Gujarat Water Resources Development Corporation Ltd. (GWRDC)

Govt. of Gujarat

Monitoring Network carried out by Gujarat Water Resources Development Corporation Ltd. (GWRDC) Govt. of Gujarat

1. Introduction

Gujarat Water Resources Development Corporation Ltd. is functioning under the Narmada Water Supply & Water Resources Department of Govt. of Gujarat and is carrying out ground water investigation, exploration, management & recharge works in the State of Gujarat.

2. Monitoring Network carried out by (GWRDC)

At present Regional Data Processing center monitors 10 Nos. of observation wells and 07 Nos of tubewells monitored during May & October every year i.e. Pre & Post monsoon. In addition to these 30 Nos. of Narmada Canal Command area piezometer are monitored four times in a year i.e. January, May, August & October since 1992-93. In Ahmedabad district 42 Nos., of piezometers drilled under Hydrology Project, are also monitored monthly from 2001-02. Water samples are collected in the month of May & October (Pre & Post monsoon) and during the month of Jan, May, August and October for Narmada Canal Command area piezometers and Hydrology project piezometers. In Ahmedabad district to observe water level rise due to construction of check dams under different schemes, total 07 wells are monitored. Monitoring of these wells is carried out during four times i.e., in January, May, April & October in a year along with collection of water samples.

3. Ground water condition

Ground water occurs under Unconfined and Confined conditions. The average rise in water level for five years (2003-2007) in the district for unconfined aquifer is observed to vary from 01.82 m. to 03.03 m. in alluvial formation and in hard rock formation, it is observed to vary from 04.87 m. to 06.97 m.

4. Taluka wise information on water level behaviour, hydrogeology and rainfall

Barwala: The average water level rise during pre and post-monsoon is 04.87 m. in Hard-rock area. The average rainfall is 618.51 mm.

Bavla: The average water level rise during pre and post-monsoon is 02.42 m. in Alluvium area. The average rainfall is 667.07 mm.

City-Daskroi : The average water level rise during pre and post-monsoon is 01.96 m. in Alluvium area. The average rainfall is 736.18 mm.

Detroj-Rampura : As there is no purpose built observation station for water level measurement to study the water level behavior Rp. formula is used for the ground water estimation. The average rainfall is 613.00 mm.

Dhandhuka : The entire area consist of alluvium formation which is totally saline The average rainfall is 636.00 mm.

Dholka :The average water level rise during pre and post-monsoon is 02.43 m. in Alluvium area. The average rainfall is 683.96 mm.

Mandal : The average water level rise during pre and post-monsoon is 03.03 m. in Alluvium area. The average rainfall is 609.62 mm.

