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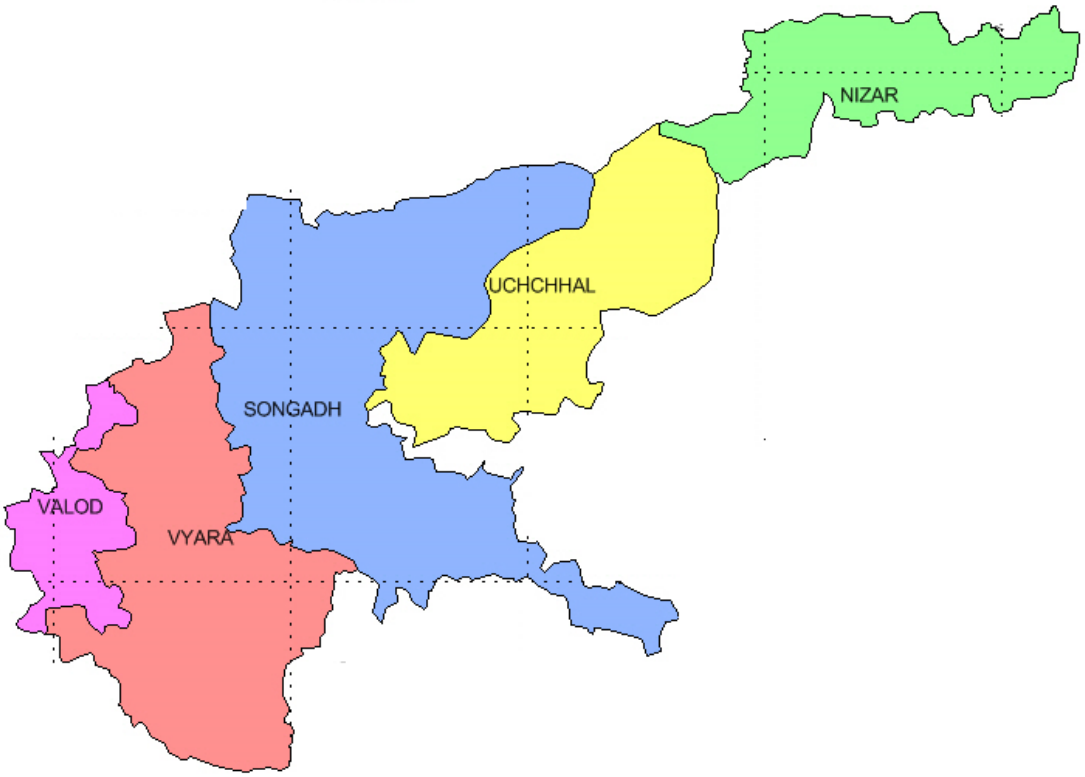
Technical Report Series

GROUNDWATER BROUCHURE
TAPI DISTRICT
GUJARAT



Compiled
By
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Government of India
Ministry of Water Resources
Central Ground Water Board
West Central Region
Ahmedabad
AAP Year 13-14

TAPI DISTRICT AT A GLANCE

SL No.	Items	Statistics
1	General Information	
	i) Geographical area as per state territory/as per village papers (Sq. Km)	3,238.83
	ii) Administrative Divisions (As on 3/2011) Number of Talukas Number of Villages	 5 488
	iii) Populations (As on 2011 census)	8,06,489
	iv) Average Annual Rainfall (mm) (1982 to 2011) normal annual rain fall (mm)	1344
2.	GEOMORPHOLOGY	
	Major Physiographic Units: Hilly areas, piedmont slopes and Alluvium	
	Major Drainages: Perenial rivers-Tapi, Kim, Ver, Mindola, Jhankhari and Purna rivers	
3.	MAJOR SOIL TYPES : Light coloured soils, Garot soils and black cotton soils	
4.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-3-2011)	11 Dug wells
5.	PREDOMINANT GEOLOGICAL FORMATIONS: Deccan trap basalts with dykes and older alluvium(Quarternary) fine, light coloured argillaceous loam with nodular lime concretions (kankar), younger alluvium river and stream deposits.	
6.	HYDROGEOLOGY	

- Major Water Bearing Formation: Deccan trap basalts with dykes and alluvium

Depth to water Level during 2011-12				
Period	*Phreatic Aquifer (DTW)*		*Semi-confined Aquifer (PZ head)*	
	Min	Max	Min	Max
Pre Monsoon	2.76 (Vadalekhord)	14.75 (Nizar)	NA	NA
Post Monsoon	0.92 (Vadalikhord)	11.32 (Nizar)	NA	NA

Long Term (10 Years) Water Level Trend (2001 to 2010)		
Trend	*Pre-Monsoon*	*Post- Monsoon*
Rise (m/Yr)	0.0295 (Jaisinghpura) to 0.1526 (Tawali)	0.0068 (Gandhinagar) to 0.2355 (Kherwa)
Fall (m/Yr)	0.007 (vyara 1) to 0.3414 (Bedchit)	0.0171 (Valod) to 0.162 (Jesingpura)

7.	GROUND WATER QUALITY: In general potable and fresh.	
8.	DYNAMIC GROUND WATER RESOURCES (2009)	
	Annual Replenishable Ground Water Resources (MCM)	514.96
	Net Ground water Availability (MCM)	468.60
	Projected Demand for Domestic and industrial Uses upto 2025 (MCM)	18.24
	Stage of Ground Water Development (%)	22.94

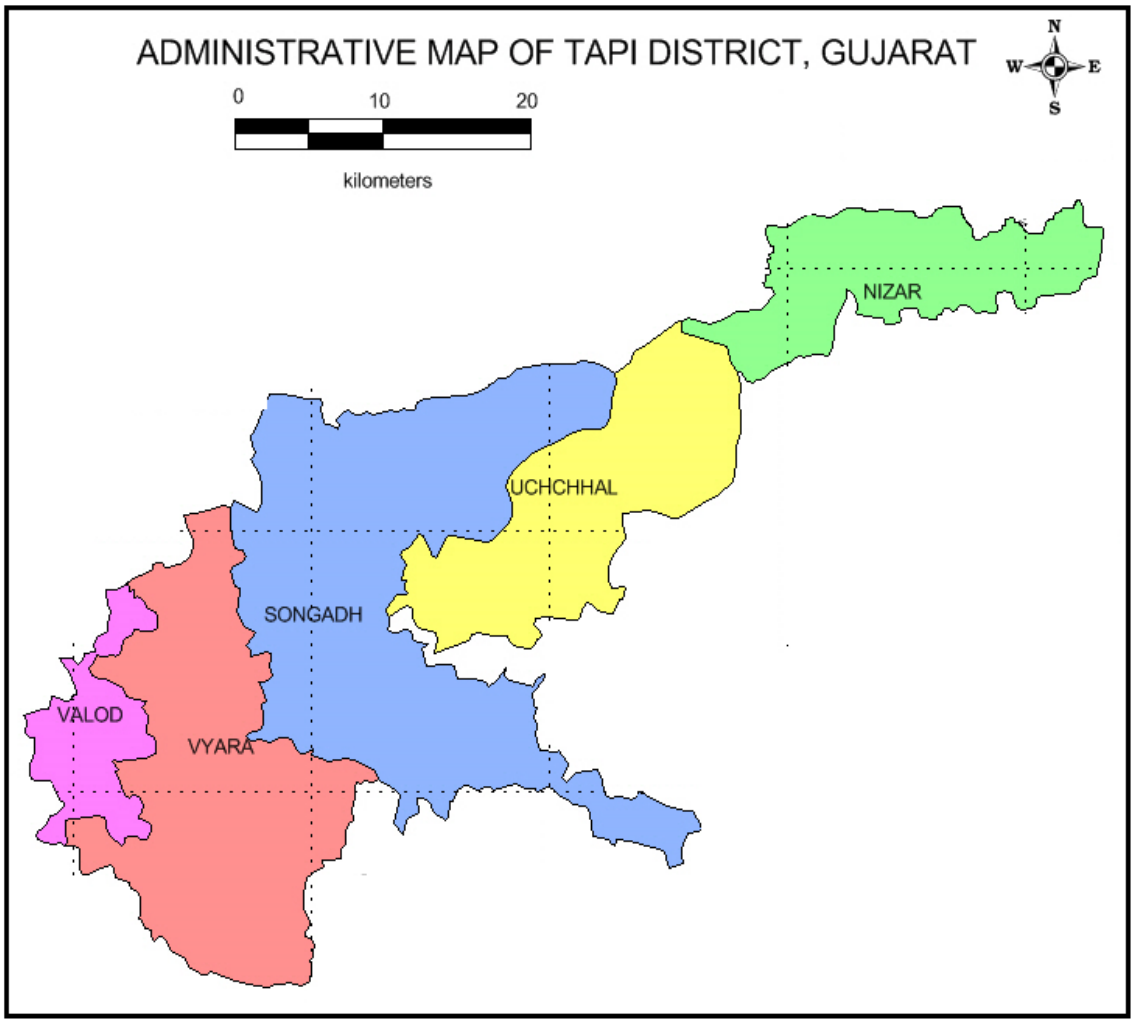
9.	AWARENESS AND TRAINING ACTIVITY- Nil	
	Mass Awareness Programmes	Nil
	Water Management Training Programmes	Nil
10.	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING (31/3/2011)	
	Projects completed by CGWB (No & Amount spent)	Nil
	Projects under technical guidance of CGWB (Numbers)	Nil
11	GROUND WATER CONTROL AND REGULATION (2009)	
	Number of OE Talukas	Nil
	Number of Critical Talukas	Nil
	Number of Semi Critical Talukas	Nil
	Number of Safe Talukas	05
	Number of Saline Talukas	Nil
	No. Of Talukas Notified	Nil
12	MAJOR GROUND WATER PROBLEMS AND ISSUES	
	i) Excess run off due to rugged topography ii) Heterogeneity of aquifer iii) Un planned construction of ground water structures iv) Pumping pattern v) Optimum use of water vi) Water conservation vii) Rain water harvesting and roof top rain water harvesting viii) Feasible artificial recharge projects	

DISTRICT GROUND WATER BROCHURE
TAPI DISTRICT
GUJARAT

INTRODUCTION

Tapi district is lying between latitude 20°30' - 21°35'N and longitude 73°05' - 74°20' E and has a total geographical area of 3238.83 sq. km. The district is situated in the southern part of the state. It is bounded by the Surat district on the west, Narmada in the north, the Navsari district in the south, The Dangs district in the south-east, and Maharashtra state in the east. The district has been divided into five talukas namely.

Figure-1



The district comprises of 5 Talukas, i.e., Nizar, Songadh, Uchhal, Valod and Vyara. The administrative divisions of the district have been reconstituted recently by bifurcating Surat district into two districts namely Surat and Tapi. The district Tapi has headquarter at Vyara and has fairly good network of roads and all the taluka headquarters are connected with all weather roads. Location and Administrative Map of the Tapi district as shown in Figure- 1.

Table 1 Geographical Area

Sl. No	Taluka	Geographical Area (Sq. Km.)
1	Nizar	395.90
2	Songadh	1206.67
3	Uchhal	621.51
4	Valod	202.26
5	Vyara	812.49
Total Area		3238.83

2.HYDROMETEOROLOGY

The district has been bifurcated from earlier Surat district and its meteorological station is located in Surat town. Therefore, the climatological data of IMD station located at Surat is discussed here.

There are many rain gauge stations which are being monitored by different state government agencies. The Water Resources Investigation Circle (WRI) under the department of Narmada Water Resources, Govt. of Gujarat, monitors most of the rain gauge stations and also collects and compiles the rainfall data collected by different agencies.

Long term mean monthly climatological parameters (IMD 1951-80) like maximum and minimum temperatures, relative humidity, wind speed and rainfall are given in Table 2.1 and depicted in Figure- 2