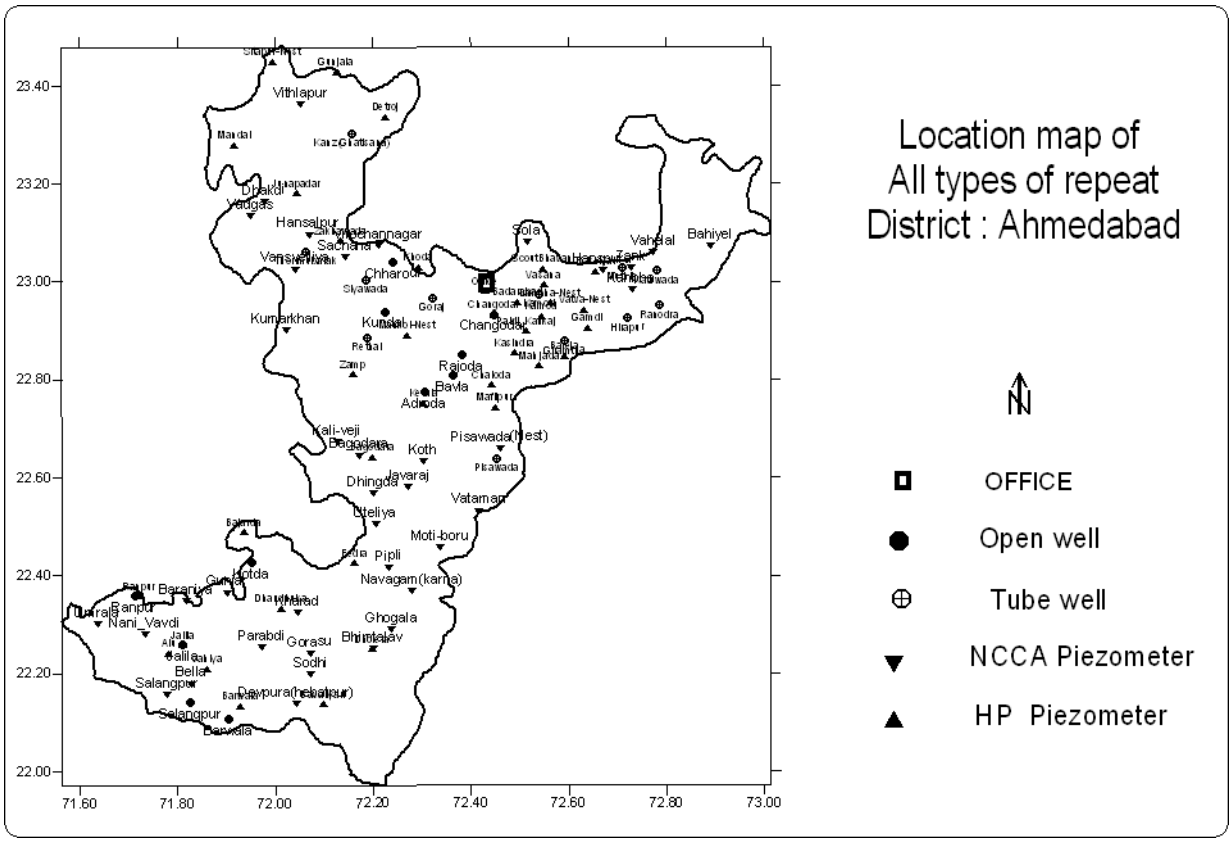
Ranpur : The average water level rise during pre and post-monsoon is 06.97 m. in Hard-rock area. The average rainfall is 629.73 mm.

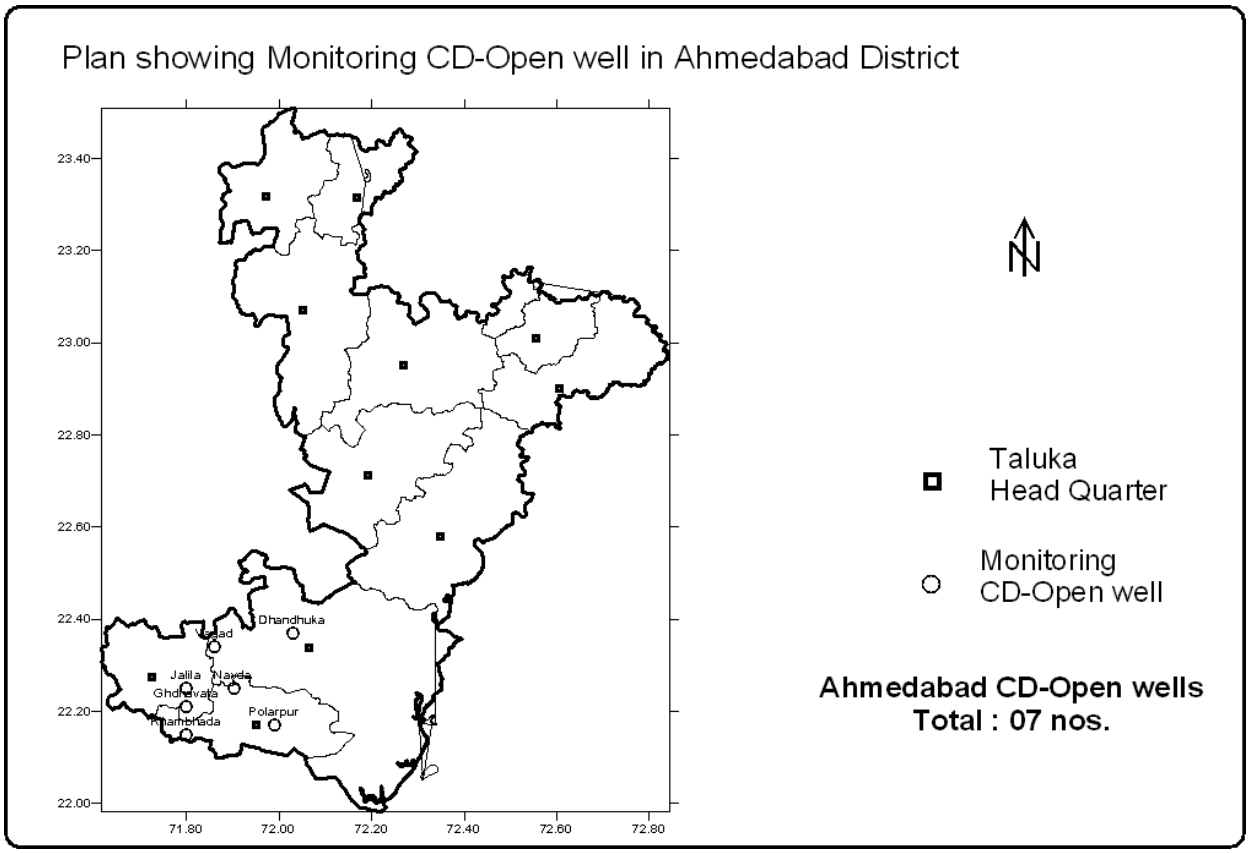
Sanand : The average water level rise during pre and post-monsoon is 01.82 m. in Alluvium area. The average rainfall is 662.58 mm.