Table -II IMD Climatological Data

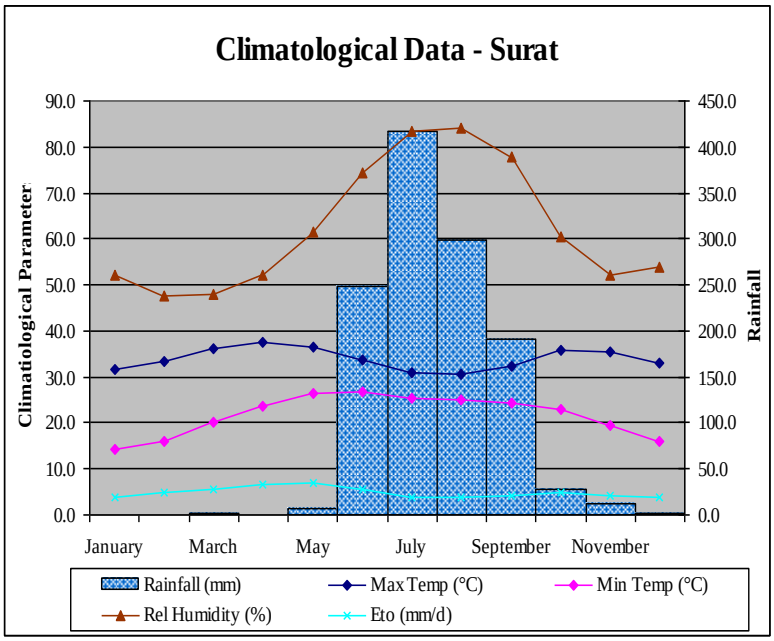
Month	Max Temp	Min Temp	Humidity	Wind Speed	Sunshine	PET	Rainfall
	(°C)	(°C)	(%)	Km/h	(Hours)	(mm/d)	(mm)
January	31.5	14.3	52.0	4.70	9.7	3.9	0.0
February	33.5	16.1	47.5	4.83	10.3	4.7	0.4
March	36.2	20.1	48.0	5.10	9.9	5.7	1.5
April	37.7	23.7	52.0	5.65	10.5	6.6	0.3
May	36.4	26.4	61.5	8.10	10.3	6.9	7.3
June	33.8	26.6	74.5	9.19	7.4	5.5	249.3
July	31.0	25.4	83.5	8.58	4.0	3.9	417.7
August	30.6	25.0	84.0	7.48	4.3	3.8	299.4
September	32.2	24.4	78.0	5.38	6.2	4.2	190.7
October	35.9	23.0	60.5	4.22	9.4	4.8	27.2
November	35.3	19.3	52.0	4.49	9.7	4.3	13.0
December	32.9	16.1	54.0	4.90	9.5	3.9	2.6
Total	**-**	**-**	**-**		**-**	**-**	**1209.4**
Average	**33.9**	**21.7**	**62.3**	**6.05**	**8.4**	**4.8**	**-**

General climate of the district is sub-tropical and is characterised by three well-defined seasons, i.e. summer - from April to June, monsoon - from July to September, and winter from October to March.

3.Rainfall

Long term normal rainfall (1951-80) at the Surat IMD station is about 1210 mm. The rainfall data from various stations in the district is available for the period between 1963-2008.

Figure- 2



The data indicates that the average annual rainfall varies between 831.3 mm at Nizar and 1743. mm at Songadh . The coefficient of variation ranges from 35.8% (Valod) to 49.3% (Songadh) indicating a high variability of rainfall. There is considerable temporal variation also. The minimum recorded rainfall during these 47 years varied between 306 mm (Niza-1996) and 641 mm (Valod –1987). The maximum recorded rainfall varied from 2123 mm (Nizar –2006) to 4661 mm (Songadh –2005).

GEOMORPHOLOGY

Physiography

Geographically, the district belongs to the western coastlands of the Deccan peninsula. The main Sahyadri scarp is at a little outside the limits of the district towards east, but it gives the district its orientation, landscape features and drainage pattern. The district has five zones, viz., hilly areas, piedmont slopes, alluvial plains and coastal plains.

Hilly areas: The northern, north-eastern parts of the district fall in this category. Here the general elevation is more than 100m amsl. The topography is rugged with low to moderate high hills and steep hill slopes. This parts are poorly populated and are infested by dense jungle of teak and bamboo. The highest elevation of the district is 569.0m amsl.

Piedmont slopes: East-central parts of the district fall in this category. Here the elevation range between 60 and 100m.amsl. This part has a gentle slope towards west. Topography is mainly plain with moderate to deep cutting river valleys and occasional hillocks.

Alluviual plains: Alluvial plains occupies in the central parts of the district and is characterized by flood plains of the Tapi, Kim, Mindola and Purna rivers. Tapi has a meandering channel entrenched fairly deep and has cut deep terraces. The topography is generally plain with gentle slope towards west. The general elevations are below 60 m.amsl, the lowest elevation being 45m.amsl near Madhi.

Coastal Plains: The alluvial plains towards west merge into a dry barren sandy coastal plain fringed by marshy shore line. All the rivers form estuarine mouths. There are sand bars and spits near the shore.

Drainage

The Tapi is the major river which passes through the central parts of the district and flows towards the west. The river is perennial in nature. It originates in Madhya Pradesh near Betul and has about 62225 sq. Km. of catchment area. The average width of the river in the upstream of Kathor bridge is about 500m. Downstream of the bridge the average width increases to 700m. Pickup weir was constructed on the Tapi river in 1954 at Kakarapar about 56km west of Surat. Ukai dam, constructed in 1965, is situated about 25km upstream of Kakarapar weir. Other prominent rivers draining the district are Kim, Ver, Mindola, Jhankhari and Purna. The Ver flows from north-east to south-west and flows parallel to Tapi and then it flows towards west. All other rivers are situated toward south of Tapi and flow towards west, parallel to Tapi.

GEOLOGY

Major geological formations exposed in the district are Quaternary alluvium, Tertiary limestone and sandstones and deccan trap basalt. Figure -3 shows the geology of the district and the succession of geological formations in the district, as given by Geological Survey of India in their brochure titled '' Know Your District-Surat'' is as follows.The geology of the district is depicted in Figure -3

Geological Succession

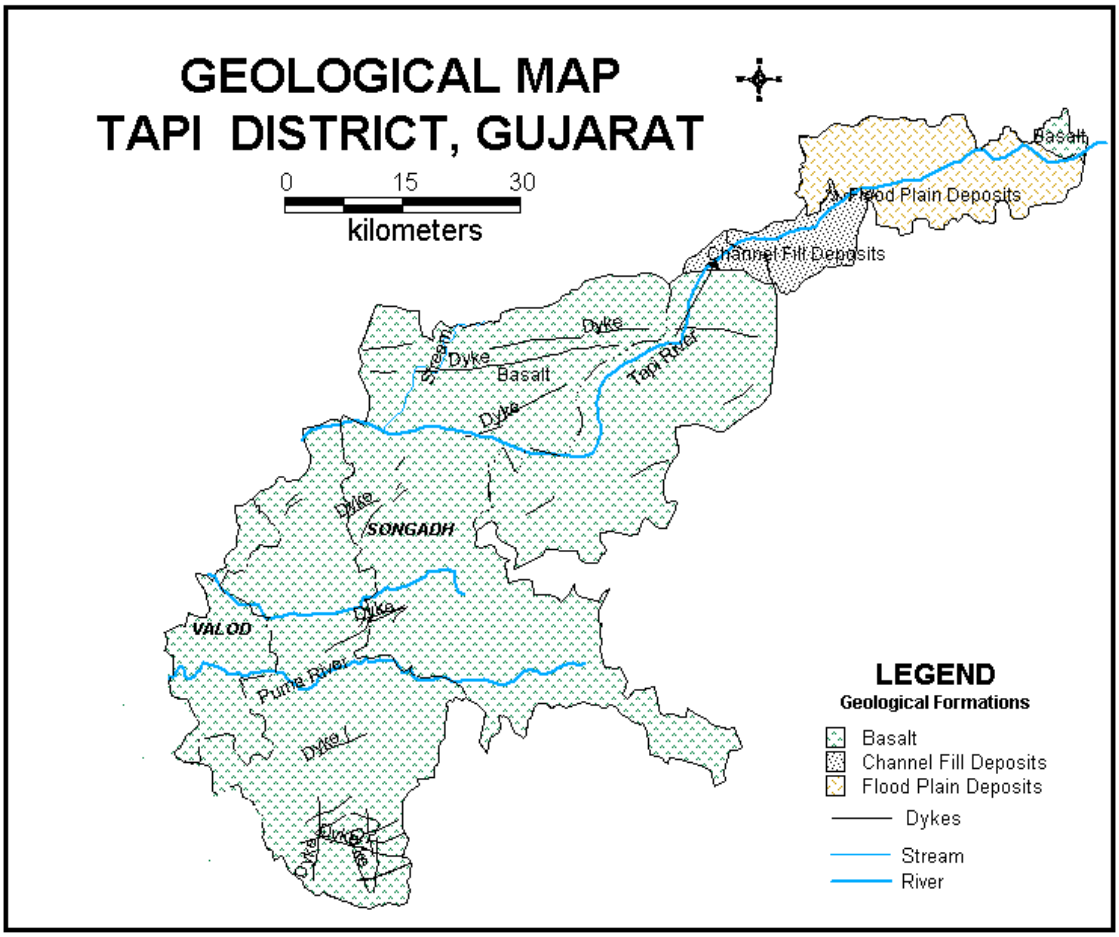
Era	Period	Epoch /Series	Description
Cenozoic	Quaternary	Holocene	Soil, Younger alluvium Blown and Fluvio-marine deposits.
	Tertiary	Pleistocene	Older alluvium, conglomerate
		Miocene	Ferruginous sandstone (Gaj)
		Eocene	Numulitic limestone
		Palaeocene	Sub-Numulitic limestone, gypseous shale,Supra- Trappean sediments lateritised and having bauxite pockets.
Mesozoic	Lower Tertiary to Upper Cretaceous	Early Eocene To Upper	Deccan Trap basalt with dykes

The Deccan Trap

The oldest rocks occurring to the north-east and south- east of the district are Deccan traps of lower Eocene age. These are present in the form of horizontal sheets at places showing gentle dips toward west. The total thickness of different trap flows aggregates to nearly 200 meters. The traps can be differentiated into two predominant rock types. One is dark gray to bluish black, hard, compact, massive, fine grained basalt which is usually found on the higher reaches of the hills. The other variety is greenish to purplish, soft, medium grained trap which is prone to spheroidal weathering. These flows are characterized by vesicles and amygdaloidal filled with secondary minerals like quartz, amythst, agate and calcite. These type of flows are generally found on hill slopes and in the valleys.

Network of dykes varying in thickess from few centimeters to more than ten meters in width are commonly found intruding the different lava flows and form knife-edge ridges in the 'steppe' topography. These dykes are mostly basic in nature but a few of these are also acidic in composition. The usual rock type of these dykes is dolerite or olivine dolerite.

Figure-3



Alluvium

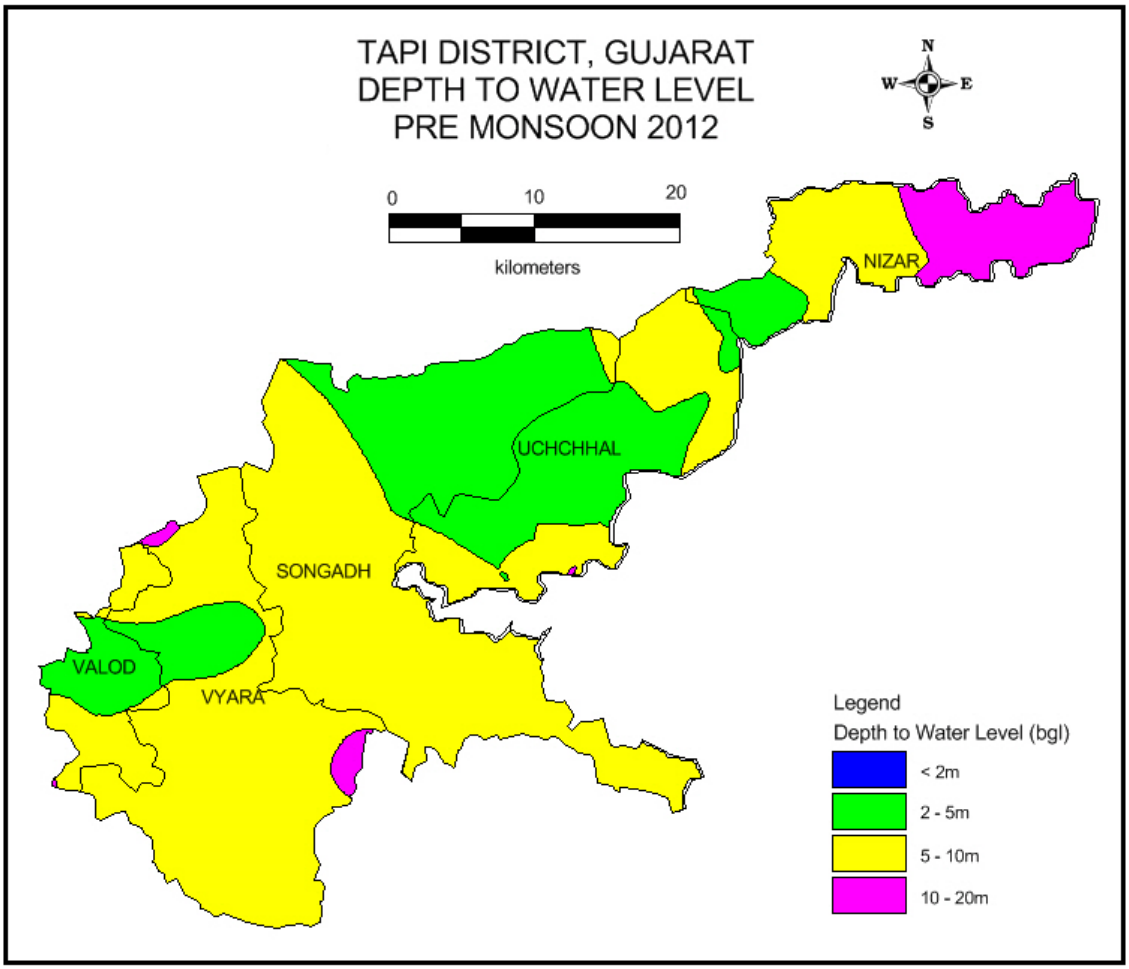
The alluvium occurs in the form of channel fill deposits (124 Sq Km) and flood plain deposits (298 Sq. Km) in north eastern part of the district.