Viramgam : The average water level rise during pre and post-monsoon is 01.91 m. in Alluvium area. The average rainfall is 622.67 mm.

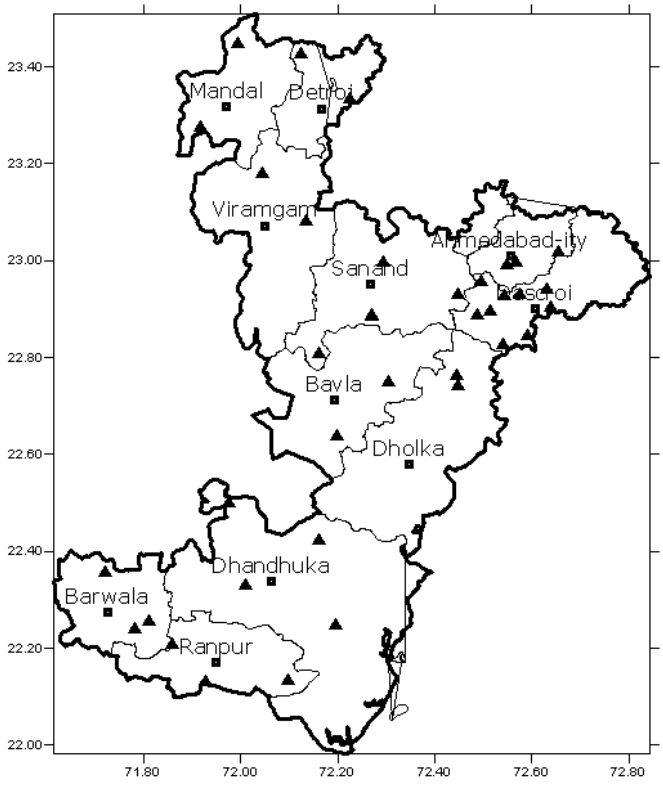
5. Taluka wise Ground Water Quality

Taluka	TDS (ppm)
Barwala:	690-50000
Bavla	1000-4000
City-Daskroi	900-2500
Detroj-Rampura	1500-3500
Dhandhuka	Saline
Dholka	1500-3500
Mandal	1600-3200
Ranpur	300-1900
Sanand	1200-4000
Viramgam	1500-3200


Location map of
All types of repeat
District : Ahmedabad
OFFICE
Open well
Tube well
NCCA Piezometer
HP Piezometer
23.40
23.20
23.00
22.80
22.60
22.40
22.20
22.00
71.60
71.80
72.00
72.20
72.40
72.60
72.80
73.00


Plan showing Monitoring CD-Open well in Ahmedabad District
Taluka
Head Quarter
Monitoring
CD-Open well
Ahmedabad CD-Open wells
Total : 07 nos.
Dhandhuka
Jalila
Navda
Ghodevada
Polarpur
23.40
23.20
23.00
22.80
22.60
22.40
22.20
22.00
71.80
72.00
72.20
72.40
72.60
72.80

Plan showing Monitoring HP-Piezometers In Ahmedabad District

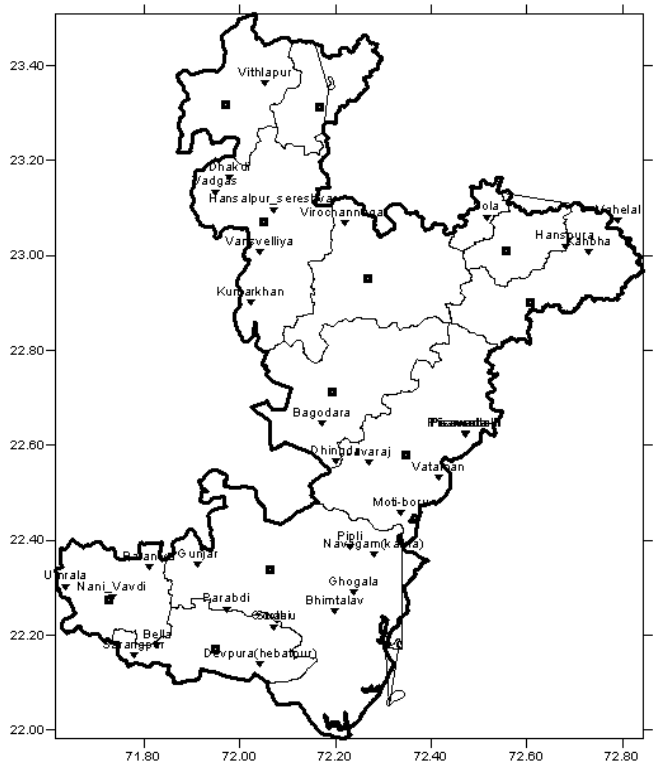


Taluka Head Quarter

Monitoring HP_Piezometer

Ahmedabad- HP-Piezometer
Total 42 nos.

Plan showing Monitoring NCC-Piezometers In Ahmedabad District

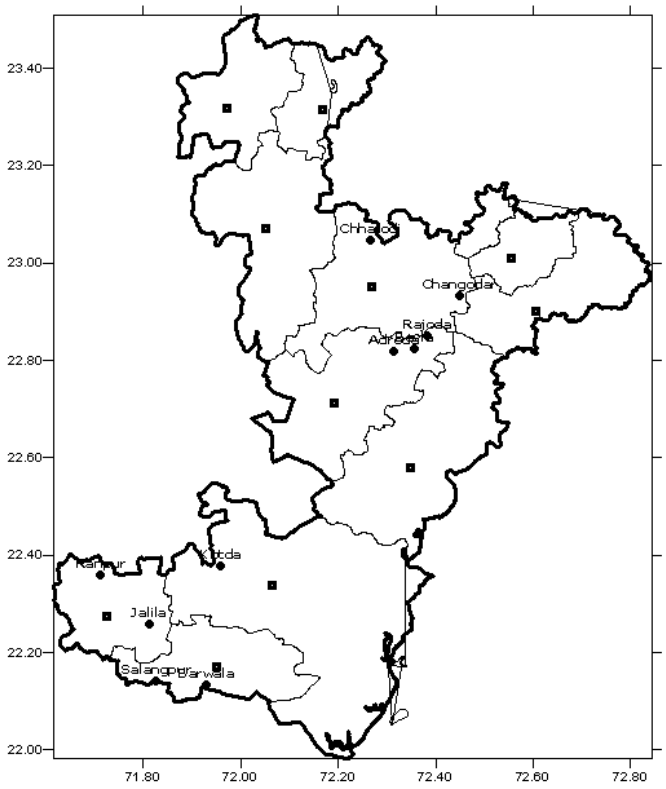


Taluka Head Quarter

Monitoring NCCA-Piezometer

Ahmedabad- NCCA-Piezometer
Total 33 nos.