HYDROGEOLOGY

Aquifer System

The hydrogeological frame work of the area is essentially governed by geological setting, distribution of rainfall and facilities of circulation and movement of water through inter connected primary and secondary porosity of the geological units forming the aquifers.The depth to water level in the district ranges between 2m to about 20m during May 2012. Nearly 35 % area of the district is covered by the water level of 2m to 5m bgl . Nearly 60 % of the area of the district has the water levels between 5m to 10m bgl. The remaining area of the district (isolated patches) i.e. 5% has the water level ranging between 10m to 20m bgl.

Figure-4

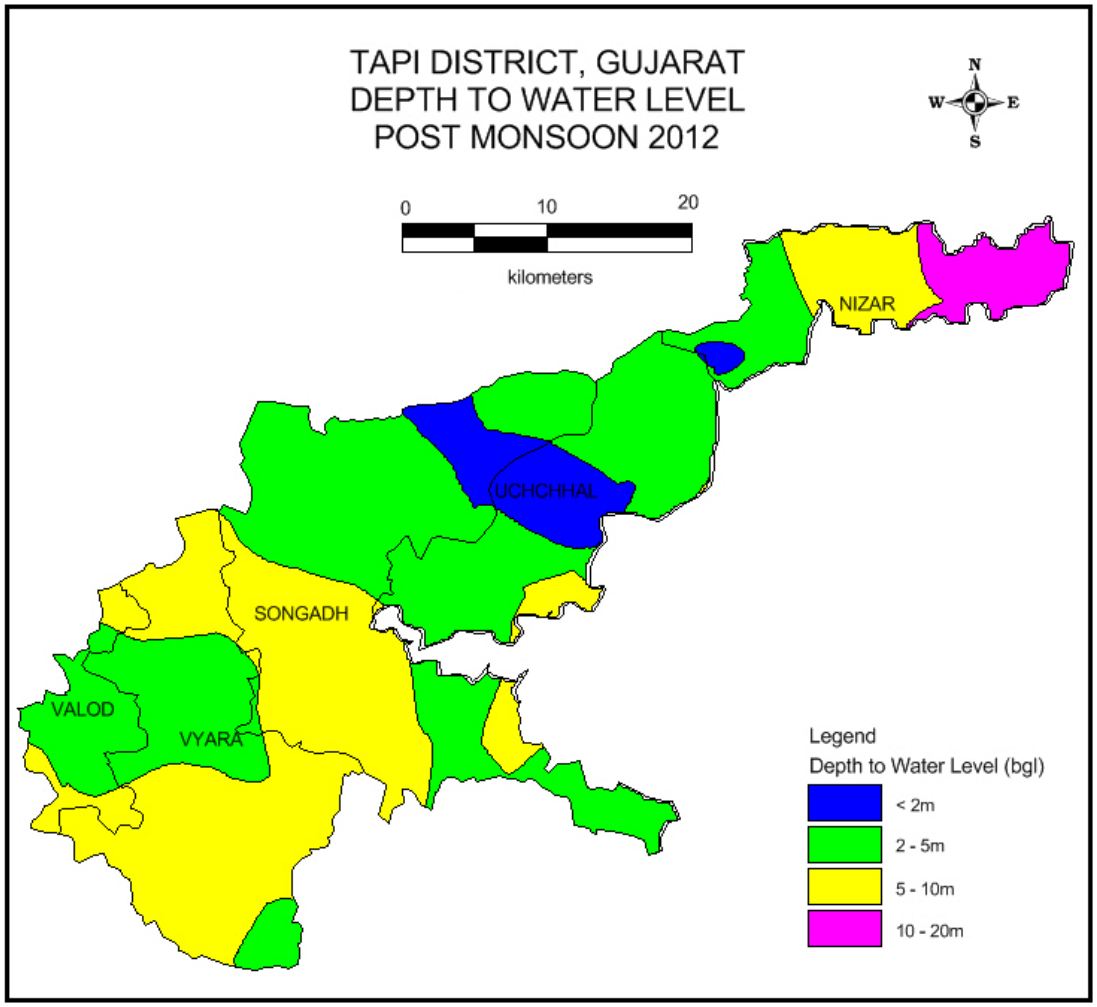


The depth to water level in the district ranges between less than 2m to nearly 20m during November 2012. There are two isolated pockets which show the water level of less than 2m (7 %) . In the major part of the district (47%) the water level ranges between 2 m and 5 m bgl. Also the water level ranges between 5 m and 10 m bgl in the area is 41%.There is one another patch which shows the water level ranges from 10 m to 20 m(5%).