Plan showing Monitoring Open well in Ahmedabad District

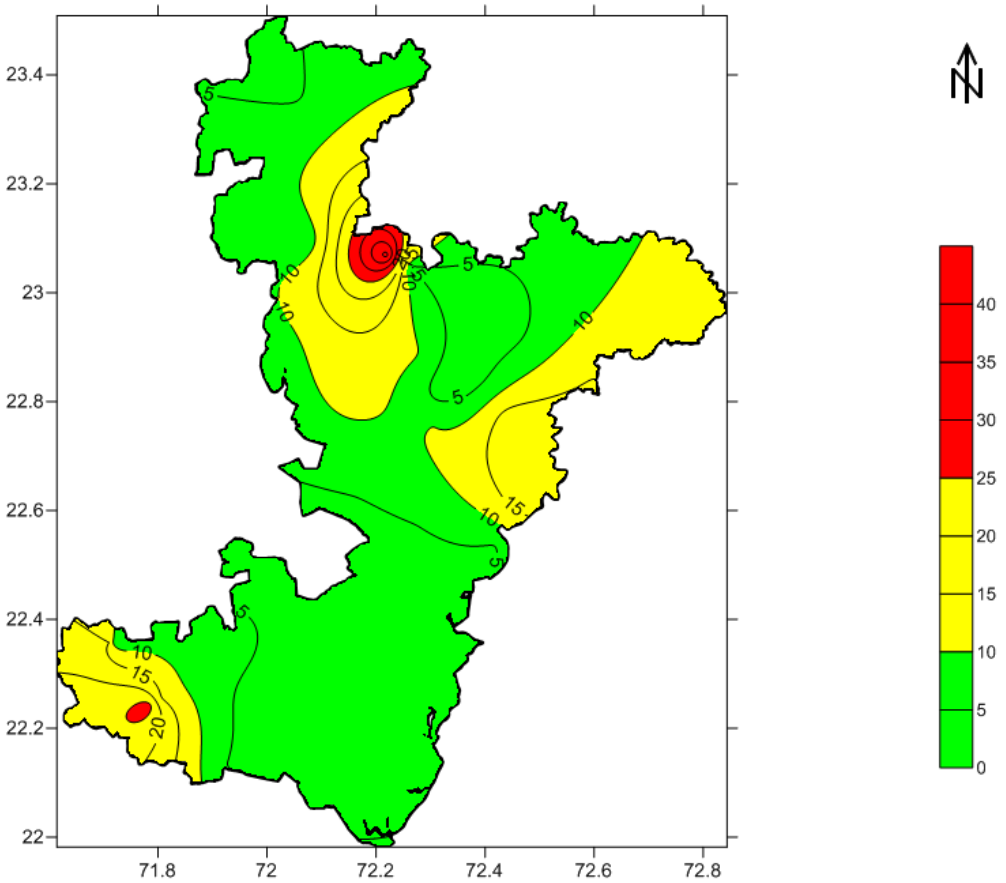


Taluka Head Quarter

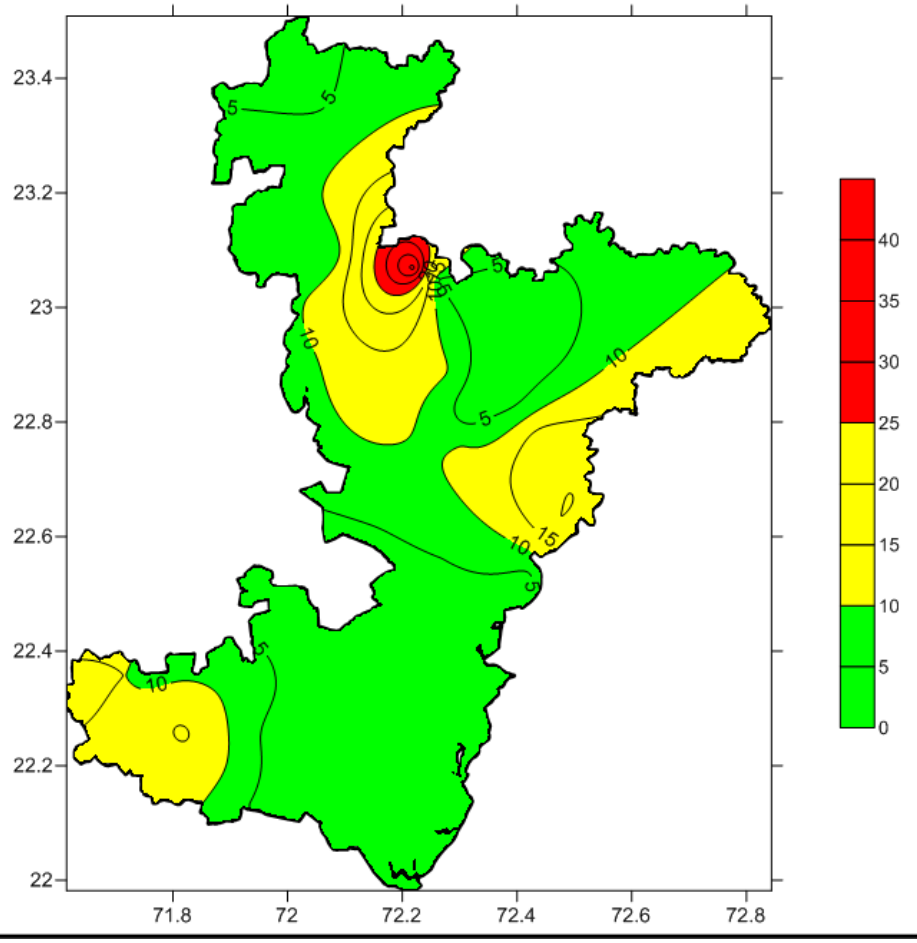