The major aquifers in the district are formed by alluvium and Deccan trap basalt with Tertiary formations occupying a small patch. The alluvium occurs in the form of channel fill deposits (124 Sq Km) and flood plain deposits (298 Sq. Km) in north eastern part of the district and along the streams whereas in eastern parts weathered and fractured basalt form aquifers. Based on the geological formation the area can be divided broadly into two hydrogeological units:

1. Fissure Formations
2. Porous Formation

Figure- 5



Fissure Formations

Deccan Traps form the aquifers in north-eastern, eastern and south eastern parts of the district comprising Mangrol, Mandvi, and Mahuva, talukas. The ground water occurs in unconfined to semi-confined conditions. The occurrence and movement of ground water is governed by the thickness and extent of weathered zone and the presence of fractures and joints. At places, dykes act as ground water barriers and restrict the flow of ground water. On the other hand, at places, the dykes themselves form good aquifers owing to deeper levels of weathering in them.

Depths of dug wells in Deccan traps ranges from less than 2m to 25m with maximum number of wells about 80%, being 5 to 15m deep. The depths to water levels in the dug wells range from 1 to 20m. However, in 90% of the wells, the water levels are less than 10m. bgl. Yields of the dug wells are low to moderate in central parts whereas they are low to very low on the hill slopes. The dug wells generally sustain pumping for 4 to 5 hours with yields of 50 to 150 m^3/day. Recuperation of water levels is generally slow.

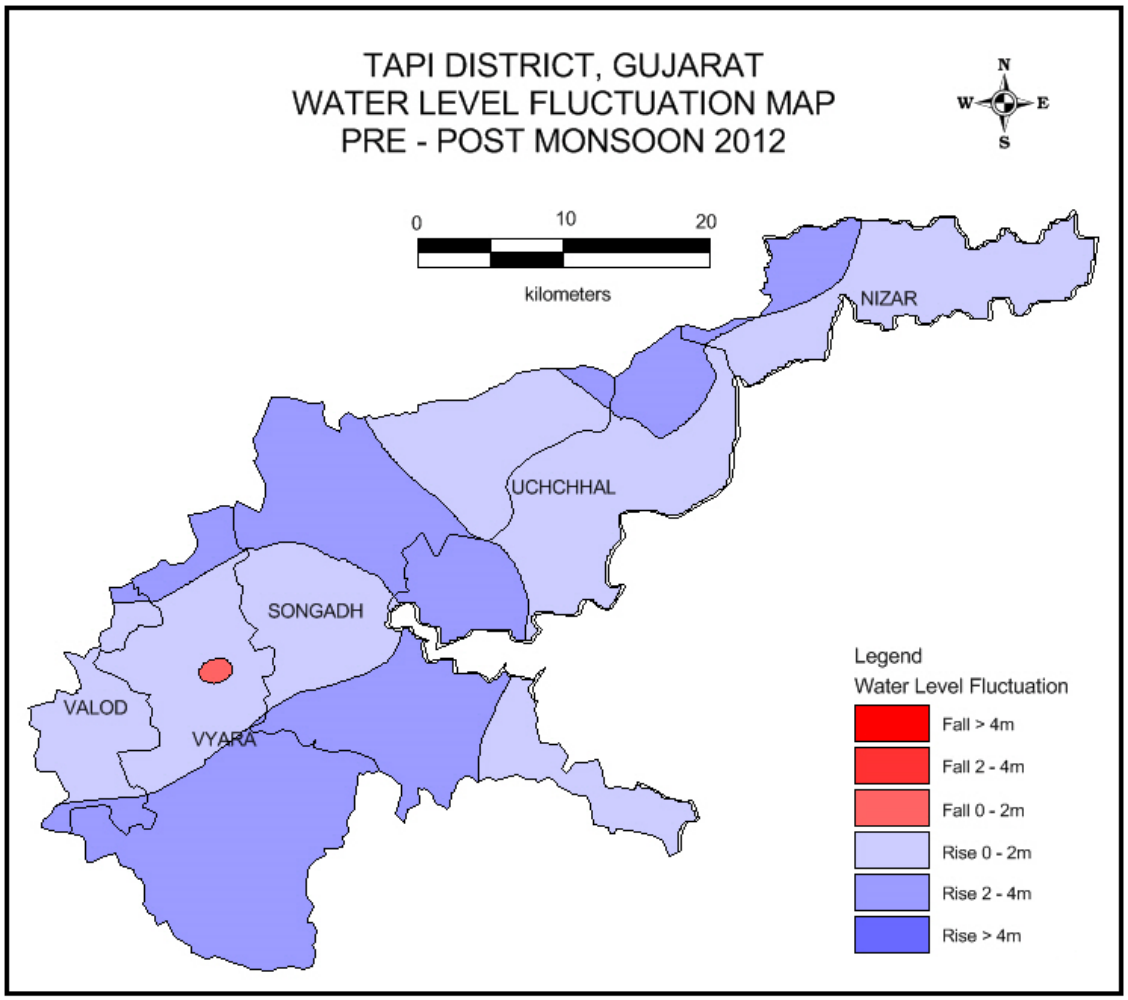
Behaviour of Water Levels

The behaviour of water levels was studied based on the water level data collected from the National Network of Hydrograph Stations (NNHS) established by CGWB and Observation wells established by GWRDC in the district. A composite map combining the data of CGWB & GWRDC (depth to water level map -May -2012) has been prepared .The water level data of May 2012 was used for preparing the depth to water level maps. The seasonal fluctuation in water levels were calculated between May and November 2012. Historical data of water levels were used for preparing the hydrographs as well as for computing long term trends.

Rise and Fall in Water Levels.

Rise and fall in water levels between May 2012 and November 2012 has been shown in Figure-6. The rise of water level from 2m to 4m meters is seen in major parts of the district. Nearly 40% to 45 % of the area in isolated patches shows a rise up to 4 meters. 50% to 55 % of the area in isolated patches shows rise of 2m to 4m in the district There are one isolated pockets in south of the district which shows decline of water level up to 2m is observed . It covers nearly 5% of the district.