Monitoring Open well

Ahmedabad Open wells Total : 10 nos.

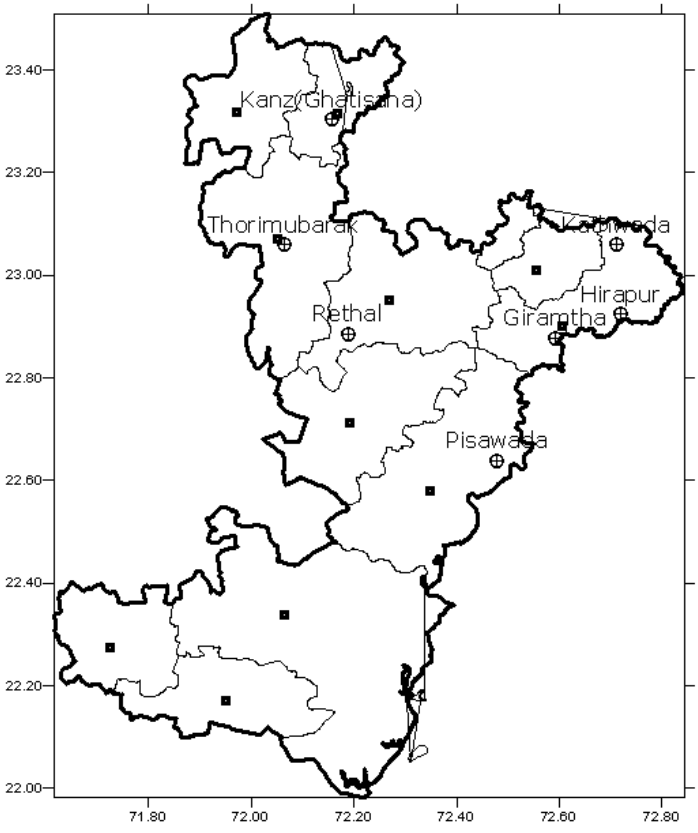
Depth to Water Level Contour Plan_ May-2009 (Unconfined Aquifer)