Figure- 6



7.Changes in Ground Water Scenario Over the Years

Long term water level data is available for 12 NNHS since 2001 and data was analysed for the period between January 2001 to November 2012 and water level trend for various period (pre-monsoon, post-monsoon period and over all trend) is shown in table –IV

Table –IV Long Term Trend of Water level
(Period 1St January 2001 to 30th November 2012)

S.No	Location	Pre Monsoon			Post Monsoon		
		Data Points	Rise (m/year)	Fall (m/year)	Data Points	Rise (m/year)	Fall (m/year)
1	Bedchit	16	.0418		10		.0360
2	Valod	19		.0563	20	.0150	
3	Vyara1	20		.0003	18		.0446
4	Gandhinagar	19		.1459	20	.0099	
5	Jesingpura[sg]	19		.1831	19		.0737
6	Bhurvel (ukai)	20		.1027	20	.0544	
7	Vadade-Khurd	19		.0604	19		.0095
8	Tokarwa	12		.1736	14	.0376	
9	Tawali	20	0.1705		20		.0139
10	Kherwa	16		.0729	17	.1414	
12	Nizar1	20	0.0104		20		.2246
13	Nizar	18		.1796	19		.1509
Max		**20**	**0.1705**	**.1831**	**20**	**.1414**	**.2246**
Min		**12**	**0.0104**	**.0003**	**10**	**.0099**	**.0095**

Pre-monsoon water level trend shows that the hydrograph stations indicate a rise of water level ranging from 0.0104 m/year to 0.1705 m/year where as a decline of water level ranging from 0.0003m/year to 0.1831 m/year. During post- monsoon period water level trend shows that the hydrograph stations indicate a rise of water level ranging from 0.0099m/year to 0.1414 m/year where as a decline of water level ranging from 0.0095m/year to 0.2246 m/year. The details are tabulated above.Pre-monsoon and post-monsoon long term rising and declining trend of water level of various hydrograph stations established by CGWB are also studied in graphic form. Majority of the hydrographs are showing rising trend during the pre and post monsoon period. However , declining trend in few hydrographs is also observed.

GROUND WATER RESOURCES

The Ground Water Resources and Irrigation Potential of the district were calculated as on March 2012 in collaboration with the Government of Gujarat using the methodology suggested by "Ground Water Estimation Committee (GEC-97). These resources were computed after reorganisation of the districts. The ground water resources for different Talukas of the district are given in the Table –V& VI.The annual ground water recharge varies from 5265.0425 ha m. in Uchchhal Taluka to 11096.15 ha m. in Vyara Taluka and total gross recharge for the district is 3547.427 ha m. The net available recharge, after leaving natural discharge for non-monsoon period varies from 263.252 (Ucchchhal) to 554.808 ha m. (Vyara), the recharge for district is 1773.71 ha m.

Ground Water Draft

The Table –V also shows the draft from Irrigation and Domestic/Industrial uses. The gross draft in the district for all uses (Domestic, Industrial and Irrigation uses) is 11030.40 ha m. and varies from 656 ha m. (Uchchhal) to 3268 ha m. (Vyara).

Table –V Ground Water Resources Potentials

S. No.	Taluka	Annual Ground Water Recharge	Natural Discharge During Non-Monsoon	Net Annual Available Ground Water (3-4)	Existing Draft for Domestic and industrial Water Supply	Ground Water Draft for Irrigation	Existing Gross Draft For All Uses (6+7)
		(Ha m)	(Ha m)	(Ha m)	(Ha m)	(Ha m)	(Ha m)
1	Nizar	5832.955	291.648	5541.3072	204	2688.5	2892.5
2	Songadh	7544.7156	377.236	7167.4798	398	1272.4	1670.4
3	Uchchhal	5265.0425	263.252	5001.7904	139	517	656
4	Valod	5735.4064	286.77	5448.636	169	3099.5	3268.5
5	Vyara	11096.15	554.808	10541.343	487	2056	2543
	Total	**35474.27**	**1773.71**	**33700.56**	**1397.00**	**9633.40**	**11030.40**

Ground Water Balance for Irrigation

The irrigation potential available for future use for ground water has been computed after allocating for the domestic and industrial requirements (Up to 2025 years) for all the talukas. The ground water available for future irrigation varies from 2128.1360 ham in Valod taluka to 7852.3428 ham in Vyara taluka and total ground water balance for irrigation for the district is **22243.16** ha m.

Level of Ground Water Development and Category

The level of Ground Water Development varies from 13.12% (Uchchhal Taluka) to 59.99% (Valod Taluka) and overall Level of Development for the district is 32.73 %. The overall category of the district is also "Safe**"** shown in fig-7**.**

Table-VI Stage of Ground Water Development

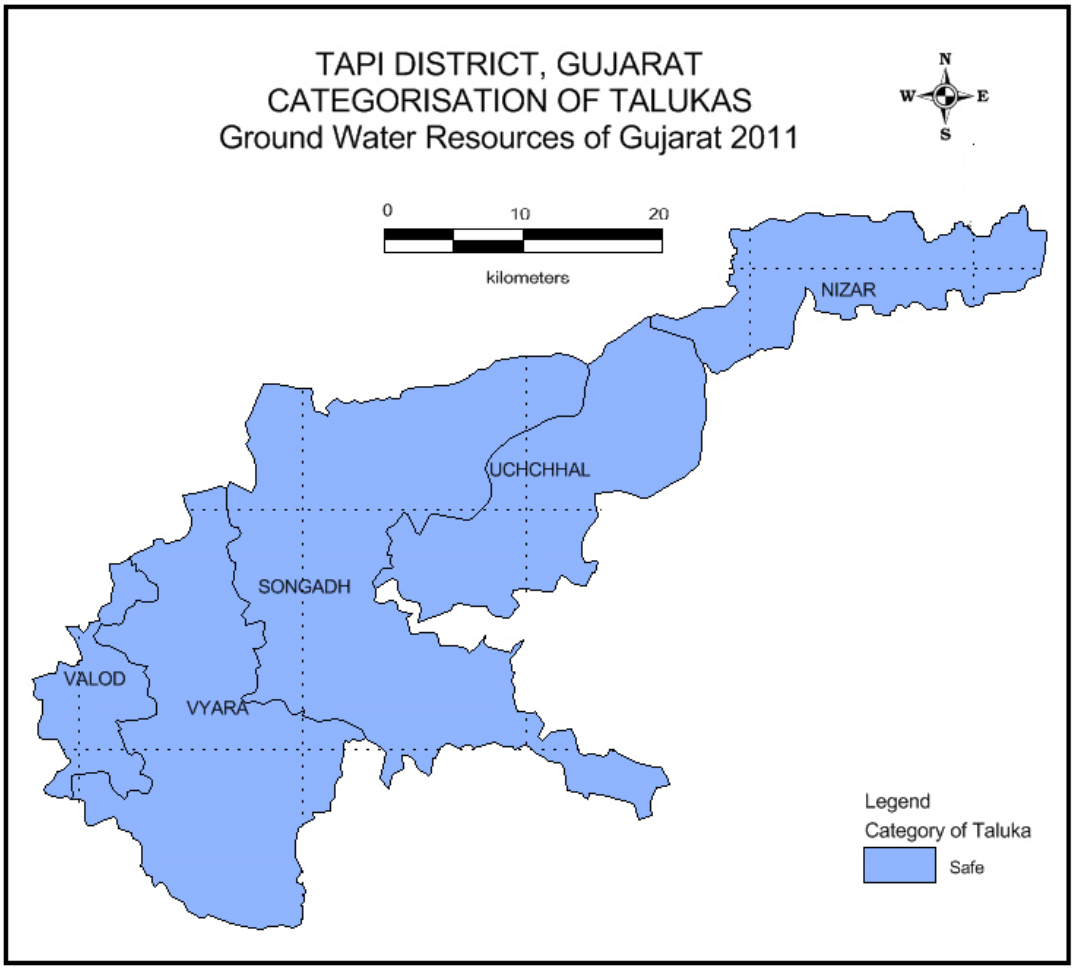
S. No.	Taluka	Net Annual Available Ground Water	Allocation for Domestic and Industrial Requirement (UP to 2025 Years)	Net Ground Water Availability for future Irrigation	Level of Ground Water Development	Stage of Development
		(Ha m)	(Ha m)	(Ha m)	(%)	
1	Nizar	5541.3072	267	2585.8072	52.20	Safe
2	Songadh	7167.4798	518	5377.0798	23.31	Safe
3	Uchchhal	5001.7904	185	4299.7904	13.12	Safe
4	Valod	5448.636	221	2128.1360	59.99	Safe
5	Vyara	10541.343	633	7852.3428	24.12	Safe
	Total	**33700.56**	**1824.00**	**22243.16**	**32.73**	**Safe**