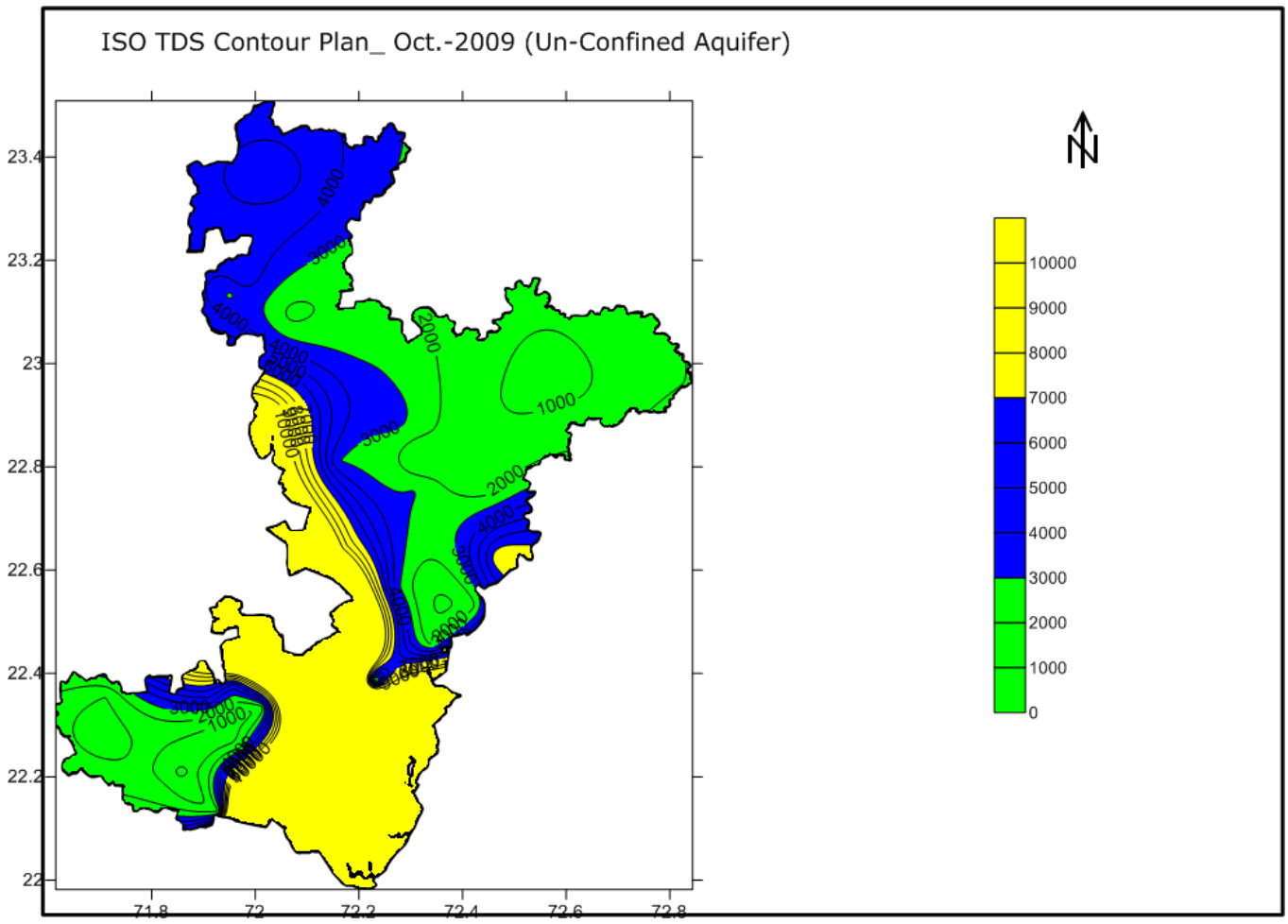
Depth to Water Level Contour Plan_ Oct-2009 (Unconfined Aquifer)