GROUND WATER DEVELOPMENT AND MANAGEMENT

Ground Water Development

Primary sources of irrigation in the district is through dug wells and canals. The yield of these well varies from 50m^3/day to 150m^3/day with the maximum sustainable pumping of 4 to 5 hours. No area is irrigated by tanks and ponds. The annual ground water recharge varies from 5265.0425 ha m. in Uchchhal Taluka to 11096.15 ha m. in Vyara Taluka and total gross recharge for the district is 3547.427 ha m. The net available recharge, after leaving natural discharge for non-monsoon period varies from 263.252 (Ucchchhal) to 554.808 ha m. (Vyara), the recharge for district is 1773.71 ha m. The gross draft in the district for all uses (Domestic, Industrial and Irrigation uses) is 11030.40 ha m. and varies from 656 ha m. (Uchchhal) to 3268 ha m. (Vyara).The level of Ground Water Development varies from 13.12% (Uchchhal Taluka) to 59.99% (Valod Taluka) and overall Level of Development for the district is 32.73 %. The overall category of the district is also "Safe"

Figure- 7



HYDROCHEMISTRY

Quality of Shallow Ground Water

The quality of ground water in the shallow aquifer has been studied based on the chemical analysis of water samples collected from NHS during November 2012. Data for a total number of 6 samples are available. The chemical constituents like EC<3200, Cl<1000, NO3<45, F<1.5 of the district are under permissible limit. So it is noticed that the ground water in the district is potable for drinking and is good for other uses also. The statistical analysis of these are presented in Table –VII.

Table- VII Statistical Analysis of Chemical Constituents (Shallow Aquifer)

Constituents	Units	(Range)
pH	(mg/l)	8.10-8.60
EC	(µS/cm)	526-1354
TDS	(mg/l)	352-907
CO3	(mg/l)	0-72
HCO3	(mg/l)	24-427
Cl	(mg/l)	35-192
NO3	(mg/l)	6-42
SO4	(mg/l)	19-151
F	(mg/l)	0.08-0.68
Alk	(mg/l)	140-350
Ca	(mg/l)	32-76
Mg	(mg/l)	24-92
TH	(mg/l)	250-470
Na	(mg/l)	22-114
K	(mg/l)	0.0-0.7
Fe	(mg/l)	0.06-0.28
SAR	(mg/l)	0.5-2.3

Water Conservation and Artificial Recharge

1. The major part of the district is occupied by Deccan trap area and the yield of wells are comparatively poor in this formation . Since the rain fall in this part of the State is generally high, suitable measures to augment the ground water resource may be adopted. Such measures could be contour bunding, gully plugging, small, check dams and bhandaras.
2. The surplus ground water potential may be utilized by construction of different ground water exploitation structures in favorable areas. Favorable locations for ground water structure are valley floors, valley fill areas, large plateaus, amphitheatrical valleys meeting point of two or more nalas. Also where there is convergence of valley lines or where the drainage from different dimensions in the surrounding region turned into a narrow catchment, the area can be favorable site for ground water structure.
3. In urban areas roof top rain water structures should be constructed on mandatory ground. In the higher plateau areas, rain water harvesting structures associated with storage tank can be constructed for domestic purpose since other sources would not be feasible .
4. During monsoon period all the irrigation wells can be recharged by diverting monsoon runoff of each agricultural plots to the irrigation wells by constructing water channels. Recharge wells can be constructed in all the public parks and monsoon runoff can be diverted to these wells.

Recommendations

1. In the eastern part of the district, in the Deccan trap area, the yield of wells are comparatively poor. Since the rain fall in these part is generally high, suitable measures to augment the ground water resource may be adopted. Such measures could be contour bunding, gully plugging, small, check dams and bhandaras.
2. The surplus ground water potential may be utilized by construction of different ground water exploitation structures in favorable areas. Favorable locations for ground water structure are valley floors, valley fill area, large plateaus, amphitheatrical valleys meeting point of two or more nalas. Also where there is convergence of valley lines or where the drainage from different dimensions in the surrounding region tunned into a narrow catchment, the area can be favorable site for ground water structure.
3. In urban areas roof top rain water structures should be constructed on mandatory ground. In the higher plateau areas, rain water harvesting structures associated with storage tank can be constructed for domestic purpose since other sources would not be feasible .
4. During monsoon period all the irrigation wells can be recharged by diverting monsoon runoff of each agricultural plots to the irrigation wells by constructing water channels. Recharge wells can be constructed in all the public parks and monsoon runoff can be diverted to these wells.
5. Ground water recharge through dug wells is also be feasible in the eastern part and may be adopted at local level. This is a cost effective method to enhance the availability of ground water and improve the ground water quality.