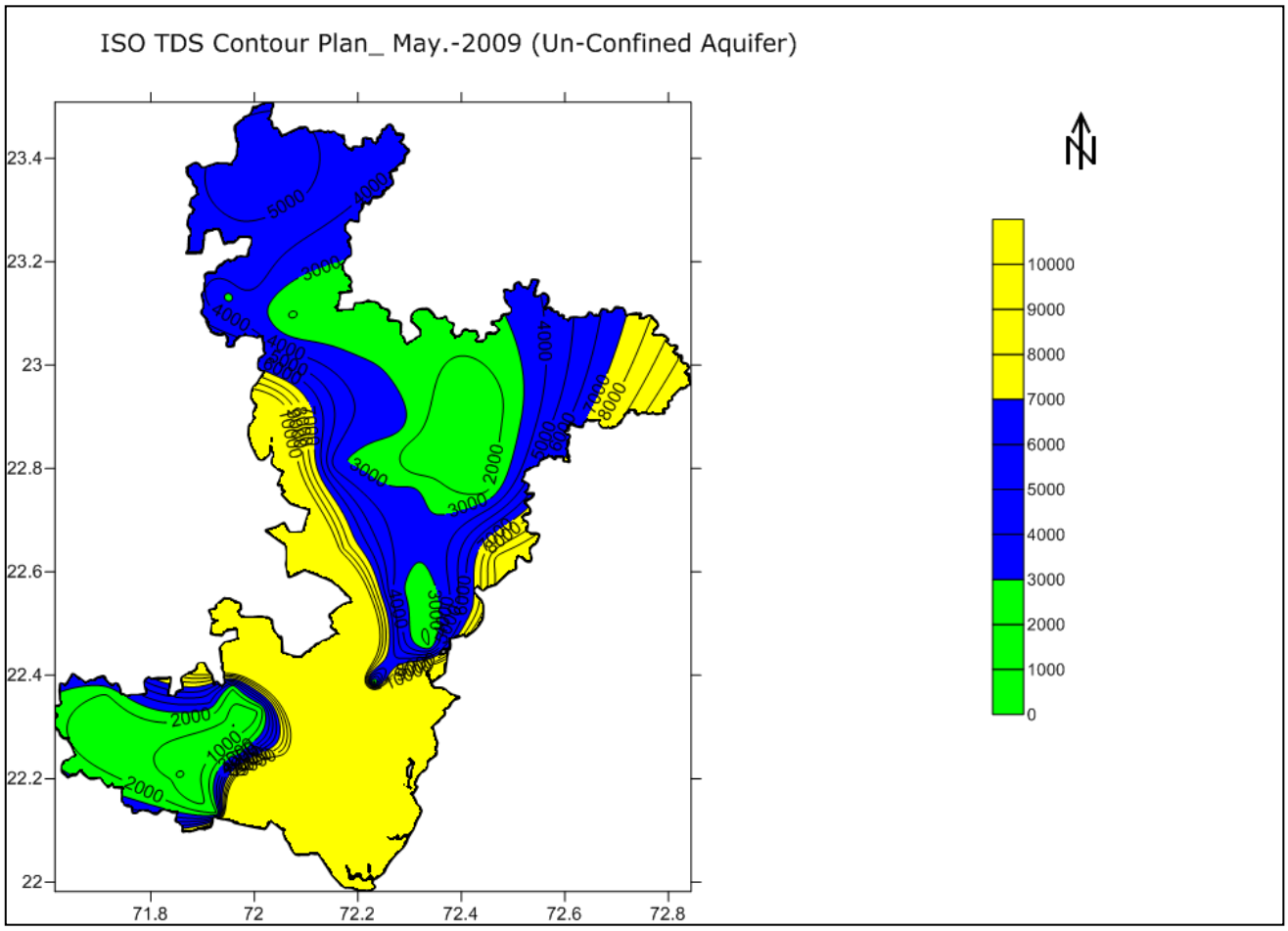


Plan showing Monitoring Tube well In Ahmedabad District



Ahmedabad Observation Tube-Wells
Total : 07 nos.


ISO TDS Contour Plan_ Oct.-2009 (Un-Confined Aquifer)
23.4
23.2
23
22.8
22.6
22.4
22.2
22
71.8
72
72.2
72.4
72.6
72.8
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0


ISO TDS Contour Plan_ May.-2009 (Un-Confined Aquifer)
23.4
23.2
23
22.8
22.6
22.4
22.2
22
71.8
72
72.2
72.4
72.6
72.8
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